MR Physics

Question Solving Med Easy

6000+ QUESTIONS

Nothing Beyond This

Complete 11th & 12th syllabus For NEET and JEE Aspirants

30 Laws of Motion

(Practice Questions)

State of Body : Inertia

1. A boy sitting on the topmost berth in the compartment of a train which is just point to stop on a railway station, drops an apple aiming at the open hand of his brother sitting vertically below his hands at a distance of about 2 meter The apple will fall:

(*a*) Precisely on the hand of his brother.
(*b*) Slightly away from the hand of his brother in the direction of motion of the train.
(*c*) Slightly away from the hand of his brother in the direction opposite to the direction of motion of the train.
(*d*) None of the above

2. When an object is in equilibrium state then

(*a*) It must be at rest
(*b*) No force is acting on it
(*c*) Its net acceleration must be zero
(*d*) All of these

3. When an object is at rest

(*a*) Force is required to keep it in rest state
(*b*) No force is acting on it
(*c*) A large number of forces may be acting on it which balance each other
(*d*) It is in vacuum

4. A body released from a balloon rising up continues to move up along with the balloon due to inertial of motion.

(*a*) True (*b*) False
(*c*) Partially true (*d*) None of the above

5. Unit of inertia is same as unit of :-

(*a*) Mass (*b*) Force
(*c*) Di-electric constant (*d*) Angle

Newton's First Law of Motion or Law of Inertia

6. An athlete does not come to rest immediately after crossing the winning line due to the

(*a*) Inertia of rest (*b*) Inertia of motion
(*c*) Inertia of direction (*d*) None of these

7. Why does the horse rider falls forward when a horse at full gallop stops suddenly?

8. **Assertion:** If a body is moving with some fixed velocity, then there must be presence of Net force acting on Body.

Reason: It is only the Net force which can change state of body from rest to motion

(*a*) If both assertion and reason are correct and reason is a correct explanation of the assertion
(*b*) If both assertion and reason are correct but reason is not the correct explanation of assertion
(*c*) If assertion is incorrect but reason is correct
(*d*) If both assertion and reason are incorrect

9. **Assertion:** Inertia is proportional to mass of object [higher the mass, higher will be it's inertia]

Reason: Inertia is physical quantity that doesn't have any unit

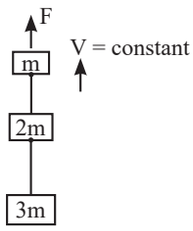
(*a*) If both assertion and reason are correct and reason is a correct explanation of the assertion
(*b*) If both assertion and reason are correct but reason is not the correct explanation of assertion
(*c*) If assertion is correct but reason is incorrect
(*d*) If both assertion and reason are incorrect

10. Newton's first law is a special case of second law.

(*a*) True (*b*) False
(*c*) Partially true (*d*) None of the above

Tension in Equilibrium

11. Three blocks with masses m, $2m$, and $3m$ are connected as shown in the diagram. A force F is applied upward on the block with mass m, and the system moves with constant velocity V. Find the net force acting on the middle block of mass $2m$.



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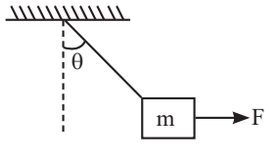
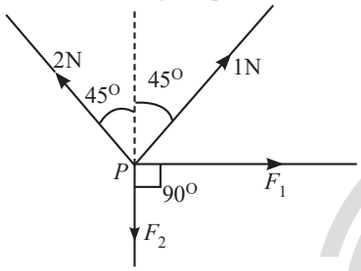
12. Find 'θ' angle by string from vertical and tension T in string where object of mans *m* is in equilibrium state.



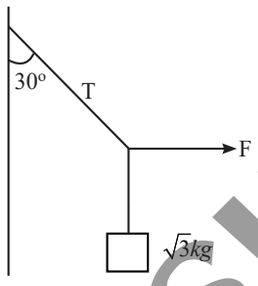
13. A mass of 10 kg is suspended vertically by a rope from the roof. When a horizontal force is applied on the mass, the rope deviated at an angle of 45° at the roof point. If the suspended mass is at equilibrium, the magnitude of the force applied is (Take, g = 10 ms^2)

(*a*) 70 N (*b*) 200 N
(*c*) 100 N (*d*) 140 N

14. Four forces are acting at a point *P* in equilibrium as shown in figure. The ratio of force F_1 to F_2 is 1: *x* where *x* =.....

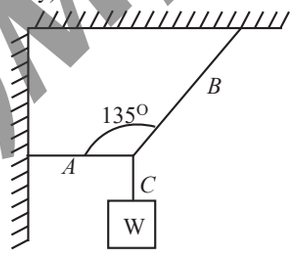


15. A block of $\sqrt{3}$ kg is attached to string whose other end is attached to the wall. An unknown force *F* is applied so that the string makes an angle of 30° with wall. The tension T is



(*a*) 15 N (*b*) 10 N
(*c*) 25 N (*d*) 20 N

16. A block of weight W is supported by three strings as shown in figure. Which of the following relations is true for tension in the strings? (Here T_1, T_2 and T_3 are the tension in the strings *A, B* and *C* respectively)



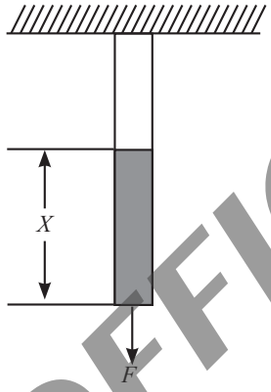
(*a*) $T_1 = T_2$ (*b*) $T_1 = T_3$
(*c*) $T_2 = T_3$ (*d*) $T_1 = T_2 = T_3$

17. A weight Mg is suspended from the middle of a rope whose ends are at the same level. The rope is no longer horizontal. The minimum tension required to completely straighten the rope is

(*a*) Mg/2 (*b*) Mg cos 8
(*c*) 2 mg cos 8 (*d*) Infinitely large

Tension in a Heavy Rope

18. A vertical force *F* is applied at one end of a uniform rope of mass *M* and length *L*. Find out tension in the rope as a function of *x*

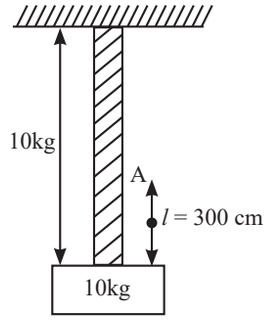


(*a*) $F + Mg$ (*b*) $F + \frac{MgL}{x}$
(*c*) $\frac{FL + Mgx}{L}$ (*d*) $\frac{Fx + MgL}{L}$

19. A uniform rope of mass *M* and length *L* is fixed at its upper end vertically from a rigid support. Then the tension in the rope at the distance *l* from the rigid support is

(*a*) $Mg\frac{L}{L+l}$ (*b*) $\frac{Mg}{L}(L-l)$
(*c*) Mg (*d*) $\frac{l}{L}Mg$

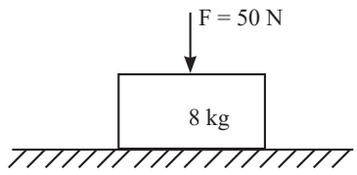
20. The adjoining figure shows a block of mass 10 kg connected to free end of a rope of mass 10 kg and length 10 m. The tension of the rope at point A is (g = 10m /s^2)



(*a*) 170 N (*b*) 30 N
(*c*) 130 N (*d*) 70 N

Contact Force

21. An 8 kg block is placed on the ground, and a vertical downward force of 50 N is applied to the block. Find the contact force (normal force) between the 8 kg block and the ground.



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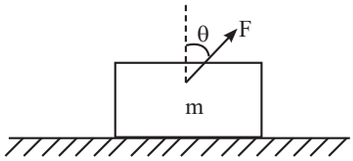
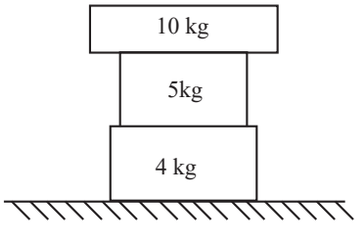
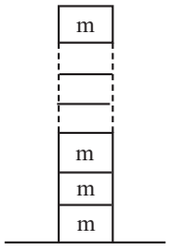
22. A block of mass m is placed on the ground. A force F is applied at an angle θ to the horizontal. Find the contact force (normal force) exerted by the block on the ground.



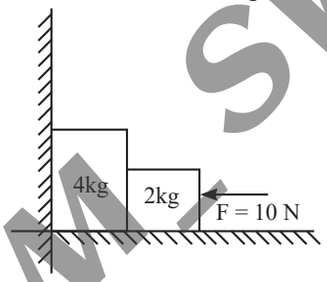
23. Three blocks of masses 4 kg, 5 kg, and 10 kg are stacked on top of each other, with the 4 kg block at the bottom, the 5 kg block in the middle, and the 10 kg block on top. Find the force applied by the 5 kg block on the 10 kg block.



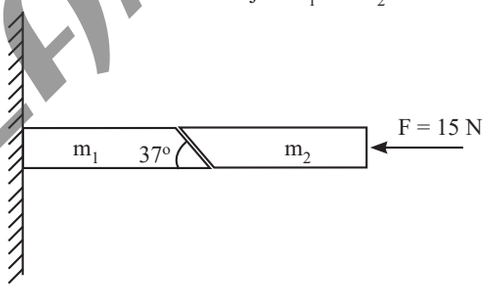
24. There are 50-identical block placed on over other shown in figure. Find contact force between 2nd and 3rd block.



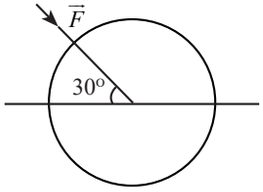
25. A 4 kg block is placed next to a 2 kg block, with a horizontal force of 10 N applied to the 2 kg block. The blocks are in contact with each other and are pushed against a wall as shown in the diagrame. Find the contact force between the 4 kg block and the 2 kg block..



26. Find contact force between object m_1 and m_2



27. As shown in figure, a 70 kg garden roller is pushed with force of $\vec{F} = 200$ N at an angle of 30° with horizontal. The normal reaction on the roller is



(*a*) 800 N (*b*) 600 N

(*c*) $200\sqrt{3}N$ (*d*) $800\sqrt{2}N$

28. Ten one-rupee coins are put on top of each other on a table. Each coin has mass m.

Find the magnitude (is mgN) and direction of

(i) The force on the 7th coin (counted from the bottom due to all the coins on its top).

(ii) The force on the 7th coin by the eighth coin,

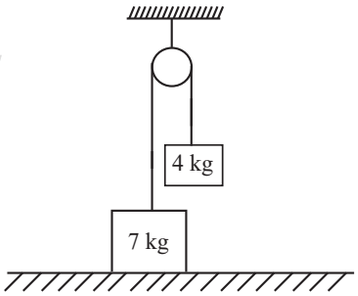
(iii) The reaction of the 6th coin on the 7th coin.

(*a*) 3, 3, –4 (*b*) –4, 3, 3

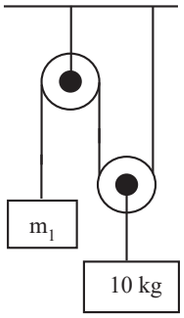
(*c*) 3, –4, 3 (*d*) None of these

Static Pulley Block System

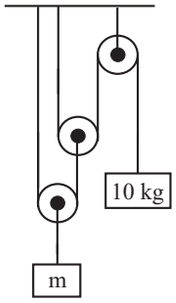
29. Find contact force between ground and 7 kg block as shown in figure.



30. Find m_1 so that system is in equilibrium.



31. Find m = ?? if system is at rest?



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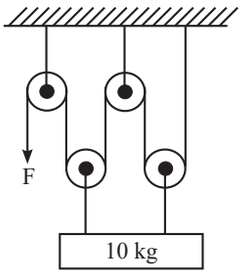
32. F = ? So that system will be in equilibrium

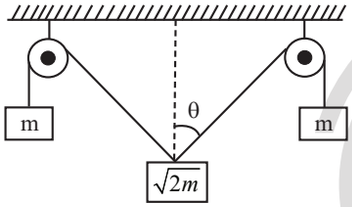


(*a*) 10 N (*b*) 25 N
(*c*) 100 N (*d*) 400 N

33. Mechanical Advantage in above is

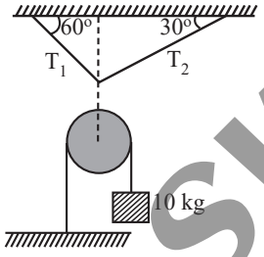
(*a*) 4 (*b*) 10
(*c*) $\frac{1}{4}$ (*d*) 1

34. The pulleys and strings shown in the figure are smooth and of negligible mass. For the system to remain in equilibrium, the angle θ should be



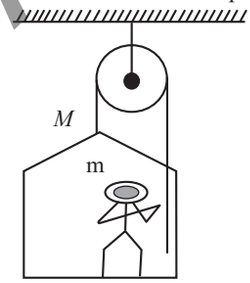
(*a*) 0º (*b*) 30º
(*c*) 45º (*d*) 60º

35. In the arrangement as Shown, tension T_2 is (g = 10 m/s^2)



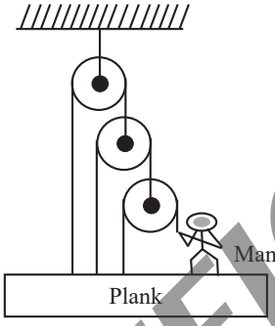
(*a*) 50 N (*b*) 100 N
(*c*) $50\sqrt{3}N$ (*d*) $100\sqrt{3}$ N

36. A man of mass *m* stands on a frame of mass *M*. He pulls a light rope, which passes over a pulley. The other end of the rope is attached to the frame. For the system to be in uniform motion, what force must the man exert on the rope ?



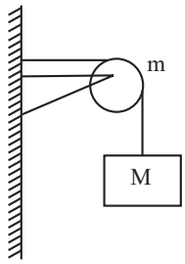
(*a*) $\frac{(M+m)g}{2}$ (*b*) (M + m)g
(*c*) (M - m)g (*d*) (M + 2m)g

37. A man (mass *m*) hold himself and plank (mass *M*) in equilibrium with the help of 3 pulley + string system. The force exerted by man upon rope is



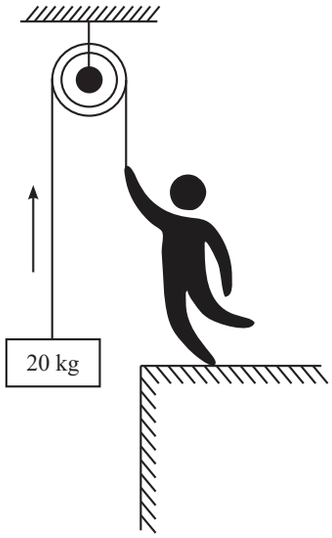
(*a*) $\frac{(M+m)g}{2}$ (*b*) $\frac{(M+m)g}{8}$
(*c*) $\frac{(M+m)g}{6}$ (*d*) $\frac{(M+m)g}{5}$

38. A string of negligible mass going over a clamped pulley of mass (m)supports a block of mass M as shown in the figure. The force on the pulley by the clamp is given by



(*a*) $\sqrt{2}$Mg (*b*) $\sqrt{2}$mg
(*c*) $g\sqrt{(M+m)^2+m^2}$ (*d*) $g\sqrt{(M+m)^2+M^2}$

39. Mass of a block is 20 kg. A man of mass 60 kg raises it with constant velocity as shown in the figure force exerted by man on the floor will be:-



(*a*) 400 N (*b*) 600 N
(*c*) 200 N (*d*) None of the above

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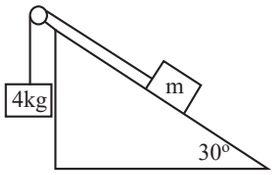
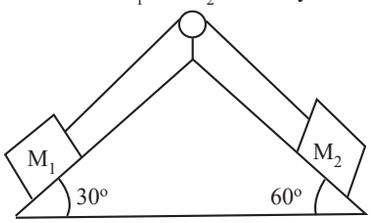
Smooth Inclined Plane

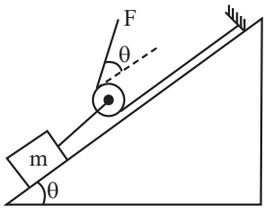
40. If system is in equilibrium then find value of m??



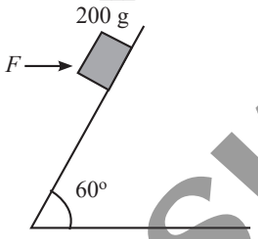
41. Find relation between m_1 and m_2 so that system is in equilibrium.



42. Find F so that object of mass m will be at rest on smooth inclined plane



43. A block of mass 200 g is kept stationary on a smooth inclined plane by applying a minimum horizontal force $F = \sqrt{x}$ as shown in figure. The value of x =____

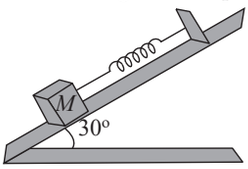


44. If a body is placed on a rough inclined plane, the nature of forces acting on the body is (are)

(*i*) Gravitational force (*ii*) Electromagnetic force
(*iii*) Nuclear force (*iv*) Weak nuclear force
(*a*) Only *i* (*b*) *i* and *iv*
(*c*) All (*d*) *i* and *ii*

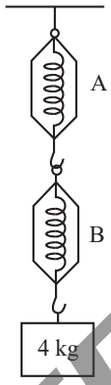
Spring Mass System

45. A body of mass 5 kg is suspended by a spring balance on an inclined plane as shown in figure. The spring balance measure:



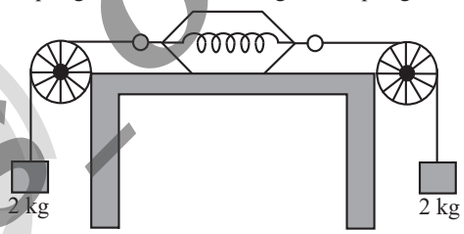
(*a*) 50 N (*b*) 25 N
(*c*) 500 N (*d*) 10 N

46. A block of mass 4 kg is suspended through two light spring balances A and B. Then A and B will read respectively:



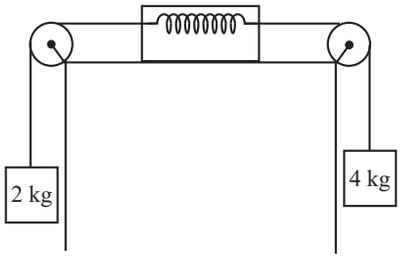
(*a*) 4 kg and zero kg (*b*) zero kg and 4 kg
(*c*) 4 kg and 4 kg (*d*) 2 kg and 2 kg

47. As shown in figure, two equal masses each of 2 kg are suspended from a spring balance. The reading of the spring balance will be



(*a*) Zero (*b*) 2 kg
(*c*) 4 kg (*d*) Between zero and 2 kg

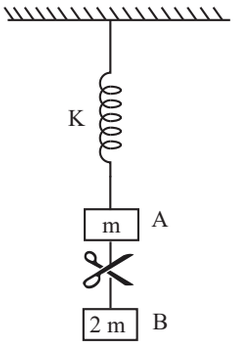
48. Reading of spring.



49. A spring whose unstretched length is l has a force constant k. The spring is cut into two pieces of unstretched lengths l_1 and l_2 where, $l_1 = nl_2$ and n is an integer. The ratio k_1/k_2 of the corresponding force constants, k_1 and k_2 will be:

(*a*) $1/n^2$ (*b*) n^2
(*c*) $1/n$ (*d*) n

50. System as shown in figure is in equilibrium. If string is cut then find acceleration of A and B.



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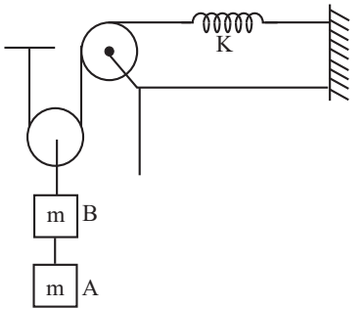
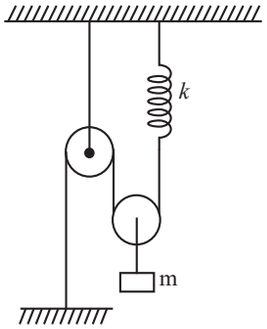
51. Initially both blocks A and B stay at equilibrium If string between A and B is cut, then acceleration of block A and B just after cut will be:



(*a*) g downward, g upward (*b*) g/2 downward, zero
(*c*) g downward, g downward (*d*) g/2 downward, g upward

52. A block of mass *m* shown in figure is in equilibrium. If it is displaced further by *x* and released. Find it acceleration just after it is released. Take pulleys to be light and smooth and strings light.

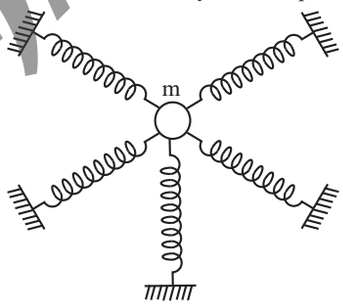


(*a*) $\frac{4kx}{5m}$ (*b*) $\frac{2kx}{5m}$
(*c*) $\frac{4kc}{m}$ (*d*) None of these

53. Three forces F_1 = 10 N, F_2 = 8 N, F_3 = 6N are acting on a particle of mass 5 kg. The forces F_2 and F_3 are applied perpendicularly, so that particle remains at rest. If the force F_1 is removed, then acceleration of particle is

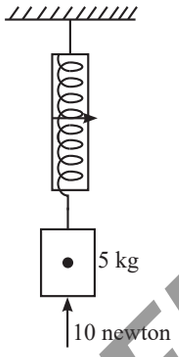
(*a*) 4.8 m/s^2 (*b*) 7 m/s^2
(*c*) 2 m/s^2 (*d*) 0.5 m/s^2

54. A sphere of mass *m* is kept in equilibrium with the help of several springs as shown in the figure. Measurement shows that one of the springs applies a Force $\vec{F}$ on the sphere. With what acceleration the sphere will move immediately after this particular spring is cut?



(*a*) Zero (*b*) $\vec{F}/m$
(*c*) $-\vec{F}/m$ (*d*) Insufficient information

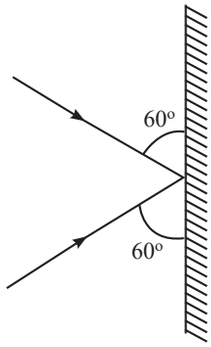
55. Reading of spring balance is (g = 10 m/s^2) if object of mass 5 kg is in equilibrium,



(*a*) 10 N (*b*) 20 N
(*c*) 30 N (*d*) 40 N

Newton's Second Law of Motion

56. A body of mass 3 kg moving with velocity 10 m/s hits a wall at an angle of 60° and returns at the same angle. The impact time was 0.2 s. Calculate the force exerted on the wall



(*a*) $150\sqrt{3}$N (*b*) $50\sqrt{3}$N
(*c*) 100 N (*d*) 75 N

57. A (0.5 kg ball moving with a speed of 12 m/s strikes a hard wall at an angle of 30° with the wall. It is reflected with the same speed and at the same angle. If the ball is in contact with the wall for 0.25 s, the average force acting on the wall is:

(*a*) 48 N (*b*) 24 N
(*c*) 12 N (*d*) 96 N

58. A cricketer catches a ball of mass 150 g in 0.1 s moving with speed 20 m/s, then the experiences force of

(*a*) 300 N (*b*) 30 N
(*c*) 3 N (*d*) 0.3 N

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59. A ball of mass 50 g is dropped from a height of 20 m. A boy on the ground hits the ball vertically upwards with a bat with an average force of 200 N, so that it attains a vertical height of 45 m. The time for which the ball remains in contact with the bat is [Take g = 10 m/s²]

(*a*) 1/20th of a second (*b*) 1/40th of a second
(*c*) 1/80th of a second (*d*) 1/20th of a second

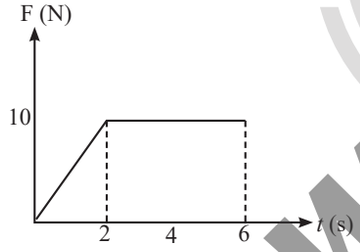
60. A force of 6 N acts on a body at rest and of mass 1 kg. During this time, the body attains a velocity of 30 m/s. The time for which the force acts on the body is

(*a*) 7 second (*b*) 5 second
(*c*) 10 second (*d*) 8 second

61. In two different experiments, an object of mass 5 kg moving with a speed of 25 ms^{-1} hits two different walls and comes to rest within (i) 3 second, (ii) 5 seconds, respectively. Choose the correct option out of the following:

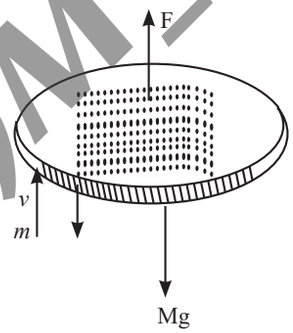
(*a*) Impulse and average force acting on the object will be same for both the cases.
(*b*) Impulse will be same for both the cases but the average force will be different.
(*c*) Average force will be same both the cases but the impulse will different.
(*d*) Average force and impulse will be different for both the cases.

62. A body of mass 3 kg is acted on by a force which varies as shown in the graph below. The momentum acquired is given by:



(*a*) Zero (*b*) 5 N-S
(*c*) 30 N-S (*d*) 50 N-S

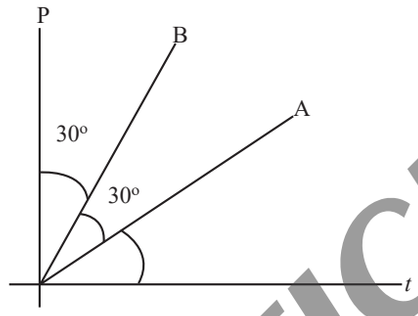
63. A disc of mass 1.0 kg kept floating horizontally in air by firing bullets of mass 0.05 kg each vertically at it, at the rate of 10 per second. If the bullets rebound with the same speed, the speed with which these are fired will be-



(*a*) 0.098 m/s (*b*) 0.98 m/s
(*c*) 9.8 m/s (*d*) 98.0 m/s

64. A stone of mass 1 kg is thrown with a velocity of 20 m/s across the frozen surface of a lake and it comes to rest after travelling a distance of 50 m. What is the magnitude of the force opposing the motion of the stone?

65. For two object P-t graph is given then find ratio of force acting on them.



66. Figures (a), (b), (c) and (d) show variation of force with time.

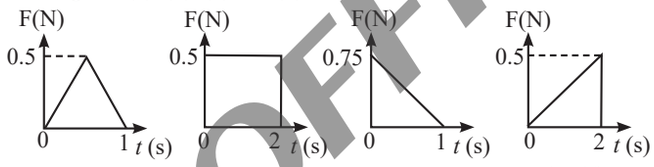


Fig. (a) Fig. (b) Fig. (c) Fig. (d)

The impulse is highest in figure

(*a*) Figure (c) (*b*) Figure (d)
(*c*) Figure (a) (*d*) Figure (b)

67. The momentum *p* (in kg/m) of a particle is varying with time *t* (in s) as $p = 2 + 3t^2$ The force acting on the particle at *t* = 3 s will be

(*a*) 18 N (*b*) 54 N
(*c*) 9 N (*d*) 15 N

68. A force $\vec{F} = (2t\hat{i} + 3t^2\hat{j})$ N acts on an object moving in D plane. Find magnitude of change in momentum of the object in time interval t = 0 to t = 2s

69. At any instant the velocity of particle of mass 500 g is $(2t\hat{i} + 3t^2\hat{j})$ m/s. If the force acting on the particle at t = 1s is $(\hat{i} + x\hat{j})$ N. Then the value of x will be

(*a*) 2 (*b*) 4
(*c*) 6 (*d*) 3

70. If impulse varies with time *t* as (kg ms^{-1}) = $20t^2$ - 40t The change in momentum is minimum at

(*a*) t = 2s (*b*) t = 1s
(*c*) t = 1/2 s (*d*) t = 3 / 2s

Variable Mass System

71. Gravel is dropped onto a conveyer belt at a rate of 0.5 kg/s. The extra force required in newton to keep the belt moving at 2 m/s is:

(*a*) 1 N (*b*) 2 N
(*c*) 4 N (*d*) 0.5 N

72. A balloon of mass 2 gram has a small hole pierced into it. The air comes out with a velocity of 4 m/s. If the balloon shrinks completely in 2.5 s. The average force acting on the balloon is

(*a*) 0.008 N (*b*) 0.0032 N
(*c*) 8 N (*d*) 3.2 N

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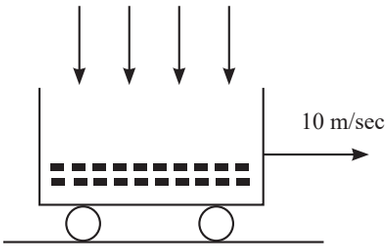
73. A balloon has mass of 10 g in air. The air escapes from the balloon at a uniform rate with velocity 4.5 cm/s. If the balloon shrinks in 5 s completely. Then, the average force acting on the balloon will be (in dyne).

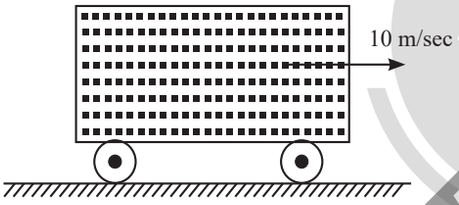
(*a*) 3 (*b*) 9
(*c*) 12 (*d*) 18

74. A cart of mass 1200 kg is moving with constant speed 10 m/sec. Due to heavy rain, water is entering in cart with rate 10 kg/sec, as shown in diagram then velocity of cart after 2 minute will be:



(*a*) 5 m/sec (*b*) 10 m/sec
(*c*) 7.5 m/sec (*d*) 2.5 m/sec

75. A cart having total mass 3000 kg is moving with constant speed 10 m/sec now sand is leaking from hole with rate 10 kg/sec, then speed of cart after 2 minute will be :



(*a*) 10 m/sec (*b*) 16.67 m/sec
(*c*) 15 m/sec (*d*) None

76. Water jet is coming out of a hose pipe of diameter 20 cm with speed 20 cm/sec. It strikes a man inelastically. Find the force exerted by water jet on the person.

(*a*) 5.04 N (*b*) 1.26 N
(*c*) 2.52 N (*d*) 9.4 N

77. A satellite in force free space sweeps stationary interplanetary dust at a rate $(dM/dt) = \alpha v$ Here v is the velocity. The acceleration of satellite of mass Mis M is

(*a*) $-2\,\alpha v^2/M$ (*b*) $-3\,\alpha v^2/M$
(*c*) $-\alpha v^2/M$ (*d*) $-\alpha v^2$

78. A cart is moving with a velocity 20 m/s. Sand is being dropped into the cart at the rate of 50 kg/min. The force required to move the card with constant velocity will be

(*a*) 50 N (*b*) 30.33 N
(*c*) 26.45 N (*d*) 16.66 N

79. A stream of water flowing horizontally with a speed of 15 ms^{-1} gushes out of a tube of cross-sectional area 10^{-2} m^2 and hits a vertical wall nearby. What is the force exerted on the wall by the impact of water, assuming it does not rebound?

(*a*) 2250 N (*b*) 2408 N
(*c*) 2048 N (*d*) None of these

Rocket Propulsion

80. A 800 kg rocket is fired from earth so that exhaust speed is 1200 m/s. Then calculate mass of fuel burning per second, to provide initial thrust to overcome its weight. ($g = 10 m/(s^2)$)

81. A cracker rocket is ejecting gases at a rate of 0.05 kg/s with a velocity 400 m/s. The accelerating force on the rocket is:

(*a*) 20 dyns (*b*) 20 N
(*c*) 200 N (*d*) zero

82. If the force on a rocket, that releases the exhaust gases with a velocity of 300 m/s is 210 N, then the rate of combustion of the fuel is

(*a*) 0.07 kg/s (*b*) 1.4 kg/s
(*c*) 0.7 kg/s (*d*) 10.7 kg/s

83. A rocket of mass 5700 kg ejected mass at a constant rate of 15 kg/s with constant speed of 12 km/s. The acceleration of the rocket 1 minute after the blast is ($g = 10 m/(s^2)$)

(*a*) 34.9 m/s^2 (*b*) 27.5 m/s^2
(*c*) 3.50 m/s^2 (*d*) 13.5 m/s^2

84. Suppose a rocket with an initial mass M_0, eject a mass Δm in the form of gases in time Δt, then the mass of the rocket after time t is:-

(*a*) $M_0 - \frac{\Delta m}{\Delta t}.t$ (*b*) $M_0 - \frac{\Delta m}{\Delta t}$
(*c*) $M_0 + \frac{\Delta m}{\Delta t}$ (*d*) M_0

Momentum & Conservation of Momentum

85. **Assertion:** Some force applied for some time causes the same change in momentum for different bodies

Reason: The total momentum of an isolated system of interacting bodies remains conserved

(*a*) If both assertion and reason are correct and reason is a correct explanation of the assertion
(*b*) If both assertion and reason are correct but reason is not the correct explanation of assertion
(*c*) If assertion is correct but reason is incorrect
(*d*) If both assertion and reason are incorrect

86. A body of mass m is projected with initial speed u at an angle θ with the horizontal. The change in momentum of body after time t is:

(*a*) m u sin θ (*b*) 2 m u sin θ
(*c*) $m\,g\,t$ (*d*) Zero

87. A particle is acted upon by a force given by $F = (12t + 3t^2)N$ where t is in seconds. Find the change in momentum of that particle from $t = 1$ to $t = 3$ sec.

Gun-Bullet System

88. A bullet of mass 50 g is fired from a gun with initial velocity of 32 m/s. If mass of the gun is 4 kg, then calculate the recoil velocity of the gun.

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89. A machine gun fires a bullet of mass 65 g with a velocity of 1300 m/s. The man holding it can exert a maximum force of 169 N on the gun. The number of bullets he can fire per second will be:

90. A bullet of mass 40 g is fired from a gun of mass 10 kg. If velocity of bullet is 400 m/s, the recoil velocity of the gun will be:

(*a*) 1.6 m/s in the direction of bullet

(*b*) 1.6 m/s opposite to the direction of bullet

(*c*) 1.8 m/s in the direction of bullet

(*d*) 1.8 m/s opposite to the direction of bullet

91. **Assertion:** A bullet is fired from a rifle. If the rifle recoils freely, the kinetic energy of rifle is more than that of bullet

Reason: Kinetic energy depends on mass directly by formula $k.e = ½ mv^2$

(*a*) If both assertion and reason are correct and reason is a correct explanation of the assertion

(*b*) If both assertion and reason are correct but reason is not the correct explanation of assertion

(*c*) If assertion is incorrect but reason is correct

(*d*) If both assertion and reason are incorrect

92. A machine gun fire bullets of mass 40 gm each with the velocity of 100 m/sec. If average force is exerted on the gun F is 400 N, then find the no. of bullets fired per minutes.

Newton's third Law of Motion

93. **Assertion:** A block of Table is at rest because gravitational force and normal R*x* are action R*x*^{n} pair and cancel out each other

Reason: Newton 3rd law states that every action has equal and opposite reaction in opposite direction

(*a*) If both assertion and reason are correct and reason is a correct explanation of the assertion

(*b*) If both assertion and reason are correct but reason is not the correct explanation of assertion

(*c*) If assertion is incorrect but reason is correct

(*d*) If both assertion and reason are incorrect

94. Swimming is possible on account of

(*a*) First law of motion

(*b*) Second law of motion

(*c*) Third law of motion

(*d*) Newton's law of gravitation

95. You are on a frictionless horizontal plane. How can you get off if no horizontal force is exerted by pushing against the surface

(*a*) By jumping

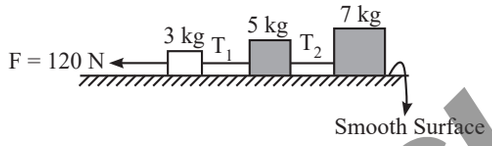
(*b*) By spitting or sneezing

(*c*) By rolling your body on the surface

(*d*) By running on the plane

Connected Body Motion

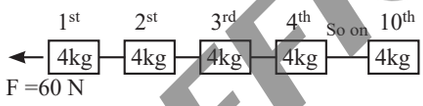
96. Find T_1 and T_2 in the given figure are



(*a*) 28 N, 48 N (*b*) 48 N, 28 N

(*c*) 96 N, 56 N (*d*) 56 N, 96 N

97. Find tension b/w 7th & 8th block

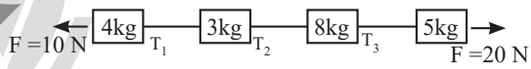


98. A block of mass *M* is pulled along a horizontal frictionless surface by rope of mass *m*. If a force *P* is applied at the free end of the rope, the force exerted by the rope on block is

(*a*) $\frac{Pm}{M+m}$ (*b*) $\frac{Pm}{M-m}$

(*c*) P (*d*) $\frac{PM}{M+m}$

99. Find tension T_1, T_2 & T_3

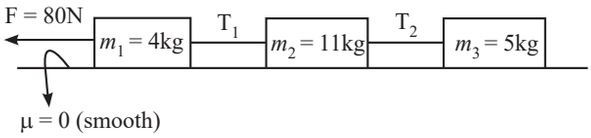


100. A train has 10 wagons each of mass 1000 kg attached to it. They are being pulled by force 10^4 N. Find out force exerted on last four wagons.

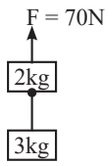
(*a*) 4×10^3 N (*b*) 4×10^4 N

(*c*) 5×10^4 N (*d*) 5×10^3 N

101. Find tension (T_1 & T_2) and acceleration of the system



102. Find tension in string connected between 2 kg and 3 kg.



103. A monkey of mass 50 kg climbs on a rope which can withstand the tension of 350 N. If monkey initially climbs down with acceleration of 4m / (s^2) and then climbs up with acceleration of 5 m / (s^2) . Choose correct option

(*a*) T = 700 N while climbing upward

(*b*) T = 350 while going downward

(*c*) Rope will break while climbing upward

(*d*) Rope will break while going downward

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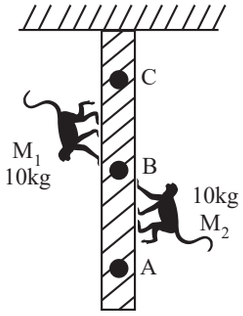
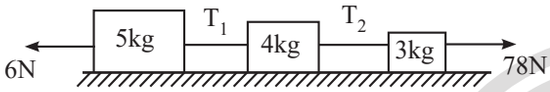
104. If monkey M_1 is at rest and breaking strength of string is 260 N, then a max of M_2 with which it can accelerate, so that string will not break is:

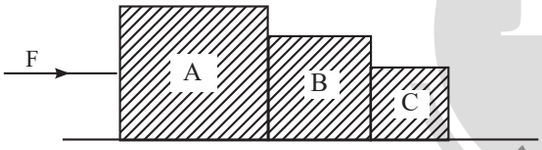


(*a*) 8 m/sec²↑ (*b*) 6 m/sec²↑
(*c*) 4 m/sec²↑ (*d*) None

105. What will be the tension T_1 and T_2 in the given figure?

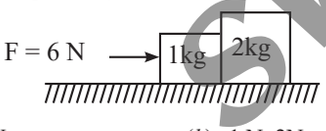


106. Three blocks A, B and C of masses 4 kg, 2 kg and 1 kg respectively, are in contact on a frictionless surface, as shown. If a force of 14 N is applied on the 4 kg block, then the contact force between A and B is



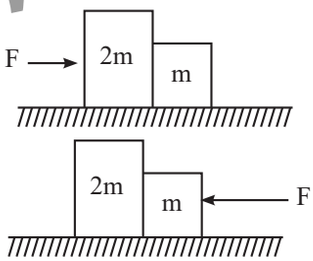
(*a*) 18 N (*b*) 2 N
(*c*) 6 N (*d*) 8 N

107. Arrangement of two block system is as shown. The net force acting on1 kg and 2 kg blocks are (assuming the surface to the frictionless) respectively



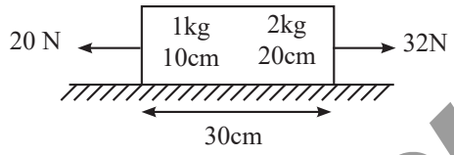
(*a*) 4 N, 8N (*b*) 1 N, 2N
(*c*) 2 N, 4 n (*d*) 3 N, 6 N

108. Two blocks are in contact on a frictionless table. One has mass m and the other 2m. A force F is applied on 2m as shown in the figure. Now the same force F is applied from the right on m. In the two cases respectively, the ratio of force of contact between the two blocks will be



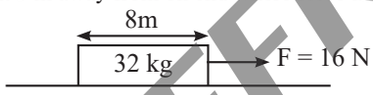
(*a*) Same (*b*) 1 : 2
(*c*) 2 : 1 (*d*) 1 : 3

109. Figure shows a uniform rod of length 30 cm having a mass 3.0 kg. The rod is pulled by constant forces of 20 N and 32 N as shown. Find the force exerted by 20 cm part of the rod on the 10 cm part (all surfaces are smooth) is:

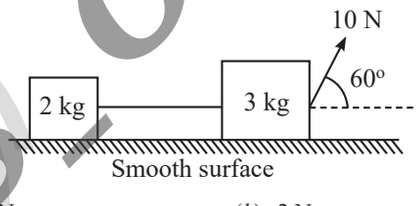


(*a*) 36 N (*b*) 12N
(*c*) 64 N (*d*) 24 N

110. A massive string of length 8 m and mass 32 kg, then find tension of a point 3 m away from on end where force is applied.

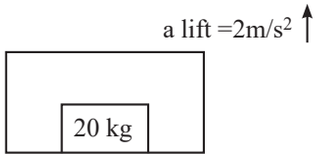


111. Figure shows two blocks connected by a light inextensible string as shown in figure. A force of 10 N is applied on the bigger block at 60° with horizontal, then the tension in the string connecting the two masses is



(*a*) 5 N (*b*) 2 N
(*c*) 1 N (*d*) 3 N

112. Find force applied on base of lift by 20 kg block.



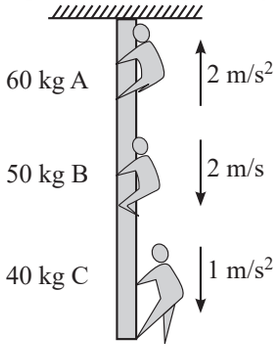
113. A lift of mass 1000 kg is moving with acceleration of 1 m/s² in upward direction, then the tension developed in string which is connected to lift is

(*a*) 9800 N (*b*) 10,800 N
(*c*) 11,000 N (*d*) 10, 000 N

114. A mass of 1 kg is suspended by a thread. It is (i) lifted up with an acceleration 4.9 m/s², (ii) lowered with an acceleration 4.9 m/s². The ratio of the tensions is

(*a*) 1 : 3 (*b*) 1 : 2
(*c*) 3 : 1 (*d*) 2 : 1

115. Tension in the rope at the rigid support is $g = 10 m / s^2$



(*a*) 760 N (*b*) 1360 N
(*c*) 1580 N (*d*) 1620 N

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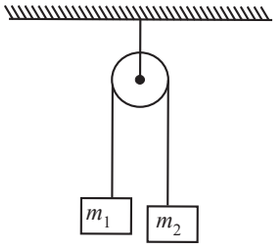
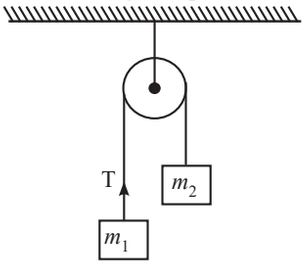
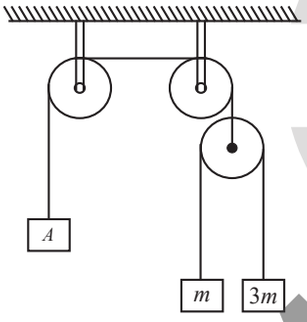
116. If ($m_2 > m_1$) then find acceleration of m_1 and m_2 and Tension in string.



117. Find tension in string if ($m_1 >> m_2$)

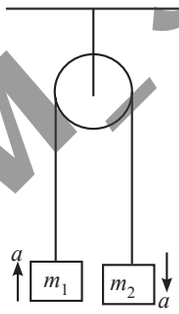


118. In the given figure, find mass of the block A if it remains at rest, when the system is released form rest. Pulleys and strings are massless. [g = 10 m/s2]

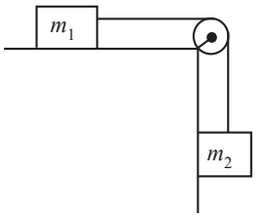


(*a*) m (*b*) 2 m
(*c*) 2.5 m (*d*) 3 m

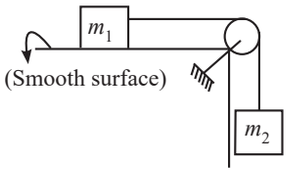
119. Find acceleration of m_1 and m_2 in given pulley block syst ($m_2 > m_1$)



120. Find acceleration of Block m_1 and m_2 and tension in string where horizontal surface is smooth.

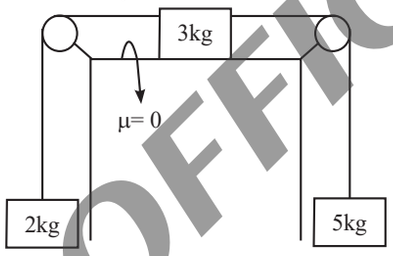


121. If $m_1 = m_2 = 1$ kg then find distance travelled by m_1 in first $\frac{1}{2}$ sec.

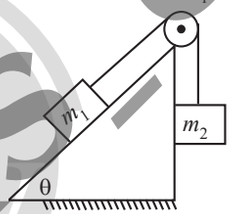


(*a*) 0.625 m (*b*) 0.425 m
(*c*) 0.725 m (*d*) 0.525 m

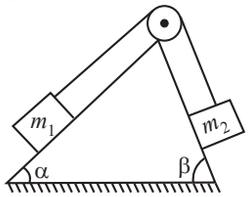
122. Find acceleration of system.



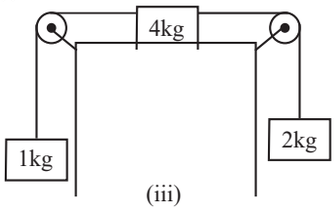
123. Find acceleration on M_1 and M_2



(i)

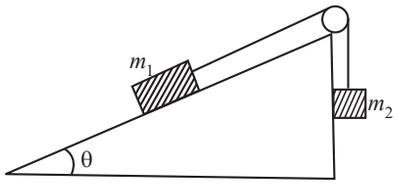


(ii)



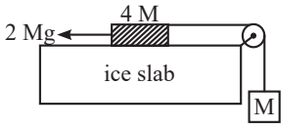
(iii)

124. Two bodies of masses m_1 = 5 kg and m_2 = 3 kg are connected by a light string going over a smooth light pulley on a smooth inclined plane as shown in the figure. The system is at rest. The force exerted by the inclined plane on the body of mass m_1 will be: [Take g = 10 ms^{-2}]



(*a*) 30 N (*b*) 40 N
(*c*) 50 N (*d*) 60 N

125. A hanging mass M is connected to a four times bigger mass by using a string pulley arrangement, as shown in the figure. The bigger mass is placed on a horizontal ice-slab and being pulled by 2 Mg force. In this situation, tension in the string is x/5 Mg for x =_____Neglect mass of the string and friction of the block (bigger mass) with ice slab



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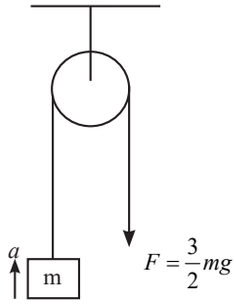
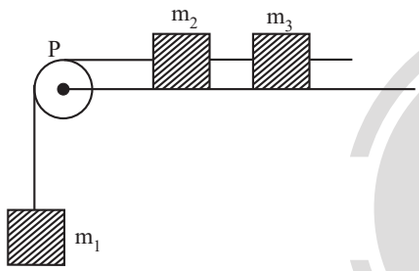
126. In the arrangement shown, the mass m will ascend with an acceleration (Pulley and rope are massless)



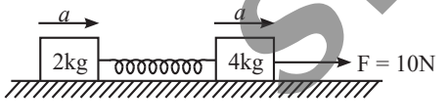
(*a*) Zero (*b*) g/2
(*c*) g (*d*) 2g

127. A system consists of three masses m_1, m_2 and m_3 connected by a string passing over a pulley P. The mass m_1 hangs freely and m_2 and m_3 are on a rough horizontal table (The coefficient of friction = μ). The pulley is frictionless and of negligible mass. The downward acceleration of mass m_1 is: (Assume $m_1 = m_2 = m_3 = m$)



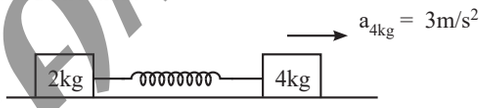
(*a*) $\frac{g(1-g\mu)}{9}$ (*b*) $\frac{2g\mu}{3}$
(*c*) $\frac{g(1-2\mu)}{3}$ (*d*) $\frac{g(1-2\mu)}{2}$

128. Two blocks of mass 2 kg and 4 kg are accelerated with same acceleration by a force 10 N as shown in figure on a smooth horizontal surface. Then the spring force between the two blocks will be (spring is massless)

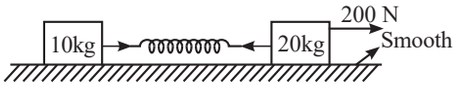


(*a*) 5 N (*b*) 10 N
(*c*) $\frac{10}{3}N$ (*d*) $\frac{5}{3}N$

129. Find acceleration of 2 kg. where acceleration of 4kg is 3m/s² in forward direction.

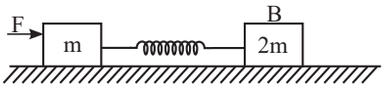


130. Two masses of 10 kg and 20 kg respectively are connected by a massless spring as shown in figure. A force of 200 N acts on the 20 kg mass. At the instant shown the 10 kg mass has acceleration 12 m/s² towards right. The acceleration of 20 kg mass at this instant is:

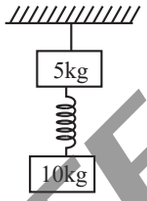


(*a*) 12 m/s² (*b*) 4 m/s²
(*c*) 10 m/s² (*d*) zero

131. Find acceleration of B block if acceleration of a block is a_0 towards left.

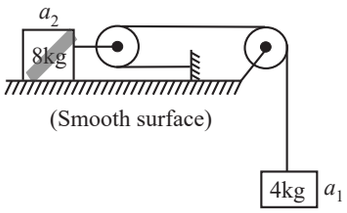


132. System in figure is in equilibrium. Now string is cut. Acceleration of both block will be:



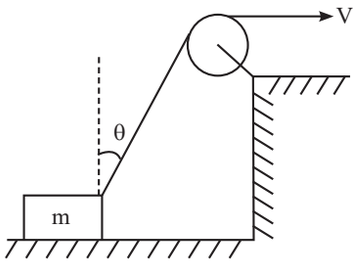
(*a*) g↓,0 (*b*) 3g↓,0
(*c*) 2g↓, g↓ (*d*) 3g↓, g↓

133. If pulleys shown in the diagram are smooth and massless and a_1 and a_2 are acceleration of blocks of mass 4 kg and 8 kg respectively, then



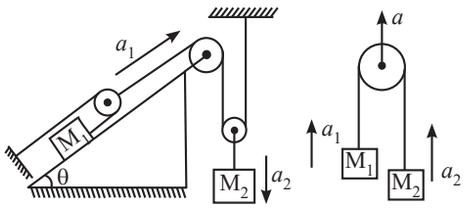
(*a*) $a_1 = a_2$ (*b*) $a_1 = 2a_2$
(*c*) $2a_1 = a_2$ (*d*) $a_1 = 4a_2$

134. A block is dragged on smooth plane with the help of a rope which moves with velocity v. The horizontal velocity of the block is:



(*a*) v (*b*) $\frac{v}{\sin\theta}$
(*c*) $v \sin\theta$ (*d*) $\frac{v}{\cos\theta}$

135. Constrain Motion: Find relation between a_1 and a_2



(i) (ii)

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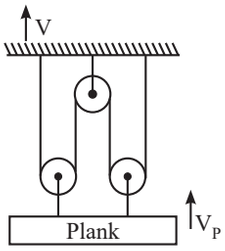
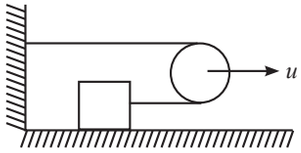
136. Constrain Motion: Find relation between V and V_p



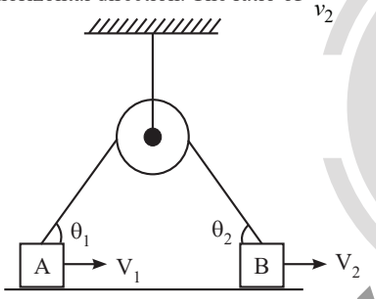
137. In the figure shown, the pulley is moving with velocity u. The velocity of the block attached with string :



(*a*) 4 u (*b*) 3 u

(*c*) 2 u (*d*) u

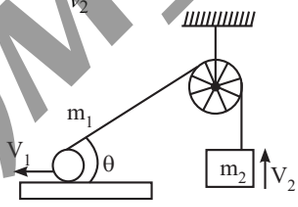
138. In the figure shown, blocks A and B move with velocities V_1 and V_2 along horizontal direction. The ratio of $\frac{v_1}{v_2}$:



(*a*) $\frac{\sin\theta_2}{\sin\theta_1}$ (*b*) $\frac{\sin\theta_1}{\sin\theta_2}$

(*c*) $\frac{\cos\theta_2}{\cos\theta_1}$ (*d*) $\frac{\cos\theta_1}{\cos\theta 2}$

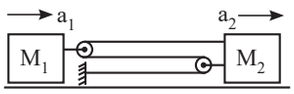
139. In figure, a ball of mass m_1 and a block of mass m_2 are joined together with an inextensible string. The ball can slide on a smooth horizontal surface. If v_1 and v_2 are the respective speeds of the ball and the block, Find $\frac{v_1}{v_2}$



(*a*) Cos θ (*b*) Sec θ

(*c*) Tan θ (*d*) Sin θ

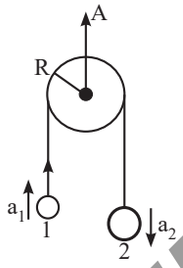
140. Constrain Motion : Find relation between a_1 and a_2



(*a*) $a_1 = a_2$ (*b*) $a_1 = 3a_2$

(*c*) $a_1 = 2a_2$ (*d*) $2a_1 = 3a_2$

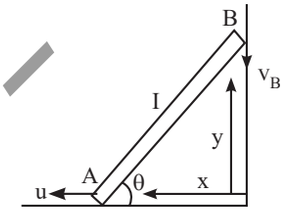
141. Two masses are connected by a string which passes over a pulley accelerating upward at a rate A as shown. If a_1 and a_2 be the acceleration of bodies 1 and 2 respectively then :



(*a*) $A = a_1 - a_2$ (*b*) $A = a_1 + a_2$

(*c*) $A = \frac{a_1 - a_2}{2}$ (*d*) $A = \frac{\alpha_1 + a_2}{2}$

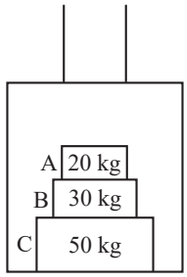
142. Figure shows a rod of length l resting on a wall and the floor. Its lower end A is pulled towards left with a constant velocity u. As a result of this, end B starts moving down along the wall. Find the velocity of the other end B downward when rod makes an angle θ with the horizontal.



(*a*) $2u \sin\theta$ (*b*) $u \sin\theta$

(*c*) $u \cot\theta$ (*d*) $2u \sin\theta$

143. In shown situation elevator is moving upward with acceleration of 5 m/s^2



Column-I		Column-II	
1	Net force acting on B	P	150 N
2	Normal reaction between A and B	Q	300 N
3	Normal reaction between B and C	R	450 N
4	Normal reaction between C and elevator	S	750 N
5		T	1500 N

(*a*) (1) – P (2) – Q (3) – S (3) – T

(*b*) (1) – Q (2) – Q (3) – R (3) – T

(*c*) (1) – P (2) – R (3) – S (3) – S

(*d*) (1) – Q (2) – R (3) – R (3) – T

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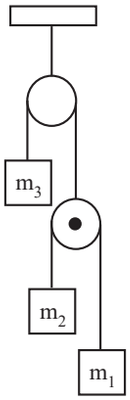
144. Three masses m_1, m_2 and m_3 are attached to a string-pulley system as shown. All the three masses are held at rest and then released. To keep m_3 at rest, the condition is



(*a*) $m_3 = m_1 + m_2$ (*b*) $m_3 = \frac{2m_1m_2}{m_1+m_2}$

(*c*) $m_3 = \sqrt{m_1m_2}$ (*d*) $m_3 = \frac{4m_1m_2}{m_1+m_2}$

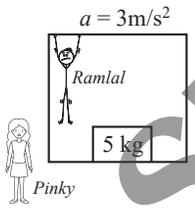
145. With what minimum acceleration can a fire man slide down a rope whose breaking strength is $3/4^{th}$ of his weight.

(*a*) g/4 m/s^2 (*b*) g m/s^2

(*c*) 3/4m/s^2 (*d*) Zero

Pseudo Force

146. Find contact force between block and surface of lift. w.r.t Ramal & Pinky



147. Normal on block with respect to pinky & Ramlal will be

(*a*) Same (*b*) Different

(*c*) Don't know

148. **Statement I:** An elevator can go up on down with uniform speed when its weight is balanced with the tension of its cable.

Statement II: Force exerted by floor of an elevator on foot of person standing on it is more than his/her weight when elevator goes down with increasing speed

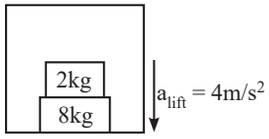
(*a*) Statement I and Statement II is false

(*b*) Statement I and Statement II is true

(*c*) Statement I is false but statement II is true

(*d*) Statement I is true but statement II is false

149. Find contact force between 2 kg and 8 kg

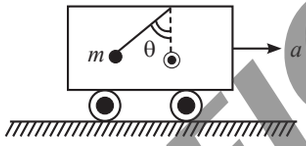


150. A small metallic sphere of mass *m* is suspended from the ceiling of a car accelerating on a horizontal road with constant acceleration *a*. The tension in the string attached with metallic sphere is

(*a*) *Mg* (*b*) *m* (*g* + *a*)

(*c*) *m* (*g* – *a*) (*d*) $m\sqrt{g^2+a^2}$

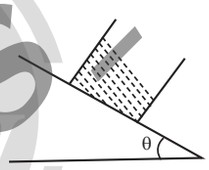
151. If trolley accelerates horizontally with acceleration a then bob is displaced backward from its initial vertical position. The angular deflection of the bob in equilibrium is

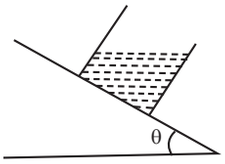


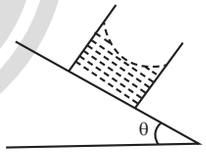
(*a*) $\theta = \cos^{-1}\left(\frac{a}{g}\right)$ (*b*) $\theta = \sin^{-1}\left(\frac{a}{g}\right)$

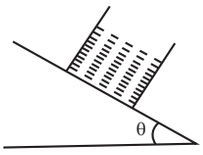
(*c*) $\theta = \cot^{-1}\left(\frac{a}{g}\right)$ (*d*) $\theta = \tan^{-1}\left(\frac{a}{g}\right)$

152. A beaker is half filled with water. It is allowed to slip down on smooth inclined plane with angle of inclination θ to the horizontal. The level of water in the beaker will be :-

(*a*) 

(*b*) 

(*c*) 

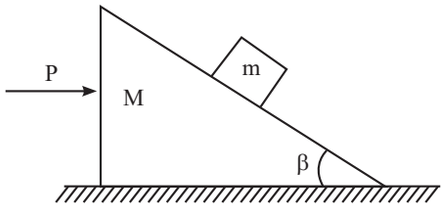
(*d*) 

153. A block of mass *m* kg is kept on a weighing machine in an elevator. If the elevator is retarding upward by *a* ms^{-2}, the reading of weighing machine is (in kg)

(*a*) *mg* (*b*) *m*(*g* – *a*)

(*c*) $m\left(1-\frac{a}{g}\right)$ (*d*) *m* (*g* + *a*)

154. A block of mass *m*, is kept on a wedge of mass *M*, as shown in figure such that mass *m* remains stationary w.r.t. wedge. The magnitude of force P is



(*a*) g tan β (*b*) *mg* tan β

(*c*) (m + M)*g* tan β (*d*) *mg* cot β

155. A block of mass *m* is placed on a smooth wedge of inclination θ. The whole system is accelerated horizontally so that the block does not slip on the wedge. The force exerted by the wedge on the block (*g* is acceleration due to gravity) will be

(*a*) *mg* cos θ (*b*) *mg* sin θ

(*c*) *mg* (*d*) *mg*/cos θ

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156. Select the correct statement regarding pseudo force

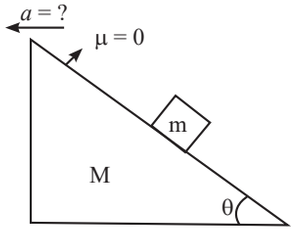
(*a*) It is electromagnetic in origin

(*b*) Newton's 3rd law is applicable for it

(*c*) It is a fundamental force

(*d*) It is used to make Newton's law applicable in non-inertial frame

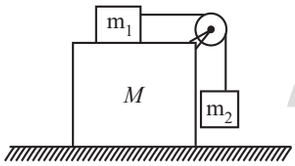
157. Find acceleration of inclined plane so that block will fall freely.



(*a*) g tan θ (*b*) g cot θ

(*c*) g (*d*) g sin θ

158. In the given arrangement all surfaces are smooth. What acceleration should be given to the system, for which the block m_2 doesn't slide down?



(*a*) $\frac{m_2 g}{m_1}$ (*b*) $\frac{m_1 g}{m_2}$

(*c*) g (*d*) $\frac{m_2 g}{m_1 + m_2}$

159. A monkey of mass 20 kg is holding a vertical rope. The rope will not break when a mass of 25 kg is suspended from it but will break if the mass exceeds 25 kg. What is the maximum acceleration with which the monkey can climb up along the rope ? (g = 10m / (s^2)

(*a*) 5 m/s^2 (*b*) 10 m/s^2

(*c*) 25 m/s^2 (*d*) 2.5 m/s^2

160. A man of mass *m* is standing in an elevator moving downward with an acceleration. $\frac{g}{4}$ The force exerted by the bottom surface of the elevator on the 4 man will be

(*a*) $\frac{3mg}{4}$ (*b*) $\frac{mg}{4}$

(*c*) $\frac{5mg}{4}$ (*d*) $\frac{7mg}{4}$

161. Two blocks of masses 2 kg and 4 kg are hanging with the help of massless string passing over an ideal pulley inside an elevator. The elevator is moving upward with an acceleration. $\frac{g}{2}$ The tension in the string connected between the blocks 2 will be (Take g = 10m / (s^2)

(*a*) 40 N (*b*) 60 N

(*c*) 80 N (*d*) 20 N

162. A reference frame attached to the earth-

(A) Is an inertial frame by definition

(B) Cannot be an inertial frame because the earth is revolving round the sun

(C) Is an inertial frame because Newton's laws are applicable in this frame

(D) Cannot be an inertial frame because the earth is rotating about its axis

(*a*) (a, b) (*b*) (b, c)

(*c*) (a, c) (*d*) (b, d)

Apparent Weight

163. A man weighs 80 kg. He stands on a weighing scale in a lift which is moving upwards with a uniform acceleration of 5 m/s^2. What would be the reading on the scale? (g = 10m /s^2)

(*a*) Zero (*b*) 400 N

(*c*) 800 N (*d*) 1200 N

164. A block of mass M placed inside a box descends vertically with acceleration '*a*'. The block exerts a force equal to one-fourth of its weight on the floor of the box. The value of '*a*' will be:

(*a*) g/4 (*b*) g/2

(*c*) 3g/4 (*d*) g

165. A man of mass 90 kg is standing in an elevator whose cable broke suddenly. If the elevator falls, apparent weight of the man is:

(*a*) 90 N (*b*) 90 g N

(*c*) Zero (*d*) any negative value

166. A person is standing in an elevator. In which situation he finds his weight less

(*a*) When the elevator moves upward with constant acceleration

(*b*) When the elevator moves downward with constant acceleration

(*c*) When the elevator moves upward with uniform velocity

(*d*) When the elevator moves downward with uniform velocity

167. A bird is sitting in a large closed cage which is placed on a spring balance. It records a weight of 25 N. The bird (mass *m* = 0.5kg) flies upward in the cage with an acceleration of 2m / s^2) The spring balance will now record a weight of

(*a*) 24 N (*b*) 25 N

(*c*) 26 N (*d*) 27 N

Friction on Horizontal & Vertical Surface

168. The limiting friction between two bodies in contact is independent of

(*a*) Nature of the surface in contact

(*b*) The area of surfaces in contact

(*c*) Normal reaction between the surfaces

(*d*) The materials of the bodies

169. Which of the following is self-adjusting force?

(*a*) Static friction (*b*) Limiting friction

(*c*) Kinetic friction (*d*) Rolling friction

170. Maximum force of friction is called

(*a*) Limiting friction (*d*) Static friction

(*c*) Sliding friction (*d*) Rolling friction

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171. Which is a suitable method to decrease friction?

(*a*) Polishing (*b*) Lubrication

(*c*) Ball bearing (*d*) All of these

172. Given below are two statements:

Statement I: The limiting force of static friction depends on area of contact and independent of materials independent

Statement II: The limiting force of kinetic friction is independent of area of contact and depends on materials

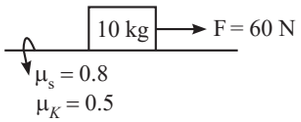
(*a*) Statement I is incorrect but statement II is correct

(*b*) Statement I and Statement II is correct

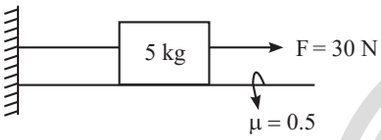
(*c*) Statement I and Statement II is incorrect

(*d*) Statement I is correct but statement II is incorrect

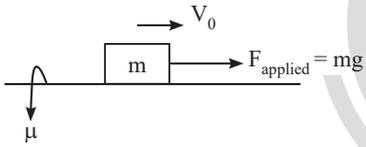
173. Find acceleration and friction between block and ground.



174. Find tension in string .....



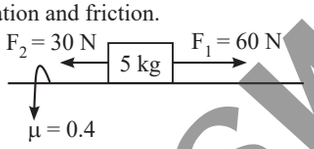
175. Object is moving with constant velocity under the applied force mg as shown in figure, then find constant force.



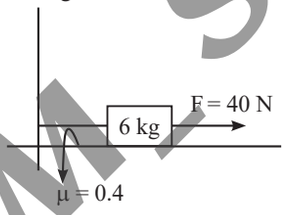
(*a*) mg (*b*) 2 mg

(*c*) μmg (*d*) $\sqrt{2}mg$

176. Find acceleration and friction.



177. Find Tension in string.....



178. Object is thrown with velocity V_0 on rough surface of coefficient of friction μ, then stopping distance and time,

179. A body of mass 10 kg is moving with an initial speed of 20 m/s. The body stops after 5s due to friction between body and the floor. The value of the coefficient of friction is: (Take acceleration due to gravity g = 10ms^{-2})

(*a*) 0.2 (*b*) 0.3

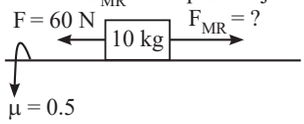
(*c*) 0.5 (*d*) 0.4

180. An object of mass 1 kg moving on a horizontal surface with initial velocity 8 m/s comes to rest after 10 s. If one wants to keep the object moving on the same surface with velocity 8 m/s the force required is

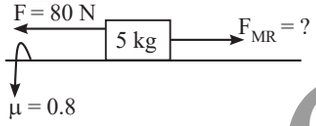
(*a*) 0.4 N (*b*) 0.8 N

(*c*) 1.2 N (*d*) Zero

181. Find the applied force F_{MR} to keep the object at rest.



182. Find value of F_{MR} to keep the object at rest.



183. A heavy box is slid across a rough floor with an initial speed of 4 m/s It stoops moving after 8 seconds. If the average resisting force of friction is 10 N, the mass of the box (in kg) is:

(*a*) 40 (*b*) 20

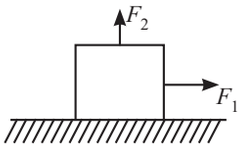
(*c*) 5 (*d*) 2.5

184. A child weighing 25 kg slides down a rope hanging from a branch of a tall tree. If the force of friction acting against him is 200 N, the acceleration of child is (g = 10m /s^2)

(*a*) 22.5 m/s^2 (*b*) 8 m/s^2

(*c*) 5 m/s^2 (*d*) 2 m/s^2

185. In the figure shown, horizontal force F_1 is applied on a block but the block does not slide. Then as the magnitude of vertical force F_2 is increased from zero the block begins to slide; the correct statement is



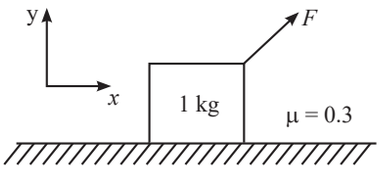
(*a*) The magnitude of normal reaction on block increases

(*b*) Static frictional force acting on the block increases

(*c*) Maximum value of static frictional force decreases

(*d*) All of these

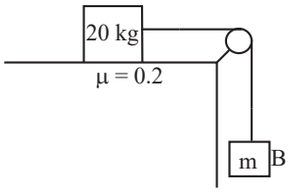
186. A force $\vec{F} = \hat{i} + 4\hat{j}$ acts on the block shown. The force of friction acting on the block is



(*a*) $-\hat{i}$ (*b*) $-18\hat{i}$

(*c*) $-2.4\hat{i}$ (*d*) $-3\hat{i}$

187. In the figure shown, the coefficient of static friction between the block A of mass 20 kg and horizontal table is 0.2. What should be the minimum mass of hanging block just beyond which blocks start moving?



(*a*) 2 kg (*b*) 3 kg

(*c*) 4 kg (*d*) 5 kg

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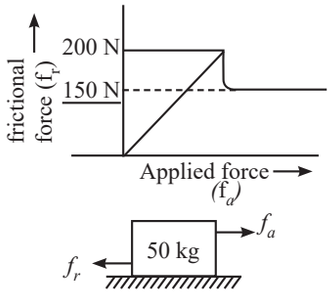
188. The graph between applied force and frictional force for a body of mass 50 kg placed in a horizontal surface is as shown in figure the value of coefficient of static and kinetic friction will be

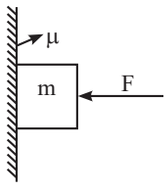


(*a*) 0.4, 0.3 (*b*) 0.3, 0.2
(*c*) 0.4, 0.2 (*d*) 0.2, 0.3

189. A metallic chain 1 long lies on a horizontal surface of a table. The chain starts sliding on the table if 25 cm (or more of it) hangs over the edge of a table. The correct value of the coefficient of friction between the table and the chain is

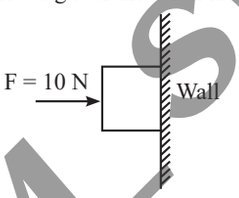
(*a*) $\frac{1}{3}$ (*b*) $\frac{2}{3}$
(*c*) $\frac{1}{4}$ (*d*) $\frac{1}{5}$

190. If object is at rest then find friction force acting on object.



(*a*) μmg (*b*) μF
(*c*) mg (*d*) Can't say

191. A horizontal force 10 N is necessary to just hold a block stationary against a wall. The coefficient of friction between the block and the wall is 0.2 , the weight of the block is



(*a*) 20 N (*b*) 50 N
(*c*) 100 N (*d*) 2 N

192. A block of mass 5 kg is placed at rest on a table of rough surface. Now, if a force of 30 N is applied in the direction parallel to surface of table, the block slides through a distance of 50*m* in an interval of time 10*s*. Coefficient of kinetic friction is

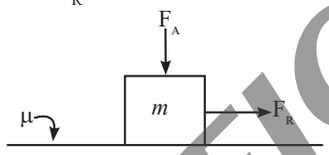
(*a*) 0.25 (*b*) 0.75
(*c*) 0.6 (*d*) 0.5

193. A Bag is gently dropped on a conveyer belt moving at speed of 2 m/s. The coefficient of friction between the conveyer belt and bag is 0.4. Initially, the bag slips on the belt before it stops due to friction. The distance travelled by bag on belt during slipping motion, is

(*a*) 2 *m* (*b*) 0.5 *m*
(*c*) 3.2 *m* (*d*) 0.8 *m*

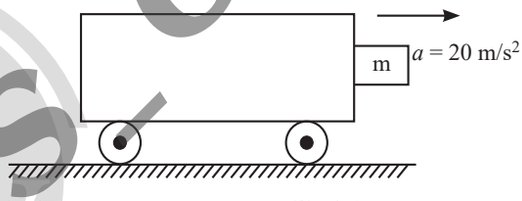
194. A block of mass *m* is placed on a flat horizontal surface and the coefficient of friction between the block and surface is μ. A force F_1 is applied to block from above and a force F_R is applied to right. In all situations being considered below the block remains at rest. Let *f* be the force of friction on the block

(P) *f* increases if *m* is increased
(Q) *f* increases if F_A is increased
(R) *f* increases if F_R is increased



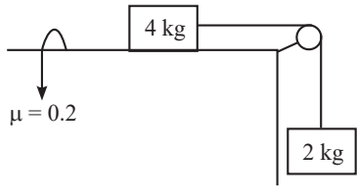
(*a*) Only P is true (*b*) Only Q is true
(*c*) P, Q is true (*d*) Only R is true

195. A vehicle is moving on a road with an acceleration a = 20m /s^2) as shown in figure. The frictional coefficient between the block of mass (*m*) and the vehicle so that block is does not fall downwards is (g = 10m /s^2)

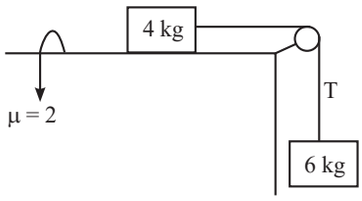


(*a*) 0.5 (*b*) 0.4
(*c*) 2 (*d*) 0.7

196. Two blocks of masses 4 kg and 2 kg are connected by a light inextensible string passing over a smooth pulley. The 4 kg block is placed on a horizontal surface with a coefficient of friction μ = 0.2, while the 2 kg block is hanging vertically. The system is released from rest. Find friction, tension in string and acceleration of system.



197. Find tension, friction and acceleration of system.



198. A block A of mass m_1 rests on a horizontal table. A light string connected to it passes over a frictionless pulley at the edge of table and from its other end another block B of mass m_2 is suspended. The coefficient of kinetic friction between the block and the table is μk. When the block A is sliding on the table, the tension in the string is

(*a*) $\frac{(m_2+\mu_k m_1)g}{(m_1+m_2)}$ (*b*) $\frac{(m_2-\mu_k m_1)g}{(m_1+m_2)}$

(*c*) $\frac{(m_1 m_2(1+\mu_k)g}{(m_1+m_2)}$ (*d*) $\frac{(m_1 m_2(1-\mu_k)g}{(m_1+m_2)}$

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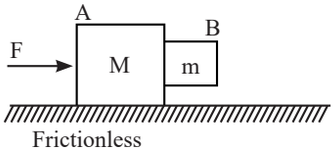
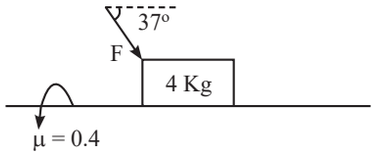
199. Coefficient of friction between A and B is μ. The minimum force F with which A will be pushed such that B will not slip down is



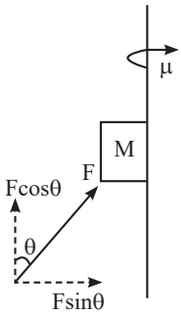
(*a*) $\frac{mg}{\mu}$ (*b*) $\frac{mg}{\mu}$

(*c*) $\frac{(M+m)g}{\mu}$ (*d*) $\frac{(M-m)g}{\mu}$

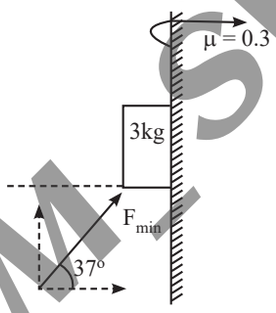
200. Find value of F so that object can move.



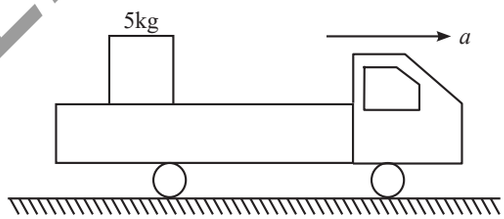
201. Find minimum value of *F* to keep the object at rest.



202. A block of mass 3 kg is held stationary against a vertical wall by applying a force F_{min} at an angle of 37° to the horizontal. The coefficient of friction between the block and the wall is μ=0.3. Determine the minimum force required to keep the block at rest.



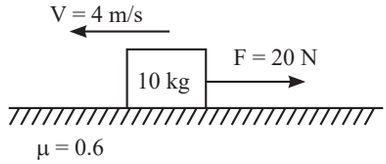
203. What will be the maximum acceleration of the truck so that the block of mass 5 kg placed on the truck does not slip? If the coefficient of friction mu =0.3:



(*a*) $3 m/s^2$ (*b*) $2 m/s^2$

(*c*) $1 m/s^2$ (*d*) Zero

204. A block of mass 10 kg is moving on a rough surface as shown in figure. the frictional force acting on block is:- ($g = 10 m/s^2$)



(*a*) 20 N (*b*) 60 N

(*c*) 40 N (*d*) 80 N

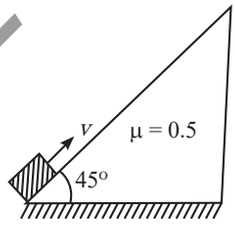
Friction on inclined Plane

205. A cubical block rests on a plane of $\mu = \sqrt{3}$. The angle through which the plane be inclined to the horizontal so that the block just slides down will be

(*a*) 30° (*b*) 40°

(*c*) 60° (*d*) 75°

206. A block of mass 1 kg is projected from the lowest point up along the inclined plane. If $g = 10 ms^{-2}$, the retardation experienced by the block is



(*a*) $\frac{15}{\sqrt{2}} ms^{-2}$ (*b*) $\frac{5}{\sqrt{2}} ms^{-2}$

(*c*) $\frac{10}{\sqrt{2}} ms^{-2}$ (*d*) Zero

207. if a block moving up an inclined plane at 30° with a velocity of 5m/s stops after 0.5 s, then coefficient of friction will be nearly

(*a*) 0.5 (*b*) 0.6

(*c*) 0.9 (*d*) 1.1

208. A block of mass m slides down an inclined plane inclined at angle 30° with an acceleration $\frac{g}{4}$. The value of coefficient of kinetic friction will be

(*a*) $\frac{2\sqrt{3}+1}{2}$ (*b*) $\frac{1}{2\sqrt{3}}$

(*c*) $\frac{\sqrt{3}}{2}$ (*d*) $\frac{2\sqrt{3}-1}{2}$

209. A block of mass 10 kg is released on rough incline plane. Angle of inclination is 30°. Block start descending with acceleration 2 m/s². Kinetic friction force acting on block is (take $g = 10 m/s^2$)

(*a*) 10 N (*b*) 30 N

(*c*) 50 N (*d*) $50\sqrt{3}$N

210. Block of mass 10 kg is moving on inclined plane with constant velocity 10 m/s. The coefficient of kinetic friction between incline plane and block is

(*a*) 0.57 (*b*) 0.75

(*c*) 0.5 (*d*) None of these

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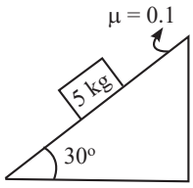
211. A block (mass = M kg) is placed on a rough inclined plane. A force F is applied parallel to the inclined (as shown in figure) such that it just starts moving upward. The value of F is if angle of inclination is 37°

(*a*) Mg sineθ – μ Mg cosμ (*b*) Mg sinθ + μMg cosθ

(*c*) Mg sinθ (*d*) μ Mg cosθ

212. A block of mass 5 kg is placed on a rough inclined surface as shown in the figure. If $\vec{F}_1$ is the force required to just move the block up the inclined plane and $\vec{F}_2$ is the force required to just prevent the block from sliding down, then the value of $|\vec{F}_1| - |\vec{F}_2|$ is



(*a*) $5\sqrt{3}$ N (*b*) 10 N

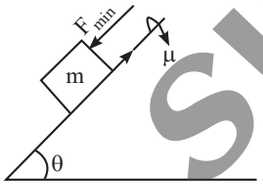
(*c*) $\frac{5\sqrt{3}}{2}$ N (*d*) $25\sqrt{3}$ N

213. A block of mass M slides down on a rough inclined plane with constant velocity. The angle made by the incline plane with horizontal is θ. The magnitude of the contact force will be:

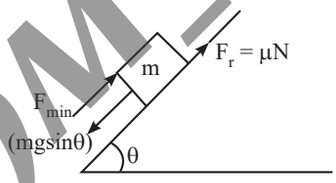
(*a*) Mg (*b*) Mg cos ω

(*c*) $\sqrt{Mg\sin\theta + Mg\cos\theta}$ (*d*) $Mg\sin\theta\sqrt{1+\mu}$

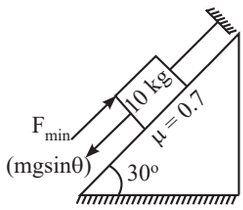
214. If μ > tan θ, then find minimum force required to move this object.



215. If μ < tanθ, then find force required to keep the object at rest.



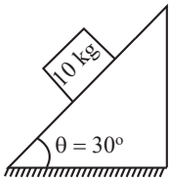
216. The tension T in the string shown in figure is



(*a*) Zero (*b*) 50 N

(*c*) 35 N (*d*) 3 N

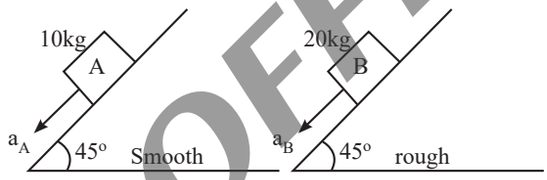
217. A block of mass 10 kg is kept on a fixed rough (μ = 0.8) inclined plane of angle of indication 30°. The frictional force acting on the block is



(*a*) 50 N (*b*) 50√3N

(*c*) 52 N (*d*) 54 N

218. The ratio of the acceleration of blocks A placed on smooth incline with block B placed on rough incline is 2: 1. The coefficient of kinetic friction between block B and incline is



(*a*) 0.5 (*b*) 0.75

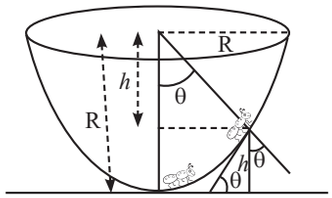
(*c*) 0.57 (*d*) None of these

219. A block of mass *m* is placed on a surface with a vertical cross-section given by $y = \frac{x^3}{6}$. If the coefficient of friction is 0.5 . The maximum height above the ground at which the block can be placed without slipping is

(*a*) $\frac{1}{6}$ m (*b*) $2\frac{2}{3}$ m

(*c*) $\frac{1}{3}$ m (*d*) $\frac{1}{2}$ m

220. Find height from where Chiti will lose contact of the bowl and slip down. the coefficient of friction between Chiti and surface of bowl is μ.

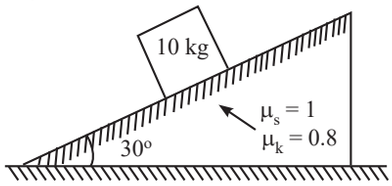


221. A block of mass m placed on an inclined plane of angle of inclination θ slides down the plane with constant speed. The coefficient of kinetic friction between block and inclined plane is

(*a*) sin θ (*b*) cos θ

(*c*) tan θ (*d*) $\tan^{-1}\theta$

222. A block of 10 kg mass is placed on a rough inclined surface as shown in figure. The acceleration of the block will be



(*a*) Zero (*b*) *g*

(*c*) $\frac{g}{2}$ (*d*) $\frac{\sqrt{3}g}{2}$

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223. The upper half of an inclined plane of inclination θ is perfectly smooth while lower half is rough. A block starting from rest at the top of the plane will again come to rest at the bottom, if the coefficient of friction between the block and lower half of the plane is given by

(*a*) $\mu = \frac{2}{\tan\theta}$ (*b*) μ = 2 tan θ

(*c*) μ = tan θ (*d*) $\mu = \frac{1}{\tan\theta}$

224. A block of 3 kg rests in limiting equilibrium on an inclined plane of inclination 30°. If the plane is raised to an inclination 60°, the force along the plane required to support it is at rest.

(*a*) $\frac{10}{\sqrt{3}}$ N (*b*) $10\sqrt{3}N$

(*c*) 10 N (*d*) $\frac{10}{3}$ N

225. A block rests on a rough inclined plane making an angle of 30° with the horizontal. The coefficient of static friction between the block and the plane is 0.8. If the frictional force on the block is 10 N, the mass of the block (in kg) is (take g = 10m /s^2)

(*a*) 2.0 (*b*) 4.0

(*c*) 1.6 (*d*) 2.5

226. The force required just to move a body up an inclined plane is double the force required just to prevent the body sliding down. If the coefficient of friction is 0.25, the angle of inclination of the plane is

(*a*) 30° (*b*) 45°

(*c*) $-\tan^{-1}\left(\frac{1}{4}\right)$ (*d*) $\tan^{-1}\left(\frac{3}{4}\right)$

227. A body of mass 10 kg is lying on a rough inclined plane of inclination 37° and μ = 1/2 the minimum force required to pull the body up the plane is

(*a*) 80 N (*b*) 100 N

(*c*) 120 N (*d*) 60 N

228. A body is sliding down an inclined plane $\left(\mu = \frac{1}{2}\right)$. If the normal reaction is twice that of the resultant downward force along the incline, the inclination of plane is

(*a*) 15° (*b*) 30°

(*c*) 45° (*d*) 60°

229. A block is released from the top of an inclined plane of inclination θ. Its velocity at the bottom of plane is *v*. If it slides down a rough inclined plane of the same inclination, its velocity at bottom is *v*/2. The coefficient of friction is

(*a*) $\frac{3}{4}\cot\theta$ (*b*) $\frac{1}{4}\cot\theta$

(*c*) $\frac{1}{4}\tan\theta$ (*d*) $\frac{3}{4}\tan\theta$

230. A given object takes *n* times as much time to slide down a 45° rough incline as it takes down a perfectly smooth 45° incline. The coefficient of kinetic friction between the object and the incline is given by

(*a*) $\left(1-\frac{1}{n^2}\right)$ (*b*) $\frac{1}{1-n^2}$

(*c*) $\sqrt{\left(1-\frac{1}{n^2}\right)}$ (*d*) $\sqrt{\frac{1}{1-n^2}}$

231. An ice cube is kept on an inclined plane of angle 30°. The coefficient of kinetic friction between the block and incline plane is the 1 /√3 What is the acceleration of the block?

(*a*) Zero (*b*) 2 m/s^2

(*c*) 1.5 m/s^2 (*d*) 5 m/s^2

232. A Rocket is fired vertically from the earth with an acceleration of 2*g*, where *g* is gravitational acceleration. On an inclined plane inside the rocket, making an angle θ with horizontal, a point object of mass *m* is kept. The minimum coefficient of friction μ_{min} between the mass and inclined surface such that the mass does not move is

(*a*) tan θ (*b*) 2 tan θ

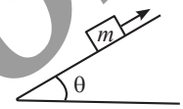
(*c*) 3 tan θ (*d*) tan 2 θ

233. A block of mass M slides down on a rough inclined plane with constant velocity. The angle made by the incline plane with horizontal is θ. the magnitude of the contact force will be:

(*a*) Mg (*b*) Mg cos θ

(*c*) $\sqrt{Mg\sin\theta + Mg\cos\theta}$ (*d*) $Mg\sin\theta\sqrt{1+\mu}$

234. A block of mass m is thrown upwards with some initial velocity as shown. On the block

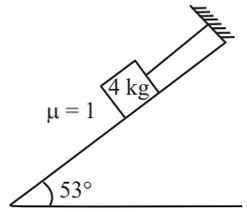


	Column-I		Column-II
1	Net force in horizontal direction	P	Zero
2	Net force in vertical direction	Q	m (gsinθ + μcos θ)
3	Net force along the plane	R	m (gsinθcosθ + μgcos^{2}θ)
4	Net force perpendicular to plane	S	m (gsin^{2}θ + μgcosθ)
			None

(*a*) (1) -P (2) -R (3) -Q (4)- P (*b*) (1) -R (2) -S (3) -Q (4)- P

(*c*) (1) -P (2) -S (3) -Q (4)- P (*d*) (1) -Q (2) -R (3) -P (4)- R

235. For the given figure, match column-I to column-II



	Column-I		Column-II
1	Tension in string	P	24 N
2	Normal on the block	Q	20 N
3	Contact force between block and inclined plane	R	12 N
4	Friction on the block	S	24 N

(*a*) (1) – Q (2) – P (3) – S (4) – R

(*b*) (1) – Q (2) – Q (3) – S (4) – R

(*c*) (1) – P (2) – Q (3) – R (4) – S

(*d*) (1) – Q (2) – P (3) – R (4) – S

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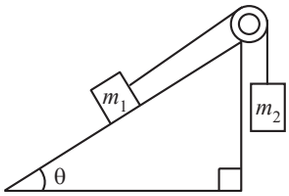
236. Mass m_1 moves on a slope making an angle θ with the horizontal and is attached to mass m_2 by a string passing over a frictionless pulley as shown in figure. The coefficient of friction between m_1 and the slopping surface is μ. Which of the following statements are true?



(*a*) If $m_2 > m_1 \sin\theta$, the body will move up the plane

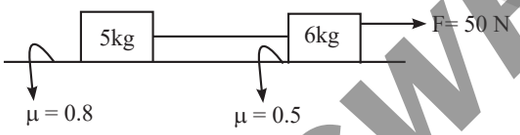
(*b*) If $m_2 > m_1 (\sin\theta + \mu\cos\theta)$, the body will move up the plane

(*c*) If $m_2 < m_1 (\sin\theta + \mu\cos\theta)$ the body will move up the plane

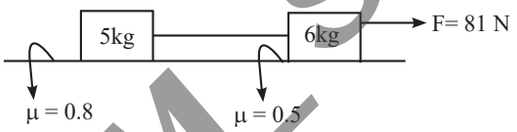
(*d*) If If $m_2 > m_1 (\sin\theta - \mu\cos\theta)$ the body will move down the plane

Connected Body Friction

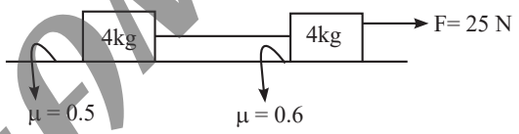
237. Two blocks of masses 5 kg and 6 kg are placed on a horizontal surface. The coefficient of friction between the 5 kg block and the surface is μ = 0.8, and the coefficient of friction between the 6 kg block and the surface is μ = 0.5. A force F = 50 N is applied horizontally to the 6 kg block. Find, the acceleration of the system. The tension in the string connecting the two blocks and the frictional forces acting on both the 5 kg and 6 kg blocks.



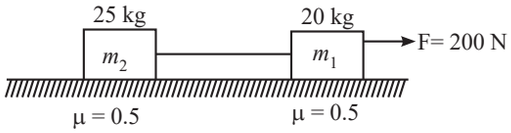
238. Find acceleration, tension in the string and friction acting on objects.



239. Find tension in the string, friction and acceleration.



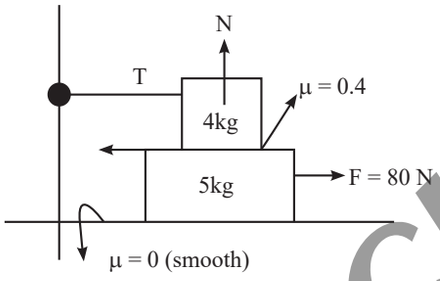
240. In the given figure, F = 200N, m_1= 20 kg m_2 = 25 kg, g = 10m /s^2 Find the friction acting on the block of mass m_2 [Take g = 10m /s ^{2}]



(*a*) 125 N (*b*) 120.5 N

(*c*) 100 N (*d*) 123.2 N

241. Find tension in string.

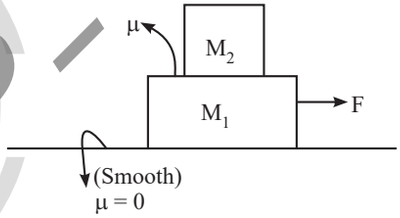


(*a*) T = 80N (*b*) T = 16N

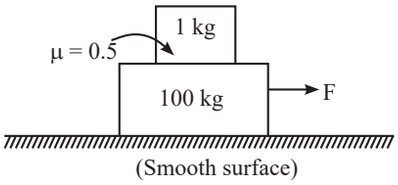
(*c*) T = 0 (*d*) T = 64 N

Friction in Block Over Block

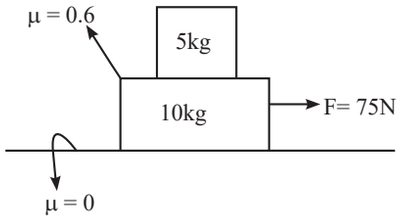
242. Two rough blocks system on smooth horizontal surface, find maximum force acting on lower block so that they will move together.



243. The maximum value of F which can be applied on the system shown in figure so that both blocks move together with same acceleration is



244. Find acceleration and friction acting on object. Will they move to gather



245. Two blocks A and B of masses 5 kg and 3 kg respectively rest on a smooth horizontal surface with B over A. The coefficient of friction between A and B is 0.5. The maximum horizontal force (in kg wt.) that can be applied to A, so that there will be motion of A and B without relative slipping is:

(*a*) 1.5 (*b*) 2.5

(*c*) 4 (*d*) 5

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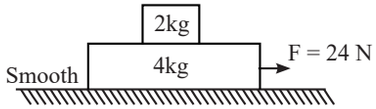
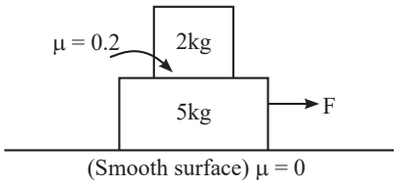
246. In the arrangement coefficient of friction between the two blocks $\mu = \frac{1}{2}$ is force of friction acting between the two blocks is:



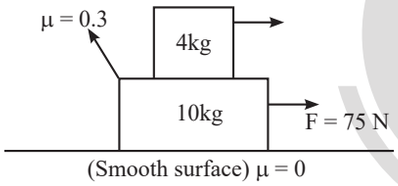
(*a*) 8 N (*b*) 6 N
(*c*) 12 N (*d*) 10 N

247. For what value of force F, the mass 2 kg starts its motion in left direction relative to 5 kg [Take g = 10m/s^2]

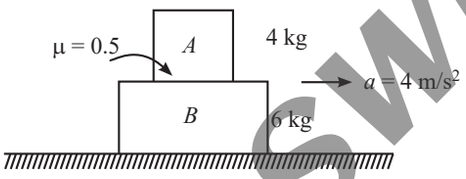


(*a*) 4 N (*b*) 10 N
(*c*) 14 N (*d*) 7 N

248. A 4 kg block is placed on top of a 10 kg block. A horizontal force of 75 N is applied to the 10 kg block. The coefficient of friction between the two blocks is μ=0.3, while the surface beneath the 10 kg block is smooth. Find the acceleration of the system and the frictional force acting between the two blocks.

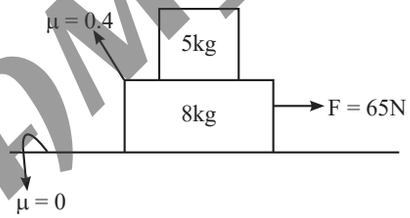


249. What is the friction force acting on the upper block when the system of two blocks moves with an acceleration of 4 m/s²?

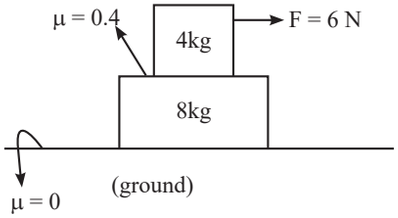


(*a*) 20 N (*b*) 16 N
(*c*) 12 N (*d*) Zero

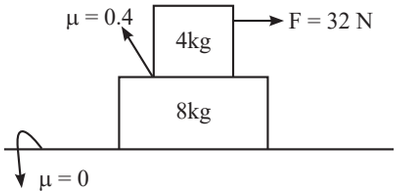
250. Find friction acting on 5 kg objects and acceleration of the system.



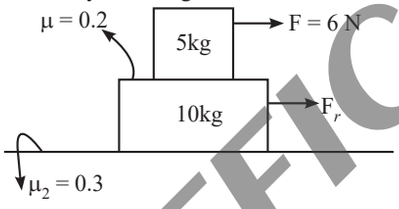
251. Find acceleration of the system and friction force acting on 4 kg object.



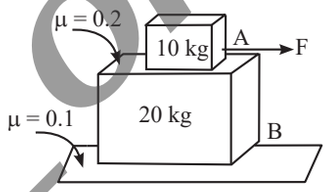
252. Find acceleration of both blocks and friction acting on objects



253. Find *F* so that they move togethet



254. In given diagram what is the minimum value of a horizontal external force Fon Block 'A' so that block 'B' will slide on ground is:



(*a*) 30 N (*b*) 20 N
(*c*) 10 N (*d*) Not possible

Circular Dynamics

255. Object of mass' *m* is moving on a straight line path with constant speed then force on that object must be zero

(*a*) True (*b*) False

256. Object is moving on a circular path with constant speed then force on that object must be zero

(*a*) True (*b*) False

257. If a force of constant magnitude acts in direction perpendicular to the motion of a particle, then its

(*a*) Speed is uniform (*b*) Momentum is uniform
(*c*) Velocity is uniform (*d*) All of these

258. A vehicle of mass 200 kg is moving along a levelled curved road of radius 70 m with angular velocity of 0.2 rad/s. The centripetal force acting on the vehicle is:

(*a*) 560 N (*b*) 2800 N
(*c*) 14 N (*d*) 2240 N

259. A stone tied to 180 cm long string at its end is making 28 revolutions in horizontal circle in every minute. The magnitude of acceleration of stone is $\frac{1936}{x}$ m/s^2 The value of *x* (Take $\pi = \frac{22}{7}$)

260. One end of string of length 1 is connected to particle of mass *m* and the other end is connected to a small peg on a smooth horizontal table. If the particle moves in circle with speed *v*, the net force on the particle (directed towards center) will be (*T* represents the tension in the string)

(*a*) Zero (*b*) T
(*c*) $T + \frac{mv^2}{1}$ (*d*) $T - \frac{mv^2}{1}$

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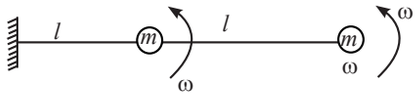
261. A stone of mass 1 kg is tied to end of a massless string of length 1 m. If the breaking tension of the string is 400 N, then maximum linear velocity, the stone can have without breaking the string, while rotation in horizontal plane, is:

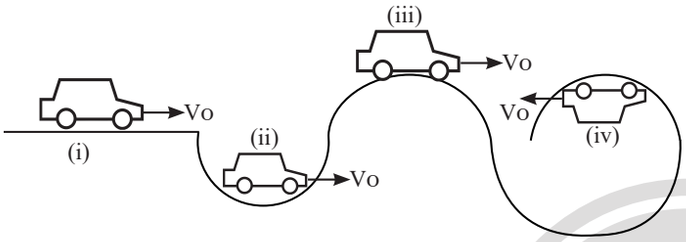
(*a*) 20 ms^{-1} (*b*) 40 ms^{-1}
(*c*) 400 ms^{-1} (*d*) 10 ms^{-1}

262. Can centripetal and centrifugal act together?

263. Find tension T_1 & T_2 in both the string



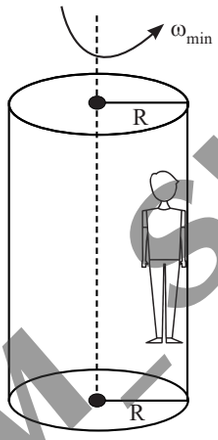
264. Find normal reaction at each point



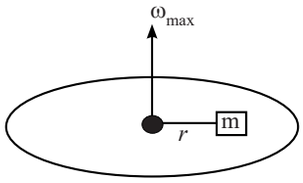
265. A roller coaster is designed such that riders experience "weightlessness" as they go round the top of a hill whose radius of curvature is 20 m. The speed of the car at the top of the hill is between

(*a*) 13 m/s and 14 m/s (*b*) 14 m/s and 15 m/s
(*c*) 15 m/s and 16 m/s (*d*) 16 m/s and 17 m/s

266. Find ω_{min} So that ramal of mass *m* in death wall of radius R, will not slip down.



267. An object of mass *m* is placed on a rotating disc at a distance r from the center. The coefficient of friction between the object and the disc is μ. Find the maximum angular velocity ω_{max} of the disc so that the object remains at rest with respect to the disc.



(*a*) $\sqrt{\frac{\mu g}{r}}$ (*b*) $\sqrt{\frac{g}{\mu r}}$
(*c*) $\frac{\mu g}{r}$ (*d*) $\frac{g}{\mu r}$

268. A boy is sitting on the horizontal platform of a joy wheel at a distance of 5 m from the center. The wheel begins to rotate and when the angular speed exceeds 1 rad/s, the boy just slips. The coefficient of friction between the boy and the wheel is ($g = 10m/s^2$)

(*a*) 0.5 (*b*) 0.32
(*c*) 0.71 (*d*) 0.2

269. A gramophone record is revolving with an angular velocity ω. A coin is placed at a distance *r* from the centre of the record. The static coefficient of friction is μ. The coin will revolve with the record if

(*a*) $r = \mu g\omega^2$ (*b*) $r < \frac{\omega^2}{\mu g}$
(*c*) $r \le \frac{\mu g}{\omega^2}$ (*d*) $r \ge \frac{\mu g}{\omega^2}$

270. A coin placed on a rotating table just slips when it is placed at a distance of 1 cm from the center. If the angular velocity of the table in halved, it will just slip when placed at a distance of from the centre:

(*a*) 2 cm (*b*) 1cm
(*c*) 8 cm (*d*) 4 cm

271. A particle of mass *m* is fixed to one end of a light spring of force constant *k* and unstretched length *l*. The system is rotated about the other end of the spring with an angular velocity ω, in gravity free space. The increase in length of the spring will be

(*a*) $\frac{m\omega^2 l}{k}$ (*b*) $\frac{m\omega^2 l}{k - m\omega^2}$
(*c*) $\frac{m\omega^2 l}{k + m\omega^2}$ (*d*) None of thes

272. A tube of length L. is filled completely with an incompressible liquid of mass M and closed at both end. The tube is then rotated in horizontal plane about one of its ends with a uniform angular velocity ω. The force exerted by the liquid at the other end is

(*a*) $\frac{1}{2}M\omega^2 L^2$ (*b*) $m\omega^2 L$
(*c*) $\frac{1}{4}M\omega^2 L$ (*d*) $\frac{1}{2}M\omega^2 L$

273. A train is moving with a speed of 12 m/s on rails which are 1.5 m apart. to negotiate a curve radius 400 m, the height by which the outer rail should be raised with respect to the inner rail is (Given, $g = 10m/(s^2)$)

(*a*) 6.0 cm (*b*) 5. 4 cm
(*c*) 4.8 cm (*d*) 4.2 cm

Bending of a Cyclist

274. A cyclist riding the bicycle at a speed of $14\sqrt{3}$ m/s takes a turn around a circular road of radius $20\sqrt{3}$ m without skidding. What is his inclination to the vertical?

(*a*) 30° (*b*) 45°
(*c*) 60° (*d*) 75°

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Motion of a Car on Rough horizontal Surface

275. A bus turns a slippery road having coefficient of friction of 0.5 with a speed of 10 m/s. The minimum radius of the arc in which bus turns is (Take $g = 10 m/s^2$)

(*a*) 4 m (*b*) 10 m
(*c*) 15 m (*d*) 20 m

276. A car is moving on a horizontal circular track of radius 0.2 km with a constant speed. If coefficient of friction between tyres of car and road is 0.45, then speed of car may be (Take $g = 10 m/s^2$)

(*a*) 15 m/s (*b*) 30 m/s
(*c*) 20 m/s (*d*) 40 m/s

277. A car is moving on a horizontal circular road of radius 0.1 km with constant speed. If coefficient of friction between tyres of car and road is 0.4, then speed of can not be ($g = 10 m/s^2$)

(*a*) 5 m/s (*b*) 10 m/s
(*c*) 20 m/s (*d*) All of these

278. A car of mass m is moving on a level circular track of radius R. If μ_s represents the static friction between the road and tyres of the car, the maximum speed of the car in circular motion is given by

(*a*) $\sqrt{\mu_s mRg}$ (*b*) $\sqrt{\frac{Rg}{\mu_s}}$
(*c*) $\sqrt{\frac{mRg}{\mu_s}}$ (*d*) $\sqrt{\mu_s Rg}$

Motion of Car on Rough Banked Road

279. A car is negotiating a curved road of radius R. The road is banked at an angle θ, the coefficient of friction between the tyres of the car and the road is μ_s. The maximum safe velocity on this road is

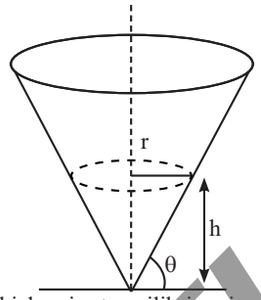
(*a*) $\sqrt{gR^2\left(\frac{\mu_s + \tan\theta}{1 - \mu_s \tan\theta}\right)}$ (*b*) $\sqrt{gR\left(\frac{\mu_s + \tan\theta}{1 - \mu_s \tan\theta}\right)}$
(*c*) $\sqrt{\frac{g}{r}\left(\frac{\mu_s + \tan\theta}{1 - \mu_s + \tan\theta}\right)}$ (*d*) $\sqrt{\frac{g}{R^2}\left(\frac{\mu_s + \tan\theta}{1 - \mu_s \tan\theta}\right)}$

Conical Pendulum

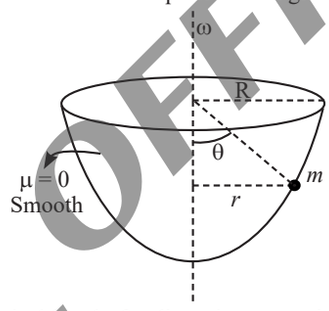
280. If the string of a conical pendulum makes an angle θ with horizontal, then square of its time period is proportional to

(*a*) sin θ (*b*) cos θ
(*c*) tan θ (*d*) cot θ

281. A particle describes a horizontal circle of radius r on the smooth surface of an inverted cone as shown. The height of plane of circle above vertex is h. The speed of particle should be



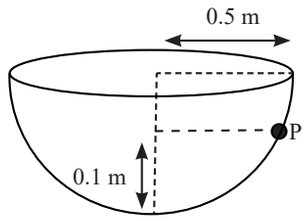
282. Find angle at which *m* is at equilibrium in given figure



283. A hemispherical bowl of radius r is set rotating about its axis of symmetry in vertical. A small block kept in the bowl rotates with the bowl without slipping on its surface. If the surface of the bowl is smooth and the angle made by the radius through the block with the vertical is, θ then find the angular speed at which the ball is rotating.

(*a*) $\omega = \sqrt{rg\sin\theta}$ (*b*) $\omega = \sqrt{g / r\cos\theta}$
(*c*) $\omega = \sqrt{\frac{gr}{\cos\theta}}$ (*d*) $\omega = \sqrt{\frac{gr}{\tan\theta}}$

284. A small mass of 10 g lies in a hemispherical bowl of radius 0.5 m at a height of 0.1 m from the bottom of the bowl. The mass will be in equilibrium if the bowl rotates at an angle ω. Then find the value of ω.



285. A particle of mass m is suspended form a ceiling through a string of length *L*. The particle moves in a horizontal circle of radius *r* such that $r = \frac{L}{\sqrt{2}}$ The speed of particle will be

(*a*) $\sqrt{rg}$ (*b*) $\sqrt{rg/2}$
(*c*) $2\sqrt{rg}$ (*d*) $\sqrt{2rg}$

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1. **Statement I:** If all Matter were made of electrically neutral particles such as Neutrons, It would be not possible to sit on a chair.

   Statement II: If all Matter were made of electrically Neutral particles such as Neutrons, The earth could not move around the Sun.

   Statement III: If all Matter were made of electric ally be neutral particles such as Neutrons. There would be ro tension in the string.

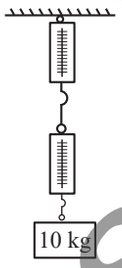
2. **Statement I:** Nuclear forces Between Two electrons at a given separation would be greater in magnitude than electromagnetic force between Two.

   Statement II: When you stay on Trunk of tree, it exerts a frictional upward force on you to hold you there and you exert an equal frictional down word force on Tree.

   Statement III: When a horse pulls a cart, the force that helps the horse to Move forward is the force exerted by the cort on the horse.

3. **Statement I:** The ceiling will pull the chain by $\frac{w_1 + w_2}{2}$ force if A Body of weight W_1 is suspended from the ceiling of a room through a chain of weight W_2.

   Statement II: Both the scales will read 5 kg, if a Block of mass 10 kg is suspended through two light spring Balances as shown.



4. The force exerted by the smooth inclined wedge of inclination θ on the Block placed over it will reduced to _____Times when the whole system is accelerated horizontally so that the block do not slip on the wedge.

5. **Statement I:** A force F_1 acts on a particle so as to accelerate it from rest to velocity v. The force of F_2 which decelerates it to rest must be of equal magnitude as that of f_1.

   Statement II: Two objects A and B (mass of A > B) are thrown upwards simultaneously with same speed. Then, A will go higher than B if the air exerts a constant and equal force of resistance on two Bodies.

6. A smooth wedge A is fitted in chamber hanging from a fixed ceiling near the earth's surface. A Block B placed at top of wedge takes Time T to slide down the length of wedge. of wedge. The Block will_____ when it is Released from Top of wedge & cable supporting the chamber is Broken at Same instant.

   (*a*) Take longer Time than T to slide down the wedge.
   (*b*) Remain at top of the wedge.
   (*c*) Take shorter Time than T to slide down the wedge.
   (*d*) Jump off the wedge.

7. **Statement I:** A person standing on floor of an elevator drops coin. The coin reaches the floor of elevator in a lesser time when lift is moving uniformly upwards as compared to time taken by the coin to reach the floor of stationary elevator.

   Statement II: A person standing on floor of an elevator drops coin. The coin reaches the floor of elevator in a longer time when lift is moving uniformly downwards as compared to time taken by the coin to reach the floor of stationary elevator.

8. **Assertion I:** A particle stays at Rest as seen in a frame. We cannot conclude that Resultant force on the particle must Be Zero.

   Reason II: The frame May be non inertial but there is non zero resultant force.

9. The force exerted by the floor of an elevator on foot of a person standing there is more than the weight of the person if elevator is _____and_____.

   (*a*) going up, slowing down
   (*b*) going up, speeding up
   (*c*) going down, slowing down
   (*d*) going down, speeding up.
   (*e*) Both (b) and (c)

10. **Statement I:** The Tension in the cable supporting an elevator must be greater than weight of elevator so that elevator goes upward with uniform speed.

    Statement II: A person must be a liar when he says that he measured the acceleration of particle to be non zero while no force was acting on the particle.

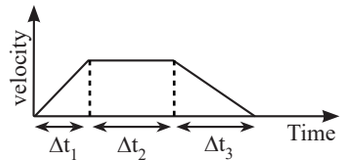
11. If the angle between the net contact Force having constant magnitude (provided by rough horizontal surface on a body placed on it) and vertical is decreased, the frictional force between the surface and body will_____.

12. **Statement I:** While walking on ice, one should take small steps to avoid slipping this is because smaller steps ensure larger amount of friction.

    Statement II: Two cars of unequal masses use similar tyres. The minimum stopping distance will be same for both cases if they are moving at the same initial speed.

13. A Body of mass M is kept on α rough horizontal surface [coefficient of friction = μ]. person is trying to pull the body by applying horizontal force but body is not moving. The net force applied by surface on body is F, where maximum value of F is_____ and it's minimum value is_____.

14. A scooter Starting from rest moves according to the given graph. A 500 N man sitting on scooter behind driver manages to stay at rest with respect to scooter without touching any other part. The force exerted by seat on man is_____for time Δt_1,_____ for time Δt_2 and _____ for time Δt_3. (you have to compare w. r. t 500 N force, i.e. Greater than / equal to/ less than 500N)



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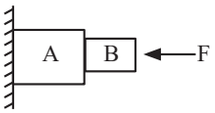
15. **Statement I:** The following system cannot remain in equilibrium if wall is smooth but the surfaces of A and B in contact are rough.



Statement II: The direction of friction on B due to A will be in upward direction in order to achieve equilibrium considering all surfaces in above given figure to be rough.

16. **Statement I:** A block a kept on an inclined surface Just Begins to slide if inclination is 30° The block is replaced by another block B and it is found that it just begins to slide, if inclination is 40° from the following observation, it can be concluded that mass of A is greater than mass of B.

Statement II: The contact force exerted by a body A on another body B is equal to normal force between the bodies. We can conclude that the surfaces in contact must be frictionless.

17. **Statement I:** Static friction is always greater than the kinetic friction.

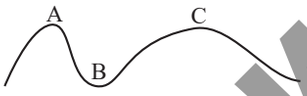
Statement II: limiting friction is never less than static & kinetic friction.

18. A Block is placed on rough floor and a horizontal force F is applied on it. The force of friction f by floor on block is measured for different values of F and a graph is plotted between them. The graph is a_____ for small F and is a_____ for large F.

19. **Statement I:** When a particle moves in circle with a uniform speed, it's velocity changes continuously as constant acceleration is Acting on it.

Statement II: The centrifugal force on a particle of mass m moving in a circle of radius r with a uniform speed v as observed from an inertial frame of reference will be $\frac{mv^2}{r}$ away from centre

20. A car moves at a constant speed on a road as shown in figure.



Consider the following statement I & II and state that whether They are True or False.

Statement I: The weight experienced by drives in car will be greater than its actual weight at point B and the observed weight will be lesser weight at point A and C.

Statement II: Normal force applied by the road on car at point C will be greater than force applied by it at point A.

21. The frame rotating about the Z- axis with a uniform angular speed ω_0 observes a particle of mass m rotating about the Z– axis in a circle of radius R with uniform angular speed ω. the centrifugal force on the particle will be.

22. **Statement I:** water in bucket is whirled in vertical circle with a string attached to it The water doesn't fall down even when the Bucket is inverted at Top of it's path. We can conclude that in This position, value of mg must be equal to $\frac{mv^2}{r}$.

Statement II: A Stone of mass m tied to a string of length l is rotated in a circle with the other end of the string at the centre. If string breaks, the stone will move away from centre due to centrifugal force.

23. A coin placed on a rotating Turntable just slips if it is placed at a distance of _____ from the centre. If the angular velocity of Turntable is doubled, it will just sleep at distance of 1 cm.

24. **Statement II:** Three identical cars A, B and C are moving at the samespeed on Three Bridges. The Car A goes on plane Bridge, B on Bridge convex upward and C on a bridge concave upwards. If F_A, F_B, & F_C are Normal forces exerted by cars on Bridges when they are at Middle of bridges, then F_C will be Maximum of Three forces.

Statement II: The position vector of a particle in a circular motion about the origin sweeps out equal area in equal time. It means the velocity of particle Remains constant.

25. A circular road of radius r is Banked for a speed = 40 km/hr. The friction coefficient Between the Tyre and road is negligible. Then

Statement I: If the car Turns at speed less than to 40 km/hr, it will slip down.

Statement II: If the Car turns at correct speed of 40 km/hr, the force applied by the Road on the car will be equal to $\frac{mv^2}{r}$

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Answer Key

1. (*b*) **2.** (*c*) **3.** (*c*) **4.** (*a*) **5.** (*c*) **6.** (*b*) **7.** Due to inertia of motion **8.** (*c*)

9. (*c*) **10.** (*b*) **11.** Zero **12.** $\theta = \tan^{-1}\left(\frac{F}{mg}\right), T = \sqrt{(mg)^2 + f^2}$ **13.** (*c*) **14.** $x = 3$ **15.** (*d*) **16.** (*b*)

17. (*d*) **18.** (*c*) **19.** (*b*) **20.** (*c*) **21.** 130 N **22.** N = (mg –Fcosθ) **23.** 100 N **24.** 48 mg **25.** 10 N

26. 25 N **27.** (*a*) **28.** (*a*) **29.** 30 N **30.** 5 kg **31.** 40 kg **32.** (*b*) **33.** (*a*) **34.** (*c*) **35.** (*b*)

36. (*a*) **37.** (*b*) **38.** (*d*) **39.** (*a*) **40.** 8 kg **41.** $\frac{M_1}{M_2} = \frac{\sqrt{3}}{1}$ **42.** $f = \frac{mg\sin\theta}{1+\cos\theta}$ **43.** $x = 12$

44. (*d*) **45.** (*b*) **46.** (*c*) **47.** (*b*) **48.** $T = \frac{80}{3}N$ **49.** (*c*) **50.** $a_A = 2g$, $a_B = -g$ **51.** (*a*)

52. (*c*) **53.** (*c*) **54.** (*c*) **55.** (*d*) **56.** (*a*) **57.** (*b*) **58.** (*b*) **59.** (*c*) **60.** (*b*) **61.** (*b*)

62. (*d*) **63.** (*c*) **64.** f = 4 N **65.** $F_A : F_B = 1 : 3$ **66.** (*d*) **67.** (*a*) **68.** $4\sqrt{5}\ N.s$ **69.** (*d*)

70. (*b*) **71.** (*a*) **72.** (*b*) **73.** (*b*) **74.** (*a*) **75.** (*a*) **76.** (*b*) **77.** (*c*) **78.** (*d*) **79.** (*a*)

80. 6.67 kg/s **81.** (*b*) **82.** (*c*) **83.** (*b*) **84.** (*a*) **85.** (*b*) **86.** (*c*) **87.** (74kg m/s) **88.** 0.4 m/s

89. 2 bullets/sec **90.** (*b*) **91.** (*c*) **92.** 3 **93.** (*c*) **94.** (*c*) **95.** (*b*) **96.** (*c*) **97.** 18 N

98. (*d*) **99.** 12 N, 13.5 N, 17.5 N **100.** (*b*) **101.** $T_1 = 64N$, $T_2 = 20N$, $a = 4m/s^2$ **102.** 42 N **103.** (*c*)

104. (*b*) **105.** $T_1 = 36$ N, $T_2 = 60$ N **106.** (*c*) **107.** (*c*) **108.** (*b*) **109.** (*d*) **110.** 10 N **111.** (*b*)

112. 240 N **113.** (*c*) **114.** (*c*) **115.** (*c*) **116.** $a = \frac{(m_2 - m_1)g}{m_1 + m_2}, T = \frac{2m_1 m_2}{m_1 + m_2}g$ **117.** $2\ m_2 g$ **118.** (*d*)

119. $a = \frac{(m_2 - m_1)g}{m_1 + m_2}$ **120.** $a = \frac{M_2 g}{M_1 + M_2}$ $T = \frac{M_1 M_2 g}{M_1 + M_2}$ **121.** (*a*) **122.** 3 m/s^2

123. (*i*) $\frac{M_2 g - M_1 g\sin\theta}{M_1 + M_2}$, (ii) $\frac{M_2 g \operatorname{Sin}\beta - M_1 g\sin\alpha}{M_1 + M_2}$, (iii) $\frac{10}{7} m/s^2$ **124.** (*b*) **125.** $x = 6$ **126.** (*b*) **127.** (*c*) **128.** (*c*)

129. 6 m/s^2 **130.** (*b*) **131.** $\frac{F + ma_0}{2m}$ **132.** (*b*) **133.** (*b*) **134.** (*b*) **135.** (i) $4a_2 = a_1$, (ii) $a_1 = -a_2$

136. $V_p = \frac{V}{4}$ **137.** (*c*) **138.** (*c*) **139.** (*b*) **140.** (*d*) **141.** (*c*) **142.** (*c*) **143.** (*a*) **144.** (*d*) **145.** (*a*)

146. 65 N w.r.t Both **147.** (*a*) **148.** (*d*) **149.** 12 N **150.** (*d*) **151.** (*d*) **152.** (*d*) **153.** (*c*) **154.** (*c*)

155. (*d*) **156.** (*d*) **157.** (*b*) **158.** (*a*) **159.** (*d*) **160.** (*a*) **161.** (*a*) **162.** (*d*) **163.** (*d*) **164.** (*c*)

165. (*c*) **166.** (*b*) **167.** (*c*) **168.** (*b*) **169.** (*a*) **170.** (*a*) **171.** (*d*) **172.** (*a*) **173.** $a = 0$ m/s^2 friction = 60 N

174. 5 N **175.** (*d*) **176.** $a = 2$m/s^2, friction = 20 N **177.** 16N **178.** $S = \frac{V_0^2}{2\mu g}$ **179.** (*d*) **180.** (*b*)

181. 10 N to 110N **182.** (F_{mr}) minimum = 40N, (F_{mr}) maximum =120 N **183.** (*b*) **184.** (*d*) **185.** (*c*)

186. (*a*) **187.** (*c*) **188.** (*a*) **189.** (*a*) **190.** (*c*) **191.** (*d*) **192.** (*d*) **193.** (*b*) **194.** (*d*) **195.** (*a*)

196. Friction = 8N, Tension = 16 N & Acceleration = 2m/s^2 **197.** 60 N, 60 N, 0 **198.** (*c*) **199.** (*c*)

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200. $F = \frac{200}{7} N$ **201.** $F = \frac{mg}{\mu \sin\theta + \cos\theta}$ **202.** $F_{min} = 35.7$ **203.** (*a*) **204.** (*b*) **205.** (*c*) **206.** (*a*)

207. (*b*) **208.** (*b*) **209.** (*b*) **210.** (*b*) **211.** (*b*) **212.** (*a*) **213.** (*a*) **214.** $F_{min} = \mu mg \cos\theta - mg \sin\theta$

215. $F_{min} = mg \sin\theta - \mu mg \cos\theta$ **216.** (*a*) **217.** (*a*) **218.** (*a*) **219.** (*a*) **220.** $h = R\left[1 - \frac{1}{\mu^2 + 1}\right]$ **221.** (*a*)

222. (*a*) **223.** (*b*) **224.** (*b*) **225.** (*a*) **226.** (*d*) **227.** (*b*) **228.** (*c*) **229.** (*d*) **230.** (*a*) **231.** (*a*)

232. (*a*) **233.** (*a*) **234.** (*b*) **235.** (*a*) **236.** (*b*) **237.** $a = 0$, T = 20 N, $f_{5kg} = 20$ N, $f_{6kg} = 30$ N

238. $a = 1 m/s^2$, T = 45 N, $f_{5kg} = 40$, $f_{6kg} = 30$ N **239.** T = 1N, $f_{4kg} = 20$ N, $f_{4kg} = 24$ N, $a = 0$ **240.** (*c*) **241.** (*b*)

242. $F_{max} = (m_1 + m_2)\mu g$ **243.** 505 N **244.** $a = 5 m/s^2$, $f_r = 25$N, they move together **245.** (*c*) **246.** (*a*) **247.** (*c*)

248. $2 m/s^2$, 8N **249.** (*b*) **250.** 20 N, $5 m/s^2$ **251.** $0.5 m/s^2$, 4N **252.** $a_8 = 2 m/s^2$, $a_4 = 4 m/s^2$, $f_r = 16$ N

253. 75 N **254.** (*d*) **255.** (*b*) **256.** (*b*) **257.** (*a*) **258.** (*a*) **259.** $x = 125$ **260.** (*b*) **261.** (*a*) **262.** No

263. $T_1 = \omega^2 (2l)$, $T_2 = 3\omega^2 l$ **264.** (*i*) N = mg, (*ii*) $N = mg + \frac{mV_0^2}{R}$, (*iii*) $N = mg - \frac{mV_0^2}{R}$, (*iv*) $N = \frac{mV_0^2}{R} - mg$ **265.** (*b*)

266. $\sqrt{\frac{g}{\mu R}}$ **267.** (*a*) **268.** (*a*) **269.** (*c*) **270.** (*d*) **271.** (*b*) **272.** (*d*) **273.** (*b*) **274.** (*c*) **275.** (*d*)

276. (*b*) **277.** (*d*) **278.** (*d*) **279.** (*b*) **280.** (*a*) **281.** $V = \sqrt{gh}$ **282.** $\theta = \tan^{-1}\left(\frac{\omega^2 r}{g}\right)$ **283.** (*b*)

284. 5 *rad/s* **285.** (*a*)

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1. I. - True, II. - False, III. - True **2.** I. - False, II. - True, III. - True **3.** Both are False

4. Initially when not accelerated. Ni = mg cos θ when accelerated by a = gtan θ, $N_2 = \frac{mg}{\cos\theta}$, $N_2 = \frac{N_1}{\cos^2\theta}$ **5.** I. - False, II. - True

6. (*b*) **7.** Both False **8.** Both are Correct and R is correct Explanation of A. **9.** (*e*) Both *b* and *c*

10. Both are false **11.** Decrease **12.** I. - False, II. - True **13.** $F_{max} = Mg\sqrt{\mu^2 + 1}$, $F_{min} = Mg$

14. Greater than 500N for time Δt_1, 500N for time Δt_2, Greater than 500N for time Δt_3 **15.** Both are True

16. Both are False **17.** I. False, II. True **18.** Straight line with slope 45°, straight line parallel to the *F*-axis

19. Both are False **20.** Both are True **21.** $m\omega_0^2 R$ **22.** Both are false **23.** 4cm **24.** I. = True, II. = False

25. I. = True, II. = False

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Thermal Properties of Matter

(Practice Questions)

Heat & Temperature

1. If heat is given to the body, then body will store that heat

(*a*) True (*b*) False

2. If heat is given to the body, then body will gain some heat

(*a*) True (*b*) False

3. If temperature of the body is decreasing hence some temperature loss by the body

(*a*) True (*b*) False

4. If some heat is removed then, heat decrease in a body or heat loss by the body

(*a*) True (*b*) False

Measurement of Temperature on Different Scales

5. If temperature of object raised by 27ºC. Then raise temperature in kelvin ?

(*a*) 300 K (*b*) 27 K (*c*) 273 K (*d*) 246 K

6. If temperature of an object is 27ºC, then its temperature in kelvin ?

(*a*) 27 K (*b*) 273 K (*c*) 300 K (*d*) 246 K

7. A temperature different of 5ºC on Celsius scale corresponds to the following temperature difference in the Fahrenheit scale:-

(*a*) 9º (*b*) 41º (*c*) 2.8º (*d*) 15º

8. At what temperature, the centigrade (Celsius) and Fahrenheit readings are the same?

(*a*) –40º (*b*) 40º (*c*) 36.6º (*d*) –37º

9. 0ºC is equivalent to the following:-

(*a*) 273.15 K (*b*) 273 K

(*c*) 0 K (*d*) 32 K

10. If the temperature of a patient is 40ºC his temperature in the Fahrenheit scale will be

(*a*) 72ºF (*b*) 96ºF (*c*) 100ºF (*d*) 104ºF

11. The freezing point on a thermometer is marked as 20º and the boiling point as 150º A temperature of 60ºC on this thermometer will be read as

(*a*) 40º (*b*) 65º (*c*) 98º (*d*) 110º

12. A faulty thermometer has its fixed points marked at 60º and 96º. What is the correct temperature on the Centigrade scale when this thermometer reads 87º

(*a*) 83º C (*b*) 93º C (*c*) 90º C (*d*) 85º C

13. On a new scale of temperature (which is linear) and called the *W* scale, the freezing and boiling points of water are 39ºW and 239ºW respectively. What will be the temperature on the new scale, corresponding to a temperature of 39ºC on the Celsius scale?

(*a*) 78ºW (*b*) 117ºW

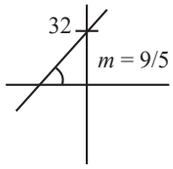
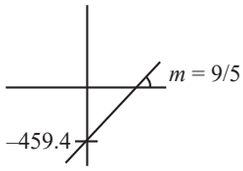
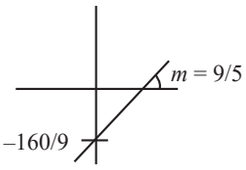
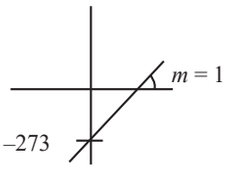
(*c*) 200ºW (*d*) 139ºW

14. A Centigrade and a Fahrenheit thermometer are dipped in boiling water. The water temperature is lowered until the Fahrenheit thermometer register 140º. What is the fall in temperature as registered by the centigrade thermometer.

(*a*) 40º (*b*) 80º

(*c*) 50º (*d*) 90º

15. Match List - I with List - II.

	List-I		List-II
A.	Celsius v/s Fahrenheit	I.	
B.	Celsius v/s Kelvin	II.	
C.	Fahrenheit v/s Celsius	III.	
D.	Fahrenheit v/s Kelvin	IV.	

(*a*) (A) -(II), (B)-(I), (C)-(IV), (D)-(III)

(*b*) (A) -(I), (B)-(III), (C)-(IV), (D)-(II)

(*c*) (A) - (III), (B)-(IV), (C)-(I), (D)-(II)

(*d*) (A) -(III), (B)-(I), (C)-(II), (D)-(IV)

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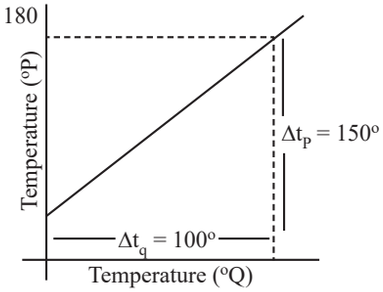
16. A temperature of 100 ºF (Fahrenheit scale) is equal to T K (Kelvin scale). The value of T is:

(*a*) 310.9 (*b*) 37.8 (*c*) 100 (*d*) 122.4

17. The graph between two temperature scales *P* and *Q* is shown in the figure. Between upper fixed point and lower fixed point there are 150 equal divisions of scale *P* and 100 divisions on scale *Q* . The relationship for conversion between the two scales is given by:



(*a*) $\frac{t_Q}{150} = \frac{t_P - 180}{100}$ (*b*) $\frac{t_Q}{100} = \frac{t_P - 30}{150}$

(*c*) $\frac{t_p}{180} = \frac{t_Q - 40}{100}$ (*d*) $\frac{t_P}{100} = \frac{t_Q - 180}{150}$

18. A faulty thermometer reads 5ºC in melting ice and 95ºC in steam. The correct temperature on absolute scale will be *K* when the faulty thermometer reads 41ºC.

Construction of Thermometer

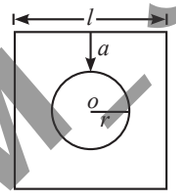
19. Resistance at 25ºC is 50Ω and at 100ºC is 80Ω then find resistant at 60º C

Thermal Expansion

20. Angular disc; when temperature increases then

(*a*) R↑, *r*↓ (*b*) R↓, *r*↑ (*c*) R↑, *r*↑ (*d*) R↓, *r*↓

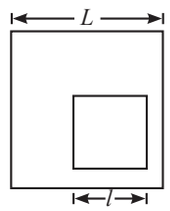
21. If temperature increases.



(*a*) *l*↑, *r*↑, *a*↓ (*b*) *l*↑, *r*↓, *a*↓

(*c*) *l*↑, *r*↑, *a*↑ (*d*) *l*↑, *r*↓, *a*↑

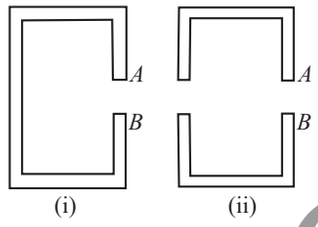
22. As temperature decrease then change in length.



(*a*) *L*↓, *l*↓ (*b*) *L*↑, *l*↓

(*c*) *L*↓, *l*↑ (*d*) *L*↑, *l*↑

23. Distance between A and B will increase or decrease as temperature increases.



(*a*) In both fig increase

(*b*) In both fig decrease

(*c*) In fig (i) increase fig (ii) decrease

(*d*) In fig (i) decrease fig (ii) increase

Linear Expansion

24. A metallic bar is heated from 0ºC to 100ºC The coefficient of linear expansion is $10^{-5}\ k^{-1}$ What will be the percentage increase in length-

(*a*) 0.01% (*b*) 0.1% (*c*) 1% (*d*) 10%

25. Two rods of length l_1 and l_2 are made of materials whose coefficient of linear expansions are α_1 and α_2 If the difference between two lengths is independent of temperature

(*a*) $\frac{l_1}{l_2} = \frac{\alpha_1}{\alpha_2}$ (*b*) $\frac{l_1}{l_2} = \frac{\alpha_2}{\alpha_1}$ (*c*) $l_2^2\alpha_1 = l_1^2\alpha_2$ (*d*) $\frac{l_1^2}{l_1} = \frac{\alpha_2^2}{l_2}$

26. A copper rod of 88 cm and an aluminium rod of unknown length have their Difference in length independent of increase in temperature. The length of aluminium rod is ($\alpha_{cu} = 1.7 \times 10^{-5}\ K^{-1}\ t\ \alpha_{Al} = 2.2 \times 10^{-5}\ K^{-1}$)

(*a*) 6.8 cm (*b*) 113.9 cm (*c*) 88 cm (*d*) 68 cm

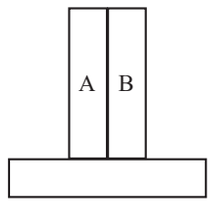
27. If two metal rods of coefficients of linear expansions α_1 and α_2 have same length at t_1ºC and t_2ºC respectively, then the common temperature at which they have again the same length is

28. A brass scale correctly calibrated at 15ºC is employed to measure a length at a temperature of 35ºC. If the scale gives a reading of 75 cm , find the true length (Coefficient linear expansion of brass = $2.0 \times 10^{-5}\ C^{o-1}$)

29. The gap between any two rails, each of length ℓ laid on a railway track equal *x* at 27ºC. When the temperature rises to 40ºC, the gap close up. The coefficient of linear expansion of the material of the rail is α. The length ℓ of a rail at 27ºC will be

(*a*) $\frac{x}{26\alpha}$ (*b*) $\frac{x}{13\alpha}$ (*c*) $\frac{2x}{13\alpha}$ (*d*) $\frac{2x}{14\alpha}$

30. A bimetallic strip consists of metals *A* and *B*. It is mounted rigidly as shown. The metal A has higher coefficient of expansion compared to that of metal *B*. When the bimetallic strip is placed in a cold bath, it will



(*a*) Bend towards the right (*b*) Not bend but shrink

(*c*) Neither bend nor shrink (*d*) Bend towards the left

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31. A unit scale is to be prepared whose length does not change with temperature and remains 20 cm, using a bimetallic strip made of brass and iron each of different length. The length of both components would change in such a way that difference between their length remains constant. If length of brass is 40 cm and length of iron will be_____cm .

$\left(\alpha_{\text{iron}} = 1.2\times10^{-5}\ \text{K}^{-1} \text{ and } \alpha_{\text{brass}} = 1.8\times10^{-5}\ \text{K}^{-1}\right)$

32. The area of cross-section of a railway track is 0.01 m^2. The temperature variation is 10ºC. Coefficient of linear expansion of material of track is 10^{-5}/ºC. The energy stored per meter in the track is J/m. (Young's modulus of material of track is 10^{11} Nm^{-2})

33. Two different wires having lengths L_1 and L_2, and respective temperature coefficient of linear expansion α_1 and α_2, are joined end-to-end. Then the effective temperature coefficient of linear expansion is

(*a*) $\sqrt[2]{\alpha_1\alpha_2}$ (*b*) $\dfrac{4\alpha_1\alpha_2}{\alpha_1+\alpha_2}\dfrac{L_2L_1}{(L_2+L_1)^2}$

(*c*) $\dfrac{\alpha_1+\alpha_2}{2}$ (*d*) $\dfrac{\alpha_1L_1+\alpha_2L_2}{L_1+L_2}$

34. A bimetallic strip is formed out of two identical strips, one of copper and the other of brass. The coefficients of linear expansion of the two metals are α_C and α_B On heating, the temperature of the strip goes up by ΔT and the strip bends to form an arc of radius of curvature R Then R is:

(i) directly proportional to ΔT
(ii) inversely proportional to ΔT
(iii) directly proportional to $|\alpha_B - \alpha_C|$
(iv) inversely proportional to $|\alpha_B - \alpha_C|$

(*a*) 1, 3 (*b*) 1, 4 (*c*) 2, 3 (*d*) 2, 4

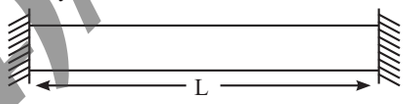
35. When the temperature of a rod increases from t to $(t + \Delta t)$, its moment of inertia increases from I to $(I + \Delta I)$. If α be the coefficient of linear expansion of the rod, then the value of $\left(\dfrac{\Delta I}{I}\right)$ is

(*a*) $2\alpha\Delta t$ (*b*) $\alpha\Delta t$ (*c*) $\dfrac{\alpha\Delta t}{2}$ (*d*) $\dfrac{\Delta t}{\alpha}$

36. A clock with a metallic pendulum gains 6 seconds each day when the temperature is 20ºC and loses 6 second when the temperature is 40ºC Find the coefficient of linear expansion of the metal.

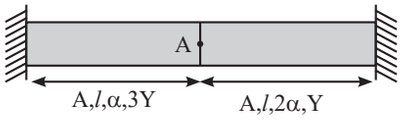
(*a*) 1.4×10^{-5} ºC^{-1} (*b*) 1.4×10^{-6} ºC^{-1}
(*c*) 1.4×10^{-4} ºC^{-1} (*d*) 0.4×10^{-6} ºC^{-1}

37. Now suppose a rod of length L at 30ºC is clamped as shown having $\alpha_{30} = 10^{-5}$/ºC. Calculate strain developed in rod if we increase its temperature by $\Delta\theta$ amount.



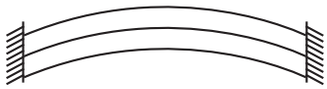
(*a*) $\alpha\Delta\theta$ (*b*) $\dfrac{\alpha\Delta\theta}{1+\alpha\Delta\theta}$ (*c*) Zero (*d*) None

38. Temperature of given composite rod is increased by $\Delta\theta$, then A will move :

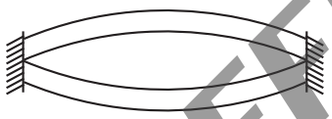


(*a*) towards right (*b*) towards left
(*c*) will remain at same (*d*) can't say

39. Two rod of different metal are clamped as shown in figure if area of cross-section of rods are same and length is L at 30ºC temperature. Now we increase its temperature by amount $\Delta\theta$ then what will be the position of rod? Given α_1 and α_2 are the coefficient of thermal expansion of rods as shown.

(*a*) 

(*b*)

(*c*) 

(*d*) Shape of strip will depend upon value of α_1 and α_2

Areal Expansion

40. If the coefficient of cubical expansion is x times of the coefficient of superficial expansion, then value of x is -

(*a*) 3 (*b*) 2.5 (*c*) 1.5 (*d*) 2

Volume Expansion

41. Relation between linear, Areal and volumetric expansion α,β and γ.

42. The volume of a solid decreases by 0.6% when it is cooled through 50ºC. Its coefficient of linear expansion is

(*a*) 4×10^{-6} K^{-1} (*b*) 5×10^{-5} K^{-1}
(*c*) 6×10^{-4} K^{-1} (*d*) 4×10^{-5} K^{-1}

43. A rectangular block is heated from 0ºC to 100ºC The percentage increase in its length is 0.10%. What will the percentage increase in it volume?

(*a*) 0.03% (*b*) 0.10%
(*c*) 0.30% (*d*) None of these

44. Relation between Bulk Modulus of elasticity and thermal coefficient of volume expansion.

45. The pressure applied from all directions on cube is P . How much its temperature should be raised to maintain the original volume ? The volume elasticity of cube is β and the coefficient of volume expansion is α.

(*a*) $P/\alpha\beta$ (*b*) $P\alpha/\beta$ (*c*) $P\beta/\alpha$ (*d*) $\alpha\beta/R$

46. The density of water at 20ºC is 998 kg/m^3 and at 40ºC 992 kg/m^3. The coefficient of volume expansion of water is

(*a*) 10^{-4}/ºC (*b*) 3×10^{-4}/ºC
(*c*) 2×10^{-4}/ºC (*d*) 6×10^{-4}/ºC

47. Each side of a box made of metal sheet in cubic shape is 'a' room temperature 'T', the coefficient of linear expansion the metal sheet is 'α'. The metal sheet is heated uniformly by a small temperature ΔT, so that its new temperature is $T + \Delta T$. Calculate the increase in the volume of the metal box.

(*a*) $\dfrac{4}{3}\pi a^3\alpha\Delta T$ (*b*) $3a^3\alpha\Delta T$
(*c*) $4\pi a^3\alpha\Delta T$ (*d*) $4a^3\alpha\Delta T$

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48. Pyrex glass and invar (a special iron-nickel alloy) having particularly low values of coefficient of volume expansion.

(*a*) True (*b*) False

49. When water is heated from 0° to 10°C, its volume:

(*a*) increases

(*b*) decreases

(*c*) first increases and then decrease

(*d*) first decreases and then increases

Coefficient of Apparent Expansion

50. The coefficient of apparent expansion of a liquid in a copper vessel is *C* and in a silver vessel *S*. The coefficient of volume expansion of copper is γ_c What is the coefficient of linear expansion of silver

(*a*) $(C + \gamma_c + S)/3$ (*b*) $(C - \gamma_c + S)/3$

(*c*) $(C + \gamma_c - S)/3$ (*d*) $(C - \gamma_c - S)/3$

51. A glass is full of water at 4°C when it is (a) cooled (b) Heated. Then which one of the following is correct?

(*a*) Water level decreases, increases

(*b*) Water overflows in both cases

(*c*) Water level increases, decreases

(*d*) In both case, water level decreases

52. A beaker is completely filled with water at 4°C. It will overflow

(*a*) when heated but not when cooled

(*b*) when cooled but not when heated

(*c*) both when heated or cooled

(*d*) neither when heated nor when cooled

Variation of Density With Temperature

53. The value of coefficient of volume expansion of glycerin is $5 \times 10^{-4}\ K^{-1}$. The fractional change in the density of glycerin for a rise of 40°C in its temperature is:

(*a*) 0.010 (*b*) 0.015

(*c*) 0.020 (*d*) 0.025

Effect on Time Period of Simple Pendulum Due to Rise in Temperature

54. The temperature of a pendulum, the time period of which is *t* is raised by ΔT. The change in its time period is

(*a*) $\frac{1}{2}\alpha t\Delta T$ (*b*) $2\alpha t\Delta T$ (*c*) $\frac{1}{2}\alpha\Delta T$ (*d*) $2\alpha\Delta T$

55. A pendulum clock keeps correct time at 20°C. The correction to be made during summer per day where the average temperature is 40°C, ($\alpha = 10^{-5}$/°C) will be:

(*a*) 5.64 sec (*b*) 6.64 sec

(*c*) 7.64 sec (*d*) 8.64 sec

56. A pendulum clock is 5s fast at a temperature of 15°C and 10s slow at a temperature of 30°C, At what temperature does it give the correct time?

(*a*) 10°C (*b*) 20°C

(*c*) 15°C (*d*) 25°C

Effect on Angular Velocity Due to Rise in Temperature

57. A sphere of coefficient of linear expansion α, mass *m* and radius *r* is spinning about an axis through its diameter with an angular velocity ω_1. If the temperature of the sphere increases by Δt then its new angular velocity is ω_2.

Thermal Stress

58. A metal of length *l* and area of cross-section *A* is fixed between rigid supports at negligible tension. If this is cooled, the tension in the wire will be-

(*a*) Proportional to *l*

(*b*) Inversely proportional to *l*

(*c*) Independent of *l* and dependent of *A*

(*d*) Independent of *l* and independent of *A*

Heat Capacity

59. The quantities of heat required to raise the temperature of two solid copper spheres of radii r_1 and r_2($r_1 = 1.5\ r_2$) through 1 K are in the ratio

(*a*) $\frac{27}{8}$ (*b*) $\frac{9}{4}$ (*c*) $\frac{3}{2}$ (*d*) $\frac{5}{3}$

60. Thermal capacity of 40*g* of aluminium (s = 0.2 cal/gK) is

(*a*) 168 J/K (*b*) 672 J/K

(*c*) 840 J/K (*d*) 33.6 J/K

61. A block of mass 100 gm slides on a rough horizontal surface. If the speed of the block decreases from 10 m/s to 5 m/s, the thermal energy developed in the process is:

(*a*) 3.75 J (*b*) 37.5 J (*c*) 0.375 J (*d*) 0.75 J

Specific Heat Capacity

62. **Statement I:** A gas possesses a unique value of specific heat capacity.

Statement II: Specific heat capacity is the heat required to raise the temperature of unit mass of the substance by one unit.

63. If specific heat of a substance is infinite, it means:

(*a*) Heat is given out

(*b*) Heat is taken in

(*c*) No change in temperature takes place whether heat is taken in or given out

(*d*) All of the above

64. Water is used to cool radiators of engines, because:

(*a*) of its lower density (*b*) it is easily available

(*c*) it is cheap (*d*) it has high specific heat

65. The rate of heat supply is the same for two liquids, *A* and *B*. After some time, the temperature of liquid *A* becomes greater than that of liquid *B*. Given that the amount of both liquids is the same, which of the following statements about their specific heat(S_A, S_B) capacities is true?

(*a*) $S_A = S_B$ (*b*) $S_A > S_B$ (*c*) $S_A < S_B$ (*d*) can't say

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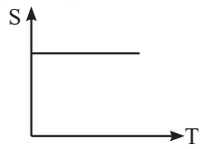
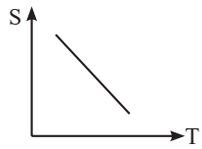
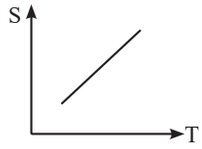
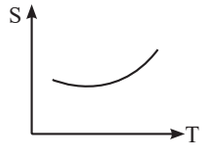
66. Graph for specific heat?

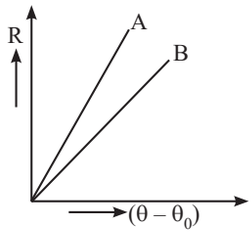
(*a*) 

(*b*) 

(*c*) 

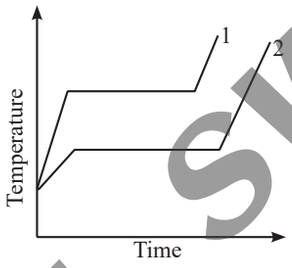
(*d*) 

67. Two circular discs *A* and *B* with equal radii R are blackened. They are heated to same temperature and are cooled under identical conditions. What inference do you draw from their cooling curves ?



(*a*) A and B have same specific heats
(*b*) specific heat of *A* is less
(*c*) specific heat of *B* is less
(*d*) nothing can be said

68. Two solid objects of the same mass are supplied with heat at the same rate $\Delta Q/\Delta t$. The temperature of the first object with latent heat L_1 and specific heat capacity c_1 changes according to graph 1 on the diagram. The temperature of the second object with latent heat L_2 and specific heat capacity c_2 changes according to graph 2 on the diagram.



Based on what is shown on the graph, the latent heats L_1 and $L_2$and the specific heat capacities c_1 and c_2 in solid state obey which of the following relationships:

(*a*) $L_1 < L_2; c_1 < c_2$ (*b*) $L_1 < L_2; c_1 > c_2$
(*c*) $L_2 < L_1; c_1 > c_2$ (*d*) $L_2 < L_1; c_2 > c_1$

Phase Conversion

69. Amount of heat required to convert 20 grm Ice from –20ºC to steam at 100ºC.

70. Heat is required to change 1 kg of ice of–20ºC into steam. Q_1 is the heat needed to warm the ice from –20ºC to 0ºC, Q_2 is the heat needed to melt the ice, Q_3 is the heat needed to warm the water from 0ºC to 100ºC and Q_4 is the heat needed to vaporize the water. Then

(*a*) $Q_4 > Q_3 > Q_2 > Q_1$ (*b*) $Q_4 > Q_3 > Q_1 > Q_2$
(*c*) $Q_4 > Q_2 > Q_3 > Q_1$ (*d*) $Q_4 > Q_2 > Q_1 > Q_3$

71. 10 gm Ice is at –50ºC the heat required to convert (5gm Ice +5 gm water) at 0ºC??

72. A piece of ice falls from a height *h* so that it melts completely. Only one quarter of the heat produced is absorbed by the ice and all energy of ice gets converted into heat during its fall. The value of *h* is [Latent heat of ice is 3.4×10^5 J/ kg and $g = 10$ N/kg]

(*a*) 136 km (*b*) 68 km
(*c*) 34 km (*d*) 544 km

73. Which is more dangerous

(*a*) Burn by 100ºC water. (*b*) Burn by 100ºC steam.
(*c*) Same by both. (*d*) Can't say

74. An ice cube of dimensions 60 cm × 50 cm × 20 cm is placed in an insulation box of wall thickness 1 cm . The box keeping the ice cube at 0ºC of temperature is brought to a room of temperature 40ºC. The rate of melting of ice is approximately:

(Latent heat of fusion of ice is 3.4×10^5J kg^{-1} and thermal conducting of insulation wall is 0.05 $Wm^{-10}C^{-1}$)

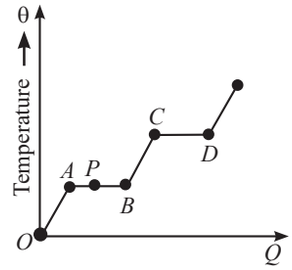
(*a*) 61×10^{-3} kg s^{-1} (*b*) 61×10^{-5} kg s^{-1}
(*c*) 208 kg s^{-1} (*d*) 30×10^{-3} kg s^{-1}

75. Due to cold weather a 1m water pipe of cross-section area $1cm^2$ is filled with ice at –10ºC. Resistive heating is used to melt the ice. Current of 0.5 A is pass through 4 k Ω resistance. Assuming that all the heat produced is used for melting, what is the minimum time required?

(Given latent heat of fusion for water/ice = 3.33×10^5 J kg^{-1} specific heat of ice = 2×10^3J kg^{-1} and density of ice =10 kg/m^3)

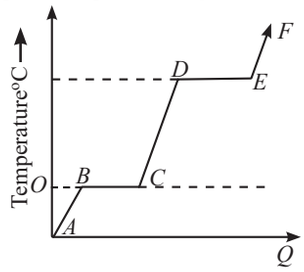
(*a*) 3.53 s (*b*) 0.353 s (*c*) 35.3 s (*d*) 70.6 s

76. The variation of temperature (θ) of material as heat is given to it at a constant rate is shown in the figure. Material is in solid state at the point *O*. The state of the material at point *P* is



(*a*) solid state
(*b*) partial liquid and partial solid
(*c*) liquid state
(*d*) partial liquid and partial gas

77. The following figure represents the temperature versus heat plot for a given amount of a substance when heat energy is supplied to it at a fixed rate and at a constant pressure. Which part of the above plot represent a phase change



(*a*) *a* to *b* and *e* to *f* (*b*) *b* to *c* and *c* to *d*
(*c*) *d* to *e* and *e* to *f* (*d*) *b* to *c* and *d* to *e*

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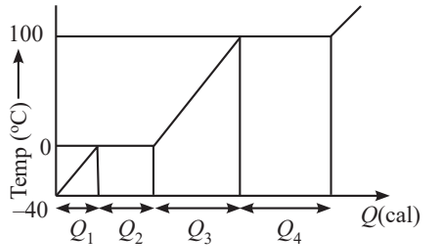
78. Figure shows the temperature variation when heat is added continuously to a specimen of ice (10g) at –40°C at constant rate. (Specific heat of ice = 0.53 cal/g °C, L_{ice} = 80 cal/g and L_{Steam} = 540 cal/g



Match the following

Column-I		Column-II	
(*a*)	Value of Q_1 (in cal)	(i)	800
(*b*)	Value of Q_2 (in cal)	(ii)	1000
(*c*)	Value of Q_3 (in cal)	(iii)	5400
(*d*)	Value of Q_4 (in cal)	(iv)	212
		(v)	900

(1) a-(v), b-(iii), c-(iv), d-(i)

(2) a-(iv), b-(i), c-(ii), d-(iii)

(3) a-(i), b-(iii), c-(ii), d-(iv)

(4) a-(ii), b-(iii), c-(i), d-(iv)

Heating

79. A refrigerator convert 100 grm of water at 10°C into ice at 0°C in one hours, then find heat removed per minute

80. A bullet of mass 5*g* , travelling with a speed of 210m/s, strikes a fixed wooden target. One half of its kinetics energy is converted into heat in the bullet while the other half is converted into heat in the wood. The rise of temperature of the bullet if the specific heat of its material is 0.030 cal/(*g* – °C) (1 cal = 4.2×10^7 ergs) close to:

(*a*) 87.5°C (*b*) 83.3°C

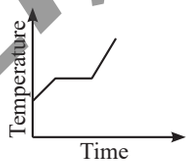
(*c*) 119.2°C (*d*) 38.4°C

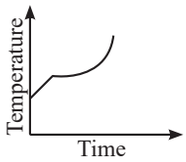
81. An electric heater rated as 2 kW is used to heat 200 kg of water from 10°C to 70°C. Assuming no heat losses, the time taken is

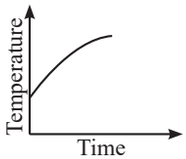
(*a*) 25.2 s (*b*) 6×10^3 s

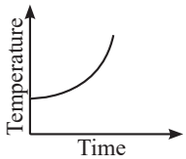
(*c*) 25.2×10^3 s (*d*) 25.2×10^6 s

82. Liquid oxygen at 50 *K*) is heated to 300 *K* at constant pressure of 1 atm . The rate of heating is constant. Which one of the following graphs represents the variation of temperature with time ?

(*a*)


(*b*)


(*c*)


(*d*)


83. A water heater of power 2000 W is used to heat water. The specific heat capacity of water is 4200 J $kg^{-1}K^{-1}$. The efficiency of heater is 70% Time required to heat 2 kg of water from 10°C to 60°C is_____S.

(Assume that the specific heat capacity of water remains constant over the temperature range of the water).

84. A 100*g* of iron nail is hit by a 1.5 kg hammer striking at a velocity of 60 ms^{-1}. What will be the rise in the temperature of the nail if one fourth of energy of the hammer goes into heating the nail?

[Specific heat capacity of iron = $0.42 Jg^{-1} – C^{-1}$]

(*a*) 675°C (*b*) 1600°C (*c*) 16.07°C (*d*) 6.75°C

85. A metal ball of mass 0.1 kg is heated upto 500°C and dropped into a vessel of heat capacity 800 JK^{-1} and containing 0.5 kg water. The initial temperature of water and vessel is 30°C. What is the approximate percentage increment in the temperature of the water? [Specific heat capacities of water and metal are, respectively 4200 $Jkg^{-1}K^{-1}$ and 400 $JKg^{-1} K^{-1}$]

(*a*) 15% (*b*) 30% (*c*) 25% (*d*) 20%

86. A metal sphere of radius *r* and specific heat *s* is rotated about an axis passing through its centre at a speed of *n* rotations per second. It is suddenly stopped and 50% of its energy is used in increasing its temperature. The rise in temperature of the sphere is

(*a*) $\frac{2\pi^2 n^2 r^2}{5sJ}$ (*b*) $\frac{\pi^2 n^2}{10r^2 sJ}$

(*c*) $\frac{7}{8}\pi r^2 n^2 sJ$ (4) $\frac{5(\pi rn)^2}{14sJ}$

87. In an experiment of measuring specific heat of a liquid, a stream of a liquid flows at a steady rate of 5g/s over an electrical heater dissipating 135W and a temperature rise of 5K is observed. On increasing the rate of flow to 10g/s the same temperature rise is produced with a dissipation of 235W . Find the specific heat (J/g K) of a liquid. Assume heat loss to the surrounding in both cases is the same.

(*a*) 2 (*b*) 4 (*c*) 6 (*d*) 2.5

Mixture of 2 Liquids

88. Two liquid of same mass at 20°C & 60°C mixed then Tempe of mixture is 30°C then find ratio of their specific heat

89. 20 gm water at 30°C mixed with 40 gm Water at 10°C then find Temperature of mixture

90. Two identical bodies are made of a material for which the heat capacity increases with temperature, One of these is at 100°C , while the other one is at 0°C. If the two bodies are brought into contact, then, assuming no heat loss, the final common temperature is

(*a*) 50°C

(*b*) More then 50°C

(*c*) less then 50°C but greater then 0°C

(*d*) 0°C

Mixture of Ice & Water

91. 40 gram water at 10°C is mixed with 10 gram ice at 0°C then find temperature of mixture

92. 80 gm water at 20°C is mixed with 15 gm ice at 0°C then temperature of mixture and mass of ice and water in mixture??

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93. If 10 gm of ice at 0ºC is mixed with 10 gm of water at 40ºC. the final mass of water in the mixture is

(*a*) 10 gm (*b*) 15 gm (*c*) 18 gm (*d*) 20 gm

94. One kg of ice at 0ºC is mixed with 1 kg of water at 10ºC. The resulting temperature will be

(*a*) Between 0ºC and 10ºC (*b*) 0ºC

(*c*) less then 0ºC (*d*) greater then 0ºC

95. 5 g of water at 30ºC and 5g of ice at -20ºC are mixed together in a calorimeter. Neglect the water equivalent of the calorimeter. The final temperature of the mixture is -

(Specific heat of ice = 0.5 cal g^{-1} $ºC^{-1}$)

(*a*) 0ºC (*b*) –20ºC (*c*) –10ºC (*d*) +1.2ºC

Water & Steam Mixture

96. Temperature of 100 *gm* water increases from 24ºC to 90ºC by adding some steam. Then mass of steam required is?

97. Steam at 100ºC is passed into 20g of water at 10ºC. When water acquires a temperature of water present will be [Take specific heat of water = 1 cal g^{-1} $ºC^{-1}$ and latent heat of steam = 540 cal g^{-1}]

(*a*) 24 g (*b*) 31.5 g

(*c*) 42.5 g (*d*) 22.5 g

Ice & Steam Mixture

98. One gram of ice is mixed with one gram of steam. After thermal equilibrium, the temperature of the mixture is

(*a*) 0ºC (*b*) 100ºC (*c*) 55ºC (*d*) 80ºC

99. If 1g of steam is mixed with 1g of ice, then resultant temperature of the mixture is

(*a*) 100ºC (*b*) 230ºC (*c*) 270ºC (*d*) 50ºC

Heat Flow

100. The two ends of a road of length L and a uniform cross-sectional area A are kept at two temperatures T_1 and $T_2 (T_1 > T_2)$. The rate of heat transfer $\frac{dQ}{dt}$, through the rod in a steady state is given by

(*a*) $\frac{dQ}{dt} = \frac{k\,A(T_1 - T_2)}{L}$ (*b*) $\frac{dQ}{dt} = \frac{k\,A(T_1 - T_2)}{A}$

(*c*) $\frac{dQ}{dt} = \frac{k\,A(T_1 - T_2)}{LA}$ (*d*) $\frac{dQ}{dt} = kLA(T_1 - T_2)$

101. A cylindrical metallic rod in thermal contact with two reservoirs of heat at its two ends conducts an amount of heat Q in time t The metallic rod is melted and the material is formed into a rod of half the radius of the original rod. What is the amount of heat conducted by the new rod, when placed in thermal contact with the two reservoirs in time t ?

(*a*) Q/4 (*b*) Q/16 (*c*) 2Q (*d*) Q/2

102. Two rods of same length and material transfer a given amount of heat in 12 seconds, when they are joined end to end. But when they are joined lengthwise, then they will transfer same heat in same conditions in

(*a*) 24 s (*b*) 3 s (*c*) 1.5 s (*d*) 48 s

103. The two ends of a metal rod are maintained at temperatures 100ºC and 110ºC. The rate of heat flow in the rod is found to be 4.0 *J/s* If the ends are maintained at temperatures 200ºC and 210ºC, the rate of heat flow will be:

(*a*) 16.8 J/s (*b*) 8.0 J/s

(*c*) 4.0 J/s (*d*) 44.0 J/s

104. Which of the following circular rods (given radius r and length l), each made of the same material and whose ends are maintained at the same temperature will conduct most heat?

(*a*) $r = r_0; l = l_0$ (*b*) $r = 2r_0; l = l_0$

(*c*) $r = r_0; l = 2l_0$ (*d*) $r = 2r_0; l = 2l_0$

105. A cylindrical rod having temperature T_1 and T_2 at its end. The rate of flow of heat Q_1 cal/sec. If all the linear dimension are doubled keeping temperature remain constant then rate of flow of heat Q_2 will be:

(*a*) $4Q_1$ (*b*) $2Q_1$ (*c*) $Q_1/4$ (*d*) $Q_1/2$

106. Heat is flowing through two cylindrical rods of same material The diameters of the rods are in the ratio 1:2 and their lengths are in the ratio 2 : 1. If the temperature difference between their ends is same, then the ratio of amounts of heat conducted through them per unit time will be

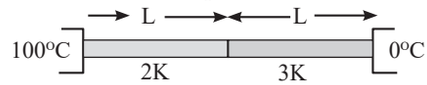
(*a*) 1 : 1 (*b*) 2 : 1 (*c*) 1 : 4 (*d*) 1 : 8

107. Consider two rods of same length and different specific heats (S_1 and S_2), conductivities K_1 and K_2 and area of cross section (A_1 and A_1) and both having temperature T_1 and T_2 at their ends. If the rate of heat loss due to, conduction is equal then

(*a*) $K_1A_1 = K_2A_2$ (*b*) $K_2A_1 = K_1A_2$

(*c*) $\frac{K_1A_1}{S_1} = \frac{K_2A_2}{S_2}$ (*d*) $\frac{K_2A_1}{S_2} = \frac{K_1A_2}{S_1}$

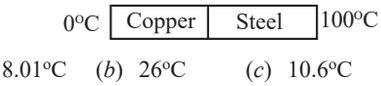
108. Find total heat flow and temperature of junction.



109. Figure shows a copper rod joined to a steel rod. The rods have equal length and equal cross-sectional area. The free end of the copper rod is kept at 0ºC and that of steel rod is kept at 100ºC Find the temperature of the junction of the rod.

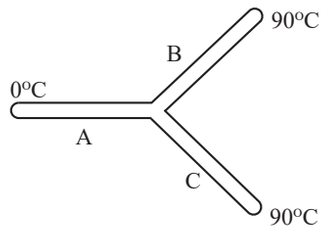
Conductivity of copper = 390 W/*m*ºC

Conductivity of steel = 46 W/*m*ºC



(*a*) 18.01ºC (*b*) 26ºC (*c*) 10.6ºC (*d*) 20ºC

110. Three rods made of the same material and having the same cross section have been joined as shown in the figure. Each rod is the same length. The left and right ends are kept at 0ºC and 90º respectively. The temperature of the junction of the three rods will be



(*a*) 45ºC (*b*) 60ºC

(*c*) 30ºC (*d*) 20ºC

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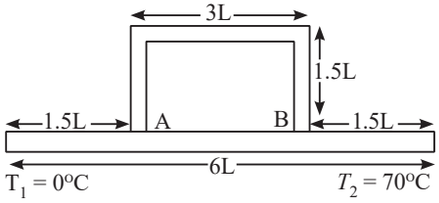
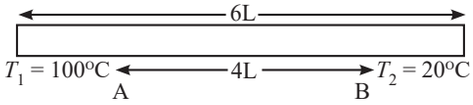
111. Given arrangement is formed of same material and same cross section area then find temperature difference between point A and B.

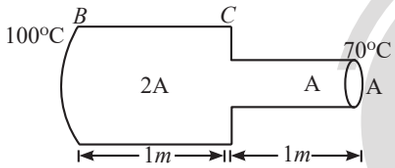


(*a*) 20°C (*b*) 32°C
(*c*) 16°C (*d*) 40°C

112. A metal rod of length 6L has its ends maintained at different temperatures: one end $T_1 = 100^oC$ and the other end $T_2 = 20^oC$ as shown in the figure : Find the temperature difference between A and B.

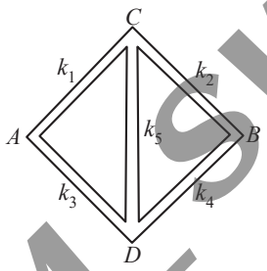


113. A metal rod of length 2m has cross-sectional areas 2A and A, as shown in the following figure. The two ends are maintained at temperatures 100°C and 70°C The temperature of middle point C is:



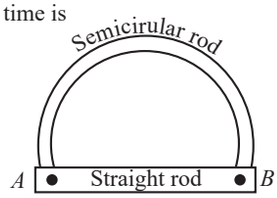
(*a*) 80°C (*b*) 85°C
(*c*) 90°C (*d*) 95°C

114. Five rods of same dimensions are arranged as shown in the figure. They have thermal conductivities, k_1, k_2, k_3, k_4 and k_5 when points A and B are maintained at different temperatures. No heat flows through the central rod if



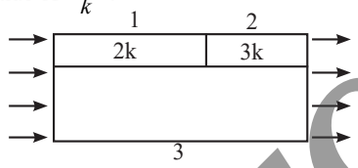
(*a*) $k_1k_4 = k_2k_3$ (*b*) $k_1 = k_4$ *and* $k_2 = k_3$
(*c*) $\frac{k_1}{k_4} = \frac{k_2}{k_3}$ (*d*) $k_1k_4 = k_3k_4$

115. Two rods (one semicircular and other straight) of same material and of same cross-sectional area are joined as shown in the figure. The points A and B are maintained at different temperature. The ratio of the heat transferred through a cross-section of a semicircular rod of the heat transferred through a cross-section of the straight rod in a given time is



(*a*) 2 : π (*b*) 1 : 2
(*c*) π : 2 (*d*) 3 : 2

116. Two rods 1 and 2 of length 2l and l, thermal conductivities 2k and 3k are joined end to end. The area of cross-sectional of each rod be A. This composite rod is connected with another rod 3 of length 3l and conductivity k. The area of cross-section of the rod 3 is 2A. If the rod 3 conducts the heat two times that through the other rods, find the value of $\frac{4k'}{k}$.



(*a*) 5 (*b*) 3 (*c*) 9 (*d*) 12

Thermal Conductivity

117. Two identical metal wires of thermal conductivities K_1 and K_2 respectively are connected in series. the effective thermal conductivity

(*a*) $\frac{2K_1K_2}{K_1+K_2}$ (*b*) $\frac{K_1+K_2}{2K_1K_2}$ (*c*) $\frac{K_1+K_2}{K_1K_2}$ (*d*) $\frac{K_1K_2}{K_1+K_2}$

118. Consider a compound slab consisting of two different materials having equal thicknesses and thermal conductivities K and 2K, respectively. The equivalent thermal conductivity of the slab is

(*a*) $\frac{2}{3}K$ (*b*) $\sqrt{2}K$ (*c*) 3 K (*d*) $\frac{4}{3}K$

119. A slab to stone of area 0.36 m^2 and thickness 0.1m is exposed on the lower surface to steam at 100°C. A block of iec at 0°C rests on the upper surface of the slab. in one hour 4.8 kg of ice is melted. The thermal conductivity of slab is - (Given latent heat of fusion of ice = 3.36×10^5) kg-1)

(*a*) 1.29 J/m/s/°C (*b*) 2.05 J/m/s/°C
(*c*) 1.02 J/m/s/°C (*d*) 1.24 J/m/s/°C

120. A cylinder of radius R made of a material of thermal conductivity K_1 is surrounded by a cylindrical shell of inner radius R and outer radius 2R made of material of thermal conductivity K_2 The two ends of the combined system are maintained at two different temperatures. There is no loss of heat across the cylindrical surface and the system is in steady state. The effective thermal conductivity of the system is

(*a*) $K_1 + K_2$ (*b*) $\frac{K_1K_2}{K_1+K_2}$ (*c*) $\frac{K_1+3k_2}{4}$ (*d*) $\frac{3K_1+k_2}{4}$

121. The ratio of thermal conductivity of two rods of different material is 5 : 4. The two rods of same area of cross-section and same thermal resistance will have the lengths in the ratio

(*a*) 4 : 5 (*b*) 9 : 1 (*c*) 1 :9 (*d*) 5 : 4

122. **Assertion:** The SI unit of thermal conductivity is watt.m^{-1}.K^{-1}.

Reason: Thermal conductivity is a measure of ability of the material to allow the passage of heat through it.

123. There are two identical vessels filled with equal amount of ice and the vessels are mode of different metals. If the ice melts in the two vessels in 20 min and 35 min , respectively, the ratio of the coefficient of thermal conductivity of the two metals is

(*a*) 4 : 7 (*b*) 7 : 4 (*c*) 16 : 49 (*d*) 49 : 36

124. The property of water that has an important environmental effect is its:

(*a*) low surface tension (*b*) high heat capacity
(*c*) maximum density at 4°C (*d*) low thermal conductivity

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Formation of ice Slab on the Surface of Lake

125. Ice starts forming in lake with water at 0ºC and when the atmospheric temperature is 10ºC. If the time taken for 1 cm of ice be 7 hr , then the time taken for the thickness of ice to change from 1 cm to 2 cm is

(*a*) 7 hrs (*b*) 14 hrs
(*c*) Less than 7 hrs (*d*) More than 7 hrs

Newton's Law of Cooling

126. An object kept in a large room having air temperature of 25ºC takes 12 minutes to cool from 80ºC to 70ºC The time taken to cool for the same object from 70ºC to 60ºC would be nearly:

(*a*) 10 min (*b*) 12 min (*c*) 20 min (*d*) 15 min

127. A body from a temperature $3T$ to $2T$ in 10 minutes. The room temperature is T. Assume that Newton's law of cooling is applicable. The temperature of the body at the end of next 10 minutes will be:

(*a*) 4/3 T (*b*) T (*c*) 7/4 T (*d*) 3/2 T

128. A body initially at 80ºC cools to 64ºC in 5 min and to 52ºC in 10 min . The temperature of the surrounding is

(*a*) 26ºC (*b*) 16ºC (*c*) 36ºC (*d*) 40ºC

129. Certain quantity of water cools from 70ºC to 60ºC in the first 5 minutes and to 54ºC in the next 5 minutes. The temperature of the surroundings is.

(*a*) 42ºC (*b*) 10ºC (*c*) 45ºC (*d*) 20ºC

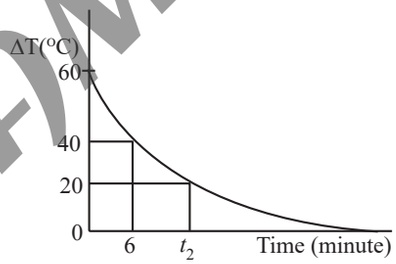
130. A cup of coffee cools from 90ºC to 80ºC in t minutes, when the room temperature is 20ºC. The time taken by a similar cup of coffee to cool from 80ºC to 60ºC at room temperature same at 20ºC.

(*a*) 10/13t (*b*) 5/13t (*c*) 13/10t (*d*) 13/5t

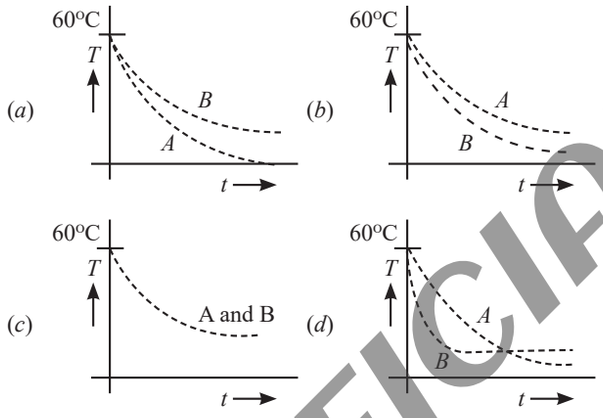
131. A bucket full of hot water cools from 75ºC to 70ºC in time T_1, from 70ºC to 65ºC in time T_2 and from 65ºC to 60ºC in time T_3 , then

(*a*) $T_1 = T_2 = T_3$ (*b*) $T_1 > T_2 > T_3$
(*c*) $T_1 < T_2 < T_3$ (*d*) $T_1 > T_2 < T_3$

132. In an experiment to verify Newton's law of cooling, a graph is plotted between, the temperature difference (ΔT) of the water and surrounding and time as shown in figure. The initial temperature of water is taken as 60ºC. The value of t_2 as mentioned in the graph will be.



133. Two identical breakers A and B contain equal volumes of two different liquids at 60ºC each and left to cool down. Liquid in A has density of 8×10^2 kg/m^3 and specific heat of 2000 J kg^{-1} K^{-1} while liquid in B has density of 10^3 kg m^{-3}and specific heat of 4000 J kg^{-1} K^{-1}. Which of the following best describes their temperature versus time graph schematically? (assume the emissivity of both the beakers to be the same).



134. **Statement I:** Two metallic spheres of same size, one of copper and the other of aluminium, heated to the same temperature, will cool at the same rate when they are suspended in the same enclosure.

Statement II: The rate of cooling of a body depends on the excess of temperature of the body over the surroundings.

Heat Transfer

135. Snow is more heat insulating than ice, because:

(*a*) Air is filled in pores of snow
(*b*) Ice is more bad sconductor than snow
(*c*) Air is filled in pores of ice
(*d*) Density of ice is more

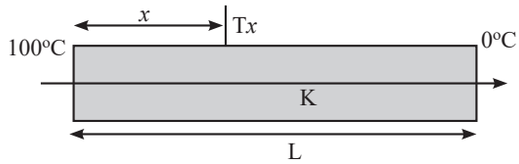
136. Mud houses are cooler in summer and warmer in winter because :

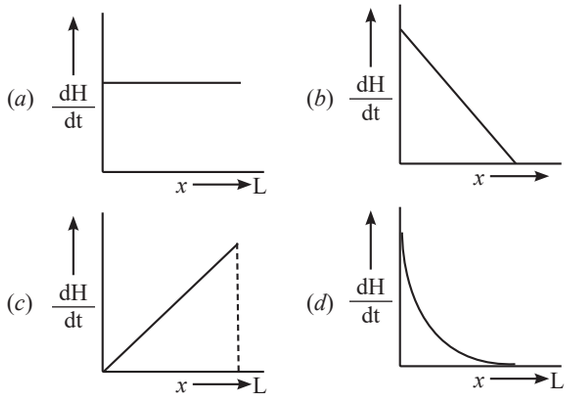
(*a*) mud is superconductor of heat
(*b*) mud is good conductor of heat
(*c*) mud is bad conductor of heat
(*d*) none of the above

137. The thermal conductivity of a rod is 2. What is its thermal resistivity?

(*a*) 0.5 (*b*) 1 (*c*) 0.25 (*d*) 2

138. Which of the following graph is correct for given rod?





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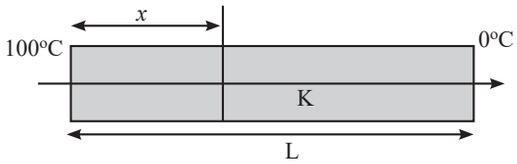
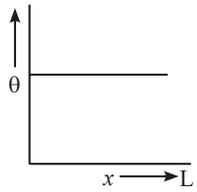
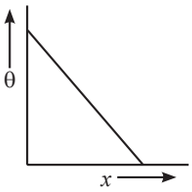
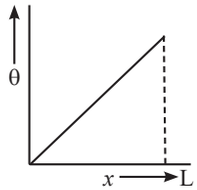
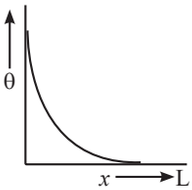
139. Which of the following graph is correct for given rod?



(*a*)


(*b*)


(*c*)


(*d*)


140. A hot and a cold body are kept in vacuum separated from each other. Which of the following causes decrease in temperature of the hot body?

(*a*) Radiation

(*b*) Convection

(*c*) Conduction

(*d*) Temperature remains unchanged

141. As compared to a person with white skin, another person with dark skin, will experience:

(*a*) less heat and more cold

(*b*) more heat and more cold

(*c*) more heat and less cold

(*d*) less heat and less cold

142. Which of the following statements is wrong?

(*a*) Rough surfaces are better radiators than smooth surfaces.

(*b*) Highly polished mirror like surfaces are very good radiators.

(*c*) Black surfaces are better absorbers than white ones.

(*d*) Black surfaces are better radiators than white ones.

143. Match the column-I with column-II and select correct option.

Column-I			Column-II
(A)	Conduction	(P)	Medium required
(B)	Convection	(Q)	Fastest mode of heat transfer
(C)	Radiation	(R)	Slowest mode of heat transfer
		(S)	Medium not required

	A	B	C
(*a*)	P,R	P	S
(*b*)	P	P,R	Q,S
(*c*)	P,R	P	Q,S
(*d*)	P	Q,S	S

144. Match the column-I with column-II and select correct option.

Column-I			Column-II
(A)	Conduction	(P)	Medium required
(B)	Convection	(Q)	Fastest mode of heat transfer
(C)	Radiation	(R)	Slowest mode of heat transfer
		(S)	Medium not required

	A	B	C	D
(*a*)	Q	P	S	R
(*b*)	S	P	Q	R
(*c*)	P	Q	R	S
(*d*)	R	P	S	Q

145. **Assertion :** The radiation from the sun's surface varies as the fourth power of its absolute temperature.

Reason : The sun is not a black body.

(*a*) If both assertion and reason are true and reason is the correct explanation of assertion.

(*b*) If both assertion and reason are true but reason is not the correct explanation of assertion.

(*c*) If assertion is true but reason is false.

(*d*) If both assertion and reason are false

146. **Assertion :** Air at some distance above the fire is hotter than the same distance below it.

Reason : Air surrounding the fire carries heat upwards.

(*a*) If both assertion and reason are true and reason is the correct explanation of assertion.

(*b*) If both assertion and reason are true but reason is not the correct explanation of assertion.

(*c*) If assertion is true but reason is false.

(*d*) If both assertion and reason are false

147. **Assertion :** Blue star is at high temperature than red star.

Reason : Wein's displacement law states that $T \propto (1/\lambda_m)$.

(*a*) If both assertion and reason are true and reason is the correct explanation of assertion.

(*b*) If both assertion and reason are true but reason is not the correct explanation of assertion.

(*c*) If assertion is true but reason is false.

(*d*) If both assertion and reason are false

148. **Assertion :** A body that is a good radiator is also a good absorber of radiation at a given wavelength.

Reason : According to Kirchhoff's law the absorptivity of a body is equal to its emissivity at a given wavelength.

(*a*) If both assertion and reason are true and reason is the correct explanation of assertion.

(*b*) If both assertion and reason are true but reason is not the correct explanation of assertion.

(*c*) If assertion is true but reason is false.

(*d*) If both assertion and reason are false

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149. **Assertion :** For higher temperatures the peak emission wavelength of a black body shifts to lower wavelengths.

Reason : Peak emission wavelengths of a blackbody is proportional to the fourth-power of temperature.

(*a*) If both assertion and reason are true and reason is the correct explanation of assertion.

(*b*) If both assertion and reason are true but reason is not the correct explanation of assertion.

(*c*) If assertion is true but reason is false.

(*d*) If both assertion and reason are false

150. **Assertion :** When hot water is poured in a beaker of thick glass, the beaker cracks.

Reason : Outer surface of the beaker expands suddenly.

(*a*) If both assertion and reason are true and reason is the correct explanation of assertion.

(*b*) If both assertion and reason are true but reason is not the correct explanation of assertion.

(*c*) If assertion is true but reason is false.

(*d*) If both assertion and reason are false

151. An aluminium sphere is dipped into water. Which of the following is true?

(*a*) Buoyancy will be less in water at 0ºC than that in water at 4ºC.

(*b*) Buoyancy will be more in water at 0ºC than that in water at 4ºC.

(*c*) Buoyancy in water at 0ºC will be same as that in water at 4ºC

(*d*) Buoyancy may be more or less in water at 4ºC depending on the radius of the sphere.

152. Heat is associated with :

(*a*) kinetic energy of random motion of molecules

(*b*) kinetic energy of orderly motion of molecules

(*c*) total kinetic energy of random and orderly motion of molecules

153. A glass full of hot milk is poured on the table. It begins to cool gradually. Which of the following statement is/are correct?

(i) The rate of cooling is constant till milk attains the temperature of the surrounding.

(ii) The temperature of milk falls off exponentially with time.

(iii) While cooling, there is a flow of heat from milk to the surrounding as well as from surrounding to the milk but the net flow of heat is from milk to the surrounding and that is why it cools.

(iv) All three phenomenon, conduction, convection and radiation are responsible for the loss of heat from milk to the surroundings.

(*a*) Both (ii) and (iii) are correct.

(*b*) Both (iii) and (iv) are correct.

(*c*) (ii), (iii) and (iv) are correct.

(*d*) All are correct.

154. A solid with coefficient of linear expansion α just floats in a liquid whose coefficient of volume expansion is γ. If the system is heated, the solid will:

(*a*) sink in all cases (*b*) continue to float in all cases

(*c*) sink if $\gamma < 3\alpha$ (*d*) sink if $\gamma > 3\alpha$

Convection

155. Gravitational force is required for -

(*a*) Stirring of liquid (*b*) Convection

(*c*) Conduction (*d*) Radiation

156. _____ is a mode of heat transfer by actual motion of matter.

Radiation

157. The fastest mode of heat transfer is

(*a*) Conduction (*b*) Radiation

(*c*) Convection (*d*) all are equally fast

158. The colour of a star is an indication of its -

(*a*) Weight (*b*) Distance (*c*) Temperature (*d*) Size

159. The energy that will be ideally radiated by a 100 kW transmitter in 1 hour is :

(*a*) 1×10^5 J (*b*) 36×10^7 J (*c*) 36×10^4 J (*d*) 36×10^5 J

160. Emissive power of any surface (e), Absorptive power (a), Reflecting power (r) and transmission power (t) are related as -

(*a*) $a + e + t = 1$ (*b*) $a + r + t = 1$

(*c*) $r + e + t = 1$ (*d*) $r + e + a = 1$

161. If transmission power of a surface is 1/6 and reflective power is 1/3, then its absorptive power will be-

(*a*) 1/3 (*b*) 1/2 (*c*) 1/6 (*d*) 1/12

162. If same amount of ice is placed in black and white cloth then ice in black cloth will -

(*a*) Melt more (*b*) Melt less

(*c*) Melt equal (*d*) Not melt at all

163. The following figure shows two air-filled bulbs connected by a U-tube partly filled with alcohol. What happens to the levels of alcohol in the limbs X and Y when an electric bulb placed midway between the bulbs is lighted

(*a*) The level of alcohol in limb X falls while that in limb Y rises

(*b*) The level of alcohol in limb X rises while that in limb Y falls

(*c*) The level of alcohol falls in both limbs

(*d*) There is no change in the levels of alcohol in the two limbs

Stefan's Law

164. Solid sphere and solid cube of same material and of same Volume at same temperature then rate of heat loss.

(*a*) More in solid Sphere (*b*) More in cube

(*c*) Equal (*d*) non of these

165. Solid sphere and solid cube of same material and of same area at same temperature then rate of heat loss

(*a*) More in solid sphere (*b*) More in cube

(*c*) equal (*d*) Non of these

166. Solid sphere and solid cube of same material and at same temperature then rate of heat loss

(*a*) More in solid sphere (*b*) More in cube

(*c*) equal (*d*) Non of these

167. Unit of σ is

(*a*) Watt m^2/k^4 (*b*) $\frac{Watt}{m^2k^4}$ (*c*) $\frac{J}{sm^2k^4}$ (*d*) $\frac{Js}{m^2k^4}$

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168. Energy radiated from a body in time t is where A is area of the body.

(*a*) $\sigma T^4 t$ (*b*) $\sigma T^4 t A$ (*c*) σT^4 (*d*) $\frac{\sigma T^4}{At}$

169. Two sphere A & B of same material at same temperature of different size, then rate of cooling:

(*a*) fast in *A* sphere (*b*) fast in B sphere
(*c*) Same (*d*) Can't say

170. Two body of same nature and same dimension at temperature 50°C & 100°C then energy radiation per unit time from per unit area.

(*a*) 1 : 2 (*b*) 1 : 16
(*c*) 16 : 1 (*d*) None of these

171. Two spheres made of same material have radii in the ratio 1:2. Both are at same temperature. Ratio of heat radiation energy emitted per second by them is

(*a*) 1 : 2 (*b*) 1 : 8 (*c*) 1 : 4 (*d*) 1 : 16

172. Two black metallic spheres of radius 4 m, at 2000*K* and 1m at 4000 *K* will have ratio of energy radiation as

(*a*) 1 : 1 (*b*) 4 :1 (*c*) 1 : 4 (*d*) 2 : 1

173. Temperature of a piece of metal is increased from 27°C to 327°C The rate of emission of radiation by a metal will become

(*a*) Double (*b*) Four times
(*c*) Eight times (*d*) Sixteen times

174. Two bodies *A* and *B* are kept in an evacuated chamber at 27°C. The temperatures of *A* and *B* are 327°C and 427°C respectively. The ratio of rates of loss of heat from *A* and *B* will be -

(*a*) 0.52 (*b*) 0.25 (*c*) 1.52 (*d*) 2.52

175. If the temperature of a black body is increased by 50% then the amount of radiation emitted by it will

(*a*) Increase by 400% (*b*) Decrease by 400%
(*c*) Decrease by 50% (*d*) Increase by 50%

176. A copper ball 2 *cm* in radius is heated in a furnace to 327°C. If its emissivity is 0.3, at what rate does it radiate energy?

(*a*) 1.72 *W* (*b*) 2.73*W* (*c*) 11.0*W* (*d*) 2.15*W*

177. The temperature of a body is increased from –73°C to 327°C. Then the ratio of emissive power is

(*a*) $\frac{1}{9}$ (*b*) $\frac{1}{27}$ (*c*) 27 (*d*) 81

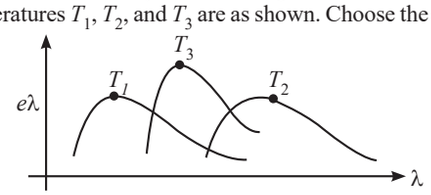
178. A spherical black body with a radius of 12 cm radiates 450 watt power at 500 *K*. If the radius were halved and the temperature doubled the power radiated in watt would be:

(*a*) 125 (*b*) 450 (*c*) 1000 (*d*) 1800

179. Two spheres of radius R_1 and R_2 have densities ρ_1 and ρ_2 and specific heat s_1 and s_2. If they are heated to the same temperature, the ratio of their rates of falling temperature will be

(*a*) $\frac{R_2}{R_1}$ (*b*) $\frac{R_1\rho_2 s_2}{R_2\rho_1 s_1}$ (*c*) $\frac{R_2\rho_2 s_2}{R_1\rho_1 s_1}$ (*d*) $\left(\frac{R_1}{R_2}\right)^2$

180. The plots of intensity *vs* wavelength for three black bodies at temperatures T_1, T_2, and T_3 are as shown. Choose the correct option



(*a*) $T_1 > T_2 > T_3$ (*b*) $T_1 > T_3 > T_2$
(*c*) $T_2 > T_3 > T_1$ (*d*) $T_3 > T_2 > T_1$

181. A solid sphere of copper of radius *R* and a hollow sphere of the same material of inner radius *r* and outer radius *R* are heated to the same temperature and allowed to cool in the same environment.

Assertion: Hollow sphere cools faster than the solid sphere.

Reason: $\left(-\frac{d\theta}{dt}\right) \propto \frac{1}{m}$

(*a*) If both assertion and reason are true and the reason is the correct explanation of the assertion.
(*b*) If both assertion and reason are true, but reason is not the correct explanation of the assertion.
(*c*) If assertion is true, but reason is false.
(*d*) If assertion is false, but reason is true.
(*e*) If both assertion and reason are false.

182. **Assertion:** Animals curl into a ball when they feel very cold.

Reason: Animals by curling their body reduces the surface area.

Stefan-Boltzmann Law

183. Two identical metal balls at temperature 200°C and 400°C kept in air at 27°C. The ratio of net heat loss by these bodies is

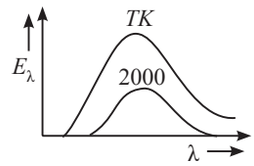
(*a*) $\frac{1}{4}$ (*b*) $\frac{1}{2}$
(*c*) $\frac{1}{16}$ (*d*) $\frac{473^4 - 300^4}{673^4 - 300^4}$

Wien's Displacement Law

184. Which of the law can be understood in terms of Stefan's law

(*a*) Wein's displacement law (*b*) Kirchhoff's law
(*c*) Newton's law of cooling (*c*) Planck's law

185. The adjoining diagram shows the spectral energy density distribution of a black body at two different temperatures. If the areas under the curves are in the ratio 16 : 1, the value of temperature *T* is



(*a*) 32,000 K (*b*) 16,000 K (*c*) 8,000 K (*d*) 4,000 K

186. The wavelength of maximum energy released during an atomic explosion was $2.93 \times 10^{-10} m$. Given that Wien's constant is 2.93×10^{-3} *m-k*. the maximum temperature attained must be of the order of

(*a*) 10^{-7} K (*b*) 10^{7} K (*c*) 10^{-13} K (*d*) 5.86×10^{7} K

187. The power radiated by a block body is *P* and it radiates maximum energy at wavelength λ_0. If the temperature of the black body is now changed so that it radiates maximum energy at wavelength $3\lambda_0/4$, the power radiated by it becomes *nP*. The value of *n* is

(*a*) $\frac{3}{4}$ (*b*) $\frac{4}{3}$ (*c*) $\frac{256}{81}$ (*d*) $\frac{81}{256}$

188. On observing light from three different stars, *P, Q* and *R*, it was found that intensity of violet colour is maximum in the spectrum of *P*, the intensity of green colour is maximum in the spectrum of *R* and the intensity of red colour is maximum in the spectrum of *Q*, If $T_P T_Q$ and T_R are the respective absolute temperature of *P*. Q and *R*, then it can be concluded from the above observation that:

(*a*) $T_P > T_R > T_Q$ (*b*) $T_P < T_R < T_Q$
(*c*) $T_P < T_Q < T_R$ (*d*) $T_P > T_Q > T_R$

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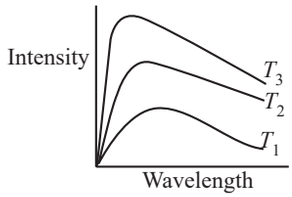
189. If for a black body the graph of change is emissive power at different temperatures T_1, T_2 and T_3 with wavelength is according to the figure then



(*a*) $T_1 = T_2 = T_3$ (*b*) $T_3 > T_2 > T_1$
(*c*) $T_1 > T_2 > T_3$ (*d*) $T_3 > T_1 > T_2$

190. A black body is at a temperature of 5760 *K*. The energy of radiation emitted by the body at wavelength 250 nm is U_1 at wavelength 500 nm is U_2 and that at 1000 nm is U_3. Wien's constant, $b = 2.88 \times 10^6$ Which of the following is correct?

(*a*) $U_1 = 0$ (*b*) $U_3 = 0$ (*c*) $U_1 > U_2$ (*d*) $U_2 > U_1$

191. The condition under which a microwave oven heats up a food item containing water molecules most efficiently is :

(*a*) Infra-red waves produce heating in a microwave oven
(*b*) The frequency of the microwaves must match the resonant frequency of the water molecules
(*c*) The frequency of the microwaves has no relation with natural frequency of water molecules
(*d*) Microwaves are heatwaves, so always produce heating

192. A piece of iron is heated in a flame. It first becomes dull red then becomes reddish yellow and finally turns to white hot. The correct explanation for the above observation is possible by using:-

(*a*) Newton's Law of cooling
(*b*) Stefan's Law
(*c*) Wien's displacement Law
(*d*) Kirchoff's Law

193. **Assertion:** Colour of a glowing black body changes on increasing its temperature.

Reason: Spectral emissive power associated with each wavelength does not increase in same proportion on increasing temperature of the Black Body.

Solar Constant

194. The total radiant energy per unit area, normal to the direction of incidence, received at a distance *R* from the centre of a star of radius *r*. whose outer surface radiates as a (black body at a temperature *TK* is given by

(a) $\sigma r^2 T^4/R^2$ (b) $\sigma r^2 T^4/4pr^2$ (c) $\sigma r^4 T^4/r^2$ (d) $4pr^2 T^4/R^2$

195. If the radius of a star is *R* and it acts as a black body, what would be the temperature of the star, in which the rate of energy production is *Q*

(*a*) $(4\pi r^2 Q/\sigma)1^{/4}$ (*b*) $(Q/4\pi R\sigma)^{1/4}$
(*c*) $Q/4\pi R^2\sigma$ (*d*) $(Q/4\pi R^2\sigma)^{-1/2}$

Triple Point

196. The temperature and pressure at which the fusion curve, the vaporisation curve and the sublimation curve meet and all the three phases of a substance coexist is called the triple point of the substance.

(*a*) True (*b*) False

197. Triple point of water is:

(*a*) 273.16ºF (*b*) 273.16 K
(*c*) 273.16ºC (*d*) 273.16 R

Kirchoff's Law

198. From Kirchhoff's law, the ratio of emissive power and absorption power of all bodies

(*a*) are different
(*b*) is equal to emissive power of black body at same temperature
(*c*) is equal to emissive power of white body
(*d*) is equal to emissive power of black body at any temperature

199. **Statement I:** The leaves of a tree will look black when illuminated with green colored light.

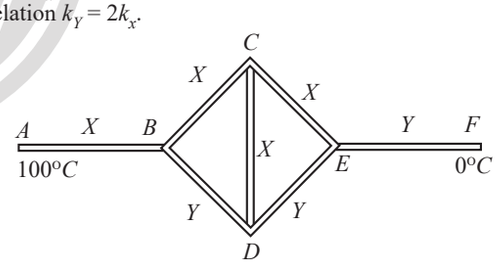
Statement II: A good emitter is a good absorber as well.

Heat Measurement Device

200. Using which of the following instruments, the temperature of the sun can be determined?

(*a*) Platinum thermometer (*b*) Gas thermometer
(*c*) Pyrometer (*d*) Vapour pressure thermometer

201. Four rods of material *X* and three rods of material *Y* are connected, as shown in the figure. All the rods are of identical lengths and cross-sectional area. Given, thermal resistance of rod of material *X* is, $R_x = R$ and thermal conductivities of materials are related by relation $k_Y = 2k_x$.



Match the column

	Column-I		Column-II
(*a*)	Thermal resistance between *B* and *E*	(i)	$\frac{500}{13}$
(*b*)	Thermal resistance between *A* and *F*	(ii)	$\frac{700}{13}$
(*c*)	Temperature of junction *B* (inºC)	(iii)	$\frac{2R}{3}$
(*d*)	Temperature of junction *D* (inºC)	(iv)	$\frac{13R}{6}$
		(v)	$\frac{5R}{3}$

Match the column

(1) a-(v), b-(iii), c-(iv), d-(i)
(2) a-(iv), b-(ii), c-(i), d-(iii)
(3) a-(iii), b-(iv), c-(ii), d-(i)
(4) a-(ii), b-(iii), c-(i), d-(iv)

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1. **Statement I:** Fahrenheit and kelvin scale may give equal numerical values of the temperature of a body
   Statement II: For a constant volume gas thermometer, one should fill the gas at high temperature & low pressure
2. **Statement I:** A square metal sheet with circular hole is heated, then the diameter of the hole will decrease.
   Statement II: The coefficient of linear expansion has similar dimension as that of coefficient of volume expansion.
3. **Statement I:** Two identical Rectangular strips, one of Copper and other of steel are riveted together to form a bimetallic strip [$\alpha_{cu} > \alpha_{steel}$]. on heating, this strip will bend with copper on convex side.
   Statement II: If the Temperature of uniform rod is slightly increased by Δt. Its moment of inertia I about a perpendicular bisector will increases by $\alpha I \Delta t$
4. **Statement I:** As the temperature is increased, the time period of a pendulum will decrease.
   Statement II: The specific heat capacity of body depends on the heat given, the temperature raised as well as on the mass of the body
5. **Statement I:** Water equivalent of a body is measured in kilograms
   Statement II: Sum of the temperature of the two bodies at different temperatures are mixed in a calorimeter.
6. **Statement I:** The heat capacity of a body depends on the mass of the body and on the material of the body as well.
   Statement II: The ratio of specific heat capacity to molar heat capacity of a body depends on the molecular weight of the body but doesn't depend on the mass of the body.
7. **Statement I:** If heat is supplied to solid, it's temperature must increase
   Statement II: If temperature of an object is observed to rise in a period, then heat is certainly supplied to it in the period.
8. **Statement I:** Heat & work are equivalent. This means that temperature of a body can be increased by doing work on it.
   Statement II: Heat & work are equivalent. This means that a body kept at rest may be set into motion along supplying heat to it
9. **Statement I:** In a room containing air, heat can go from on place to another by all three modes i.e. conduction, convection and radiation.
   Statement II: A solid at temperature T_1 is kept in an evacuated chamber at temperature T_2 ($>T_1$) the rate of increase of temperature of the body is proportional to $(T_2 - T_1)^4$
10. **Statement I:** Two bodies A and B having equal surface areas are maintained at temperatures 10°C 20°C. Then the thermal radiation emitted in a given time by A and B are in the ration 1 : 16
    Statement II: The thermal radiation emitted by a body is proportionl to T^n where T is its absolute temperature. The value of n is exactly 4 from all bodies.
11. **Statement I:** A body cools down from 65°C to 60°C in 5 minutes. It will cool down from 60° to 55°C in more than 5 minutes.
    Statement II: One end of a metal rod is dipped in boiling water & other is dipped in melting ice all parts of rod will be in thermal equilibrium with each other.
12. **Statement I:** A blackbody does not emit radiation
    Statement II: A blackbody does not reflect radiation.
13. **Statement I:** In summer, a mild wind is often found on the shore of a calm river. This is caused due to conduction between air and the soil.
    Statement II: A heated body emits radiation which has maximum intensity near the frequency ν_o. The emissivity of the material is 0.5 If the absolute temperature of the body is doubled, the maximum intensity of Radiation will be near the frequency $\nu_o/2$ and the total energy emitted will increase by a factor of 16

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Answer Key

1. (*b*) **2.** (*b*) **3.** (*b*) **4.** (*b*) **5.** (*b*) **6.** (*c*) **7.** (*a*) **8.** (*a*) **9.** (*a*) **10.** (*d*)
11. (*c*) **12.** (*c*) **13.** (*b*) **14.** (*a*) **15.** (*c*) **16.** (*a*) **17.** (*b*) **18.** 313 kelvin
19. R = 64Ω **20.** (*c*) **21.** (*c*) **22.** (*a*) **23.** (*c*) **24.** (*b*) **25.** (*b*) **26.** (*d*) **27.** $T = \frac{\alpha_1 t_1 - \alpha_2 t_2}{\alpha_1 - \alpha_2}$
28. 75.03 cm **29.** (*a*) **30.** (*d*) **31.** 60 cm **32.** (5) **33.** (*d*) **34.** (*d*) **35.** (*a*) **36.** (*a*)
37. (*c*) **38.** (*a*) **39.** (*d*) **40.** (*c*) **41.** $\alpha = \frac{\beta}{2} = \frac{\gamma}{3}$ **42.** (*d*) **43.** (*c*) **44.** $\Delta P = -\gamma\beta\Delta T$
45. (*a*) **46.** (*b*) **47.** (*b*) **48.** (*a*) **49.** (*d*) **50.** (*c*) **51.** (*b*) **52.** (*c*) **53.** (*c*) **54.** (*a*)
55. (*d*) **56.** (*b*) **57.** $\omega_2 = \omega_1[1 - 2\alpha\Delta t]$ **58.** (*c*) **59.** (*a*) **60.** (*d*) **61.** (*a*) **62.** (*d*) **63.** (*c*)
64. (*d*) **65.** (*c*) **66.** (*d*) **67.** (*b*) **68.** (*d*) **69.** 14,600 calorie **70.** (*a*) **71.** 650 cal. **72.** (*a*)
73. (*b*) **74.** (*b*) **75.** (*c*) **76.** (*b*) **77.** (*d*) **78.** (*b*) **79.** 150 cal/min **80.** (*a*) **81.** (*c*)
82. (*a*) **83.** 300 **84.** (*c*) **85.** (*d*) **86.** (*a*) **87.** (*b*) **88.** $\left(\frac{3}{1}\right)$ **89.** 16.6°C **90.** (*b*) **91.** 400°C
92. $T_{solution} = 4.21°C$, $M_{ice} = 0$, $M_{water} = 95$ gm **93.** (*b*) **94.** (*b*) **95.** (*a*) **96.** 12gm **97.** (*d*) **98.** (*b*)
99. (*a*) **100.** (*a*) **101.** (*b*) **102.** (*b*) **103.** (*c*) **104.** (*b*) **105.** (*b*) **106.** (*d*) **107.** (*a*)
108. $\frac{120KA}{L}$ **109.** (*c*) **110.** (*b*) **111.** (*c*) **112.** $\frac{160}{3}$ °C **113.** (*c*) **114.** (*a*) **15.** (*a*) **116.** (*c*) **117.** (*a*)
118. (*d*) **119.** (*d*) **120.** (*c*) **121.** (*d*) **122.** (*b*) **123.** (*b*) **124.** (*c*) **125.** (*d*) **126.** (*d*) **127.** (*d*)
128. (*b*) **129.** (*c*) **130.** (*d*) **131.** (*c*) **132.** 16 minutes **133.** (*a*) **134.** (*d*) **135.** (*a*) **136.** (*c*)
137. (*a*) **138.** (*a*) **139.** (*b*) **140.** (*a*) **141.** (*b*) **142.** (*b*) **143.** (*c*) **144.** (*a*) **145.** (*c*) **146.** (*a*)
147. (*a*) **148.** (*a*) **149.** (*c*) **150.** (*c*) **151.** (*a*) **152.** (*a*) **153.** (*c*) **154.** (*d*) **155.** (*b*)
156. (Convection) **157.** (*b*) **158.** (*c*) **159.** (*b*) **160.** (*b*) **161.** (*b*) **162.** (*a*) **163.** (*a*) **164.** (*b*)
165. (*c*) **166.** (*a*) **167.** (*c*) **168.** (*b*) **169.** (*a*) **170.** (*d*) **171.** (*c*) **172.** (*a*) **173.** (*d*) **174.** (*a*)
175. (*a*) **176.** (*c*) **177.** (*d*) **178.** (*d*) **179.** (*c*) **180.** (*b*) **181.** (*a*) **182.** (*a*) **183.** (*d*) **184.** (*c*)
185. (*d*) **186.** (*b*) **187.** (*c*) **188.** (*a*) **189.** (*b*) **190.** (*d*) **191.** (*b*) **192.** (*c*) **193.** (*a*) **194.** (*a*)
195. (*b*) **196.** (*a*) **197.** (*b*) **198.** (*b*) **199.** (*d*) **200.** (*c*) **201.** (*c*)

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1. Both True. **2.** I-False, II- True **3.** I-True, II- False **4.** Both False. **5.** I-True, II- False
6. Both True. **7.** Both false. **8.** I. True, II. False **9.** I. True, II. False **10.** I. False, II. True.
11. I. True, II. False. **12.** I. False, II. True. **13.** Both False.

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Electric Charges & Field

(Practice Questions)

Charge

1. Smallest unit of charge is

(*a*) Frankline (*b*) Faraday

(*c*) Coulomb (*d*) e.m.u

2. Which of the following is not the unit of charge?

(*a*) Farad (*b*) Coulomb

(*c*) Stat coulomb (*d*) Faraday

3. Neutral body can be negatively charged by?

(*a*) Giving some excess proton

(*b*) Giving some extra neutron

(*c*) Giving some extra electron

(*d*) Removing some proton

(*e*) Removing some electron

4. A positively charged body can be make neutral by

(*a*) Giving some electron (*b*) Giving some proton

(*c*) Removing some proton (*d*) None of these

5. During charging of body mass of the body increases then body becomes

(*a*) Positively charge (*b*) Remains neutral

(*c*) Negatively charge (*d*) None of these

6. If a body has positive charge on it, then it means it has

(*a*) Gained some protons (*b*) Lost some protons

(*c*) Gained some electrons (*d*) Lost some electrons

7. Body A is attracted by the charge +Q then body 'A'

(*a*) Negatively charged

(*b*) Positively charged

(*c*) Neutral

(*d*) May be negatively charged or neutral

8. Body A is repelled by the charge +Q then body 'A' is

(*a*) –ve charged (*b*) +ve charged

(*c*) Neutral (*d*) May be –ve or neutral

9. Sure check for presence of electric charge is

(*a*) Process of induction

(*b*) Repulsion between bodies

(*c*) Attraction between bodies

(*d*) Frictional force between bodies

10. Electric charges *A* and *B* are attracted to each other. Electric charges *B* and *C* are also attracted to each other. If *A* and *C* are held close together they will

(*a*) attract

(*b*) repel

(*c*) not affect each

(*d*) More information is needed to answer

11. Two charge θ_1 and θ_2 shows repulsion then which of the following option is correct for this:-

(*a*) $\theta_1 \times \theta_2 = 0$ (*b*) $\theta_1 \times \theta_2 > 0$

(*c*) $\theta_1\theta_2 < 0$ (*d*) all of these

12. Compare specific charge of neutron, proton, α-particle

Quantisation of Charge

13. **Assertion:** Charge is quantized

Reason: Charge which is less than 1C is not possible

(*a*) Both assertion and reason are true and reason is the correct explanation of assertion

(*b*) Both assertion and reason are true but reason is not the correct explanation of assertion

(*c*) Assertion is true but reason is false

(*d*) Assertion is false and reason is true

14. Which of the following charge is possible on object

(*a*) 24×10^{-18} C (*b*) 0.1 C

(*c*) 0.1 e (*d*) 32×10^{-20}C

15. Which of the following charge is possible :

(*a*) $\frac{1C}{100}$ (*b*) $\frac{1e}{50}$

(*c*) 4.8×10^{-21} C (*d*) 1.56×10^{-15} C

16. Which of the following charge is not possible?

(*a*) 14.4×10^{-19} (*b*) 64×10^{-20}

(*c*) 3.2×10^{-20} (*d*) 1678×10^{-14} C

17. Charge developed on the body if 10 e^- is removed from that body

18. Charge on α-particle is

(*a*) 4.8×10^{-19} C (*b*) 1.6×10^{-19} C

(*c*) 3.2×10^{-19} C (*d*) 6.4×10^{-19} C

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19. Find no of electron removed from body to charge it by + 1C.

20. When 10^{14} electrons are removed from a neutral metal sphere, then the charge on the sphere becomes

(*a*) 16 μC (*b*) –16 μC
(*c*) 32 μC (*d*) –32 μC

21. A glass rod is rubbed with a silk cloth. The glass rod acquires a charge of 19.2×10^{-19}C. Find the number of electrons lost by glass rod.

22. A conductor has 14.4×10^{-19}C positive charge. The conductor has (charge on electron = 1.6×10^{-19} C)

(*a*) 9 electrons in excess (*b*) 27 electrons in short
(*c*) 27 electrons in excess (*d*) 9 electrons in short

23. Charge on a body is –1 PC then find excess e^- given to that object. Also find mass of extra electron given to that charge during charging.

24. If 10^{10} electron are acquired by a body per sec then find time in which body will get total charge 1C ?

25. If body is loosing 10^4 electron per sec. Then find charge on a body after 2 days on that body

26. Find total charge on 5kg electrons.

27. Which of the following is correct regarding electric charge?

(i) If a body is having positive charge, i.e., shortage of electrons
(ii) If a body is having negative charge i.e., excess of electrons
(iii) Minimum possible charge = $\pm 1.6 \times 10^{-19}$ C
(iv) Charge is quantized, i.e., Q = ± ne, where n = 1, 2, 3, 4, ...

(*a*) Both (i) and (ii) (*b*) Both (ii) and (iii)
(*c*) (i), (ii), (iii) (*d*) All of these

28. Speed of a charged body is decreasing continuously then its charge and specific charge will

(*a*) Increase decrease (*b*) same, increase
(*c*) same, decrease (*d*) same

Properties of Electric Charge

29. Which of the following is not true about electric charge?

(*a*) Charge is a scalar quantity
(*b*) Charge on an isolated system is always conserved
(*c*) A particle having nonzero rest mass can have zero charge
(*d*) A particle having zero rest mass can have non-zero charge

30. Which of the following is not true about electric charge?

(*a*) Charge on a body is always integral multiple of certain charge known as charge of electron
(*b*) Charge is a scalar quantity
(*c*) Net charge on an isolated system is always conserved
(*d*) Charge can be converted into energy and energy can be converted into charge

31. Select the correct statement about electric charge

(*a*) Charge can be converted into energy and energy can be converted into charge
(*b*) Charge of a particle increases with increase in its velocity
(*c*) Charge on a body Is always integral multiple of a certain charge called charge of electron
(*d*) Charge on a a body is always positive or zero

32. Identify incorrect statements for electric charge *q*:-

(*a*) Quantised (*b*) Conserved
(*c*) Additive (*d*) Non-transferable

Conductors and Insulators

33. If a solid and a hollow conducting sphere have same radius then

(*a*) Hollow sphere will hold more maximum charge
(*b*) Solid sphere will hold more maximum charge
(*c*) Both the spheres will hold same maximum charge
(*d*) Both the sphere can't hold charge

34. If an object made of substance A rubs an object made of substance B, then A becomes positively charged and *B* becomes negatively charged, If. however, an object made of substance A is rubbed against an object made of substance C. then A becomes negatively charged. What will happen if an object made of substance B is rubbed against an object made of substance C?

(*a*) B becomes positively charged and C becomes positively charged.
(*b*) B becomes positively charged and C becomes negatively charged.
(*c*) B becomes negatively charged and C becomes positively charged.
(*d*) B becomes negatively charged and C becomes negatively charged.

35. Two metallic spheres of radii 1 cm and 3 cm are given charges of -1×10^{-2}C and 5×10^{-2}C, respectively. If these are connected by conducting wire, the final charge on the bigger sphere is :

(*a*) 4×10^{-2} C (*b*) 1×10^{-2} C
(*c*) 2×10^{-2} C (*d*) 3×10^{-2} C

36. Two sphere of Radius R and 4R having charge 15C and –5C respectively, if they are placed in contact then find final charge on each sphere.

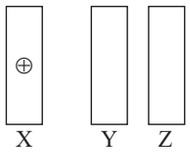
37. When three identical sphere X, Y and Z having charge Q, –2Q and 3Q respectively. At first X and Y are in contact then Y and Z are in contact then final charge on X, Y and Z will be

(*a*) $\frac{Q}{2}, \frac{3Q}{2}, \frac{Q}{2}$ (*b*) $\frac{-Q}{2}, \frac{5Q}{4}, \frac{+5Q}{4}$
(*c*) *Q*, *Q*, *Q* (*d*) $\frac{Q}{2}, \frac{3Q}{2}, \frac{-Q}{2}$

38. If point charge is placed vary near to the uncharged conducting sphere then net charge induced on sphere is

(*a*) Zero (*b*) +ve
(*c*) –ve (*d*) can't say

39. Identify nature of force between body X and Y and Y and Z (Y and Z are neutral)



(*a*) Attract, repel (*b*) repel, attract
(*c*) repel, repel (*d*) attract, attract

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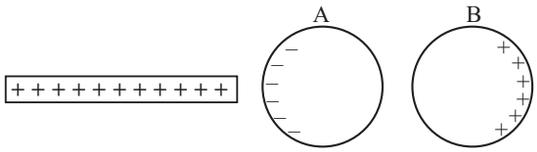
40. Electric charges A and B repel each other. Electric charges B and C also repel each other. If A and C are held close together they will

(*a*) attract
(*b*) repel
(*c*) not affect each other
(*d*) More information is needed to answer

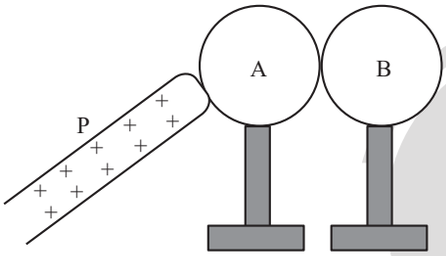
41. As shown in the figure if rod is placed vary near to the sphere but not in contact then



Not in contact

(*a*) Both become +ve (*b*) Both become -ve
(*c*) A is +ve but B is –ve (*d*) A is –ve but B is +ve

42. Two uncharged metal sphere placed in contact as shown in figure and A positive charged rod placed in contact with A, then charge on A and B will be



(*a*) Both become +ve (*b*) Both become -ve
(*c*) A is +ve but B is –ve (*d*) DA is –ve but B is +ve

43. **Assertion:** When bodies are charged through friction, there is transfer of charge from one body to another. No charge is created or destroyed.

Reason: This is according to the law of conservation of electric charge

(*a*) Both assertion and reason are true and reason is the correct explanation of assertion
(*b*) Both assertion and reason are true but reason is not the correct explanation of assertion
(*c*) Assertion is true but reason is false
(*d*) Assertion is false and reason is true

44. **Assertion:** Charging is due to transfer of electrons

Reason: Mass of a body decreases slightly when it is negatively charged

(*a*) Both assertion and reason are true and reason is the correct explanation of assertion
(*b*) Both assertion and reason are true but reason is not the correct explanation of assertion
(*c*) Assertion is true but reason is false
(*d*) Assertion is false and reason is true

Gold Leaf Electroscope

45. What is the application of a gold leaf electroscope?

(*a*) To measure temperature
(*b*) To detect charge and identify its nature
(*c*) To determine pressure
(*d*) To identify the mass of an object

46. When *a* + 20 C rod is touched to the knob, the deflection of leaves was 5°, and when an identical rod of –40 C is touched, the deflection was found to be 9°. If an identical rod of +30 C is touched, then the deflection may be :

(*a*) 0 (*b*) 2°
(*c*) 7° (*d*) 11°

47. A glass rod rubbed with silk is touched with the disc of a negatively charged gold leaf electroscope. The divergence of leaves will

(*a*) decreases
(*b*) increases
(*c*) remain uncharged
(*d*) first decreases and then increase

48. A gold leaf electroscope is given a positive charge so that its leaves diverge. How is the divergence of leaves affected, when a glass rod rubbed with silk is rolled on the disc of electroscope?

(*a*) divergence increases (*b*) divergence decreases
(*c*) divergence remains same (*d*) can't say

49. If a perform these steps one by one.

(i) A positively charged rod is brought closer to initially uncharged knob

(ii) Then the positively charged rod is touched to the knob

(iii) Now the +vely charged rod is removed, and a negatively charged.

Rod of same magnitude is brought closer at same distance In which case, the leaves will converge (come closer), as compared to the previous state ?

(*a*) (i) (*b*) (i) and (iii)
(*c*) only (iii) (*d*) In all cases, the leaves diverge

50. A charged gold leaf electroscope has its leaves apart by a certain amount of having enclosed air. When the electroscope is subjected to X-rays, then the leaves:

(*a*) Further dilate (*b*) Start oscillating
(*c*) Collapse (*d*) Remain unaltered

Coulomb's Law : Electrostatic Force

51. Find minimum electrostatic force between two electrons (1.6×10^{-19}C) places at 1m distance?

52. Two proton placed at *r* distance then find ratio of electrostatic to gravitational force acting between them?

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53. F_g and F_e represents gravitational and electrostatic force respectively between g electrons situated at a distance 10 cm. The ratio of F_g/F_e is of the order of:

(*a*) 10^{42} (*b*) 10
(*c*) 1 (*d*) 10^{-43}

54. Two point charge separated by a distance r repel each other with a force of 64 N, if distance between them becomes 4-times and each charges becomes double then new force between them will be.

55. Coulomb's law can be used to calculate the free electrons between the charged particles at rest.

(*a*) Ture (*b*) False

56. Two charge of 1 nC are at distance 3 cm apart in vacuum, then the force between them is

57. Two sphere of radius in the radio 1: 2 having equal and opposite charges exert a force F, now they placed in contact and again placed at previous position then new force acting on them will be?

(*a*) F (*b*) F/2
(*c*) 2F (*d*) Zero

58. The charge on two sphere is 8C and –4C respectively they experience a force F, if each charge is given –4C on each sphere then new force between them is

(*a*) F (*b*) F/2
(*c*) F/4 (*d*) 2F

59. Two point charges repel each other with a force of 100 N. One of the charges is increased by 10% and other is reduced by 10%. Then new force of repulsion at the same distance would be :

(*a*) 99 N (*b*) 121 N
(*c*) 100 N (*d*) 110 N

60. Two point charges A and B, having charges +Q and -Q respectively, are placed at certain distance apart and force acting between them is F. If 25% charge of A is transferred to B, then force between the charges becomes

(*a*) $\frac{4F}{3}$ (*b*) F
(*c*) $\frac{9F}{16}$ (*d*) $\frac{16F}{9}$

61. Two charge +6C and +4C are placed at some distance then force between them is 10 N now, –4C charge given to each sphere then force between them becomes.

62. Force between two charge body having charge 8C and -4C is F if they touched and Placed at same distance then force between them becomes

(*a*) *F* (*b*) *F*/8
(*c*) *F*/4 (*d*) 2*F*
(*e*) ये दुख खत्म क्यूँ नहीं होता

63. Two small conducting sphere having charge 8C and –2C respectively and placed at distance *R*, then force between them is F_1, if they are brought in contact and separated to the same distance then force F_2 then ratio of F_1: F_2 is

64. Force between two identical spheres charged with same charge is F. If 50% charge of one sphere is transferred to the other sphere then the new force will be...

65. Two charges +2C and +6 C are repelling each other with a force of 12 N. If each charge is given –2 C of charge, then the value of the force will be:

(*a*) 4 N (attractive) (*b*) 4 N (repulsive)
(*c*) 8 N (repulsive) (*d*) zero

66. A charge q is to be divided on two small conducting spheres. What should be the value of charges on the spheres so that when placed at a certain distance apart, the repulsive force between them is maximum?

(*a*) $\frac{q}{4}$ and $\frac{3q}{4}$ (*b*) $\frac{q}{2}$ and $\frac{q}{2}$
(*c*) $\frac{q}{3}$ and $\frac{q}{3}$ (*d*) $\frac{q}{4}$ and $\frac{q}{4}$

67. Two positive ions, each carrying a charge q, are separated by a distance d. If F is the force of repulsion between the ions, the number of electrons missing from each ion will be (e being the charge on an electron)

(*a*) $\frac{4\pi\varepsilon_0 Fd^2}{e^2}$ (*b*) $\sqrt{\frac{4\pi\varepsilon_0 Fe^2}{d^2}}$
(*c*) $\sqrt{\frac{4\pi\varepsilon_0 Fd^2}{e^2}}$ (*d*) $\frac{4\pi\varepsilon_0 Fe^2}{q^2}$

68. A particle of mass m and carrying charge $-q_1$ is moving around a charge $+q_2$ along a circular path of radius *r*. Find period of revolution of the charge $-q_1$

(*a*) $\sqrt{\frac{16\pi^3\varepsilon_0 mr^3}{q_1q_2}}$ (*b*) $\sqrt{\frac{8\pi^3\varepsilon_0 mr^3}{q_1q_2}}$
(*c*) $-\sqrt{\frac{q_1q_2}{16\pi^3\varepsilon_0 mr^3}}$ (*d*) Zero

69. Two point object having equal mass & equal and opposite charge q moving on circular path due to their mutual electrostatic force then find their speed ?

70. Two identical spheres are given equal charges in one case & opposite charge in another case having force F_1 & F_2 respectively. Distance between spheres is not large as compare to diameter then compare F_1 & F_2.

(*a*) $F_1 > F_2$
(*b*) $F_1 = F_2$
(*c*) $F_1 < F_2$
(*d*) Information is not sufficient to draw the conclusion

71. Suppose the charge of a proton and an electron differ slightly. One of them is –e, the other is ($e + \Delta e$). If the net of electrostatic force and gravitational force between two hydrogen atoms placed at a distance *d* (much greater than atomic size) apart is zero, then Δe is of the order of [Given mass of hydrogen m_h = underline 1.67 × 10^{-27} kg]

(*a*) 10^{-23} C (*b*) 10^{-37} C
(*c*) 10^{-47} C (*d*) 10^{-20} C

72. A rod of length *L* and linear charge density λ is placed along *x*-axis and a point charge *q* is placed and distance '*a*' from one end then find force on rod due to this point charge.

73. If two charges q_1 and q_2 are separated with distance '*d*' and placed in a medium of dielectric constant *K*. What will be the equivalent distance between charges in air for the same electrostatic force?

(*a*) $d\sqrt{k}$ (*b*) $1.5d\sqrt{k}$
(*c*) $k\sqrt{d}$ (*d*) $2d\sqrt{k}$

74. Force between two point charges q_1 and q_2 placed in vacuum at '*r*' cm apart is *F*. Force between them when placed in a medium having dielectric constant K = 5 at '*r*/5' cm apart will be:

(*a*) 5F (*b*) 25F
(*c*) F/5 (*d*) F/25

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75. Two identical charged particles each having a mass 10g and charge 2×10^{-7} C are placed on a horizontal table with separation of L between them such that they stay in limited equilibrium. If coefficient of friction between each particle and table is 0.25, find value of L

(*a*) 12 cm (*b*) 10 cm

(*c*) 8 cm (*d*) 5 cm

76. **Assertion A:** Coloumb's law is valid only for point charges and spherical symmetry.

Reason R: Electrostatic force is conservative in nature

(*a*) A is true but R is false

(*b*) A is false but R is true

(*c*) Both A and R are true but R is not the correct explanation of A

(*d*) Both A and R are true and R is the correct explanation of A

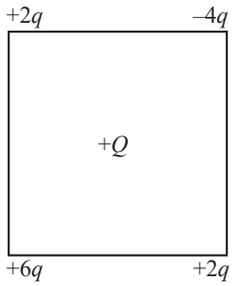
77. A particle having charge q_1 exert force F on charge q_2, If a particle having charge $-2q_1$ is placed midway between the line then new force will be on q_2

(*a*) 4F (*b*) 2F

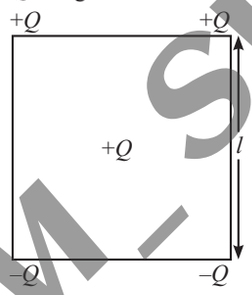
(*c*) 6F (*d*) 7F

78. Four identical charge Q placed at the corner of square then find net force on 5th charge at centre due to all four charges

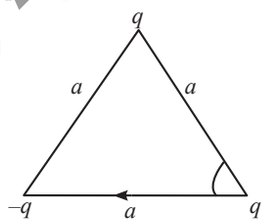
79. Find net force on $+Q$ charge which is at centre of square of length l.



80. Find net force on Q charge which is at centre of square of length l.



81. Find force on $+q$ charge due to other two charge

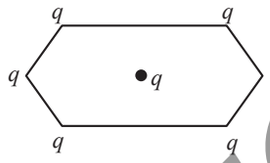


(*a*) $\frac{\sqrt{3}Kq^2}{a^2}$ (*b*) $\frac{Kq^2}{a^2}$

(*c*) Zero (*d*) $\frac{2Kq^2}{a^2}$

82. Four point charge $+Q$ placed on the corner of square of length l then find net electrostatic force on any one charge due to remaining three charges

83. Find net force on charge q which is at centre of hexogonal of side length l.

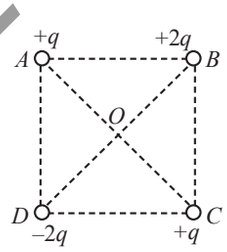


(*a*) $\frac{5Kq^2}{l^2}$ (*b*) $\frac{Kq^2}{l^2}$

(*c*) $\frac{2Kq^2}{l}$ (*d*) Zero

Connected Body Motion

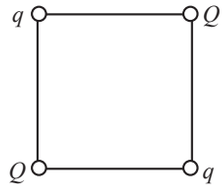
84. Four charges are arranged at the corners of a square $ABCD$, as shown in the adjoining figure. The force on the charge kept at the centre 0 is:



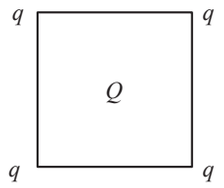
(*a*) Zero (*b*) Along the diagonal AC

(*c*) Along the diagonal BD (*d*) Perpendicular to side AB

85. Find relation between 'q' and 'Q' so that force on Q is zero.



86. Find value of Q so that force on charge q is zero which is at corner of square of figure.



87. Find force on q charge which is at origin due to all other charges

q_0	q	q	q	q	upto infinity
(0,0)	(1,0)	(2,0)	(4,0)	(8,0)	(16,0) soon

88. Find force on q charge which is at origin due to all other charges

q_0	$+q$	$-q$	$+q$	$-q$	upto infinity
(0,0)	(1,0)	(2,0)	(4,0)	(8,0)	(16,0) soon

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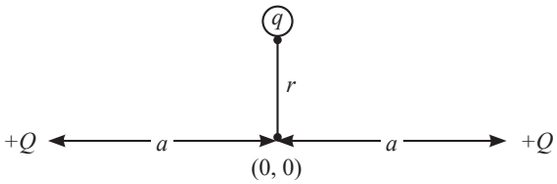
89. Two equally charged, identical metal spheres A and B repel each other with a force 'F'. The spheres are kept fixed with a distance 'r' between them. A third identical, but uncharged sphere C is brought in contact with A and then placed at the mid- point of the line joining A and B. The magnitude of the net electric force on C is

(*a*) F (*b*) $3F/4$

(*c*) $F/2$ (*d*) $F/4$

90. Find force on 'q' due to two $+Q$ charge as shown in figure.



91. A neutral bubble made of soap solution has radius R. If some negative charge is given which gets distributed uniformly on the surface of the bubble, the radius of the bubble becomes R' then

(*a*) $R' > R$ (*b*) $R' = R$

(*c*) $R' < R$ (*d*) $R' = 0.5\,R$

Coulomb's Law in Vector Form

92. Find force applied by 2C charge which is at (2, 3, 4) on 5C charge which is at (5, 7, 9)

93. Find force on $-3C$ charge at (2, 0, 4) due to $4C$ charge which is at (5, 4, 4).

94. An electron is moving round the nucleus of a hydrogen atom in a circular orbit of radius r. The Coulomb force $\vec{F}$ on the electron is:

(*a*) $K\dfrac{e^2}{r^2}\hat{r}$ (*b*) $-K\dfrac{e^2}{r^2}\hat{r}$

(*c*) $K\dfrac{e^2}{r^3}\hat{r}$ (*d*) $-K\dfrac{e^2}{r^3}\hat{r}$

Superposition Theorem

95. Electrostatic force on charge does not depends on medium.

(*a*) True (*b*) False

96. Electric force on one charge due to other charge does not depends on medium or presence of other charge

(*a*) True (*b*) False

97. **Statement I:** Electrostatic force on q_2 due to q_1 doesn't depend upon medium.

Statement II: Net electrostatic force on q_2 depends upon medium but not on presence of other charges.

(*a*) I is true but II is false

(*b*) I is false but II is true

(*c*) Both I and II are true but II is not the correct explanation of I

(*d*) Both I and II are true and II is the correct explanation of I

98. Two point charge placed on straight line as shown figure. Then find position of 3rd charge q, so that force on q will be zero.

$+Q \longleftarrow r \longrightarrow -nQ$

99. Find location of 3rd charge so that force on 3rd charge will be zero.

$A\bullet\ +Q \longleftarrow \overset{B}{\bullet} \longrightarrow -5Q\ \bullet C$

(*a*) A (*b*) B

(*c*) C (*d*) A & C

100. Find position of 3rd charge q in a given system so that net force exercised by q is zero.

$+Q \longleftarrow r \longrightarrow +nQ$

101. Find position of 3rd charge q so that force on q will be zero.

(*i*) $Q \longleftarrow 10\text{m} \longrightarrow +16Q$

(*ii*) $+3Q \longleftarrow 30\text{m} \longrightarrow 27Q$

(*iii*) $25Q \longleftarrow 20\text{m} \longrightarrow 16Q$

(*iv*) $-4Q \longleftarrow 10\text{m} \longrightarrow -8Q$

102. Find position of 3rd charge so that force on 3rd charge will be zero.

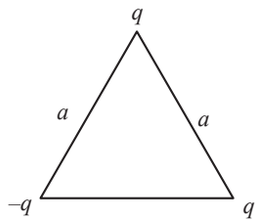
$25Q \longleftarrow 6\text{m} \longrightarrow -9Q$

103. Find position of 3rd charge so that force on 3rd charge will be zero.?

(*i*) $-Q \longleftarrow r = 10\text{ m} \longrightarrow -4Q$

(*ii*) $-2Q \longleftarrow r = 10\text{ m} \longrightarrow +8Q$

104. Find force on $+q$ charge due to other two charge.



(*a*) $\dfrac{\sqrt{3}Kq^2}{a^2}$ (*b*) $\dfrac{Kq^2}{a^2}$

(*c*) Zero (*d*) $\dfrac{2Kq^2}{a^2}$

105. Nature of equilibrium of $-q$ charge placed at mid of two $+Q$ charge

$+Q$ ---------- $-q$ ---------- $+Q$

106. Nature of equilibrium of $-q$ charge placed at mid of two $+Q$ charge

$+Q$ ---------- $-q$ ---------- $+Q$

107. Consider two identical charges placed at distance $2d$ apart. The $-q$ charge placed at centre of line joining two charges. Which of the following is not incorrect statement?

(*a*) The $-q$ charge is not in equilibrium

(*b*) $-q$ charge will oscillate if it is displaced slightly along x-axis

(*c*) $-q$ charge will oscillate if it is displaced slightly along y-axis

(*d*) The $-q$ charge is in stable equilibrium along x-axis

Pendulum Problem

108. Two pith balls carrying equal charges are suspended from a common point by strings of equal length, the equilibrium separation between them is r. Now the strings are rigidly clamped

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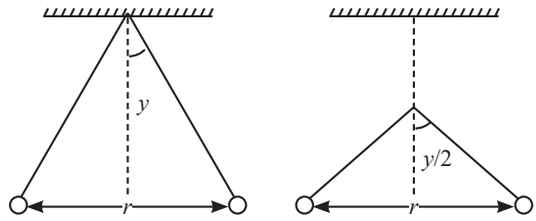
at half the height. The equilibrium separation between the balls now become

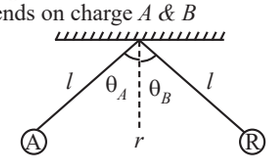


(*a*) $\left(\frac{2r}{3}\right)$ (*b*) $\left(\frac{1}{\sqrt{2}}\right)^2$

(*c*) $\left(\frac{r}{\sqrt[3]{2}}\right)$ (*d*) $\left(\frac{2r}{\sqrt{3}}\right)$

109. **Assertion A:** In the given figure, $\theta_A = \theta_B$ even if $Q_A > Q_B$ (provided $m_A = m_B$)

Reason R : Angle of deflection of one individual particle *A* or *B* does not depends on charge *A* & *B*



(*a*) A is true but R is false

(*b*) A is false but R is true

(*c*) Both A and R are true but R is not the correct explanation of A

(*d*) Both A and R are true and R is the correct explanation of A

110. The magnitude of electric field strength *E* such that an electron placed in it would experience an electric force equal to its weight is given by

(*a*) *mge* (*b*) $\frac{mg}{e}$

(*c*) $\frac{e}{mg}$ (*d*) $\frac{e^2}{mg}$

111. The magnitude of force exerted by a uniform electric field on an electron having mass m_e and proton of mass m_p are represented as F_e and F_p respectively are related as

(*a*) $F_p = F_e$ (*b*) $\frac{F_e}{F_p} = \frac{m_e}{m_p}$

(*c*) $\frac{F_e}{F_p} = \frac{m_p}{m_e}$ (*d*) $\frac{F_e}{F_p} = \frac{m_p}{m_e}$

112. **Statement I:** Force experienced by unit charge (+ or –) is called electric field intensity.

Statement II: Electric field can form closed loop.

(*a*) Both correct

(*b*) Both incorrect

(*c*) Both I and II are true but II is not the correct explanation of A

(*d*) Both I and II are true and II is the correct explanation of A

113. The electric field at a point is:

(*a*) Always continuous X

(*b*) Continuous if there is no charge at that point

(*c*) Discontinuous only if there is a negative charge at the pointX

(*d*) Discontinuous if there is a charge at that pointy

(*a*) (a, b) (*b*) (b, d)

(*c*) (c, d) (*d*) (a, d)

114. Electric field inside conductor must be zero.

(*a*) True (*b*) False

115. The electrostatic field due to a charged conductor just outside the conductor is:

(*a*) zero and parallel to the surface at every point inside the conductor

(*b*) zero and is normal to the surface at every point inside the conductor

(*c*) parallel to the surface at every point and zero inside the conductor

(*d*) normal to the surface at every point and zero inside the conductor

116. In a metallic conductor, under the effect of applied electric field, the free electrons of the conductor:

(*a*) Move in the straight line paths in the same direction

(*b*) Move with the uniform velocity throughout from lower potential to higher potential

(*c*) Drift from higher potential to lower potential

(*d*) Move in the curved paths from lower potential to higher potential

117. **Assertion:** In a cavity in a conductor, the electric field is zero

Reason: Charges in a conductor reside only at its surface

(*a*) Both assertion and reason are true and reason is the correct explanation of assertion

(*b*) Both assertion and reason are true but reason is not the correct explanation of assertion

(*c*) Assertion is true but reason is false

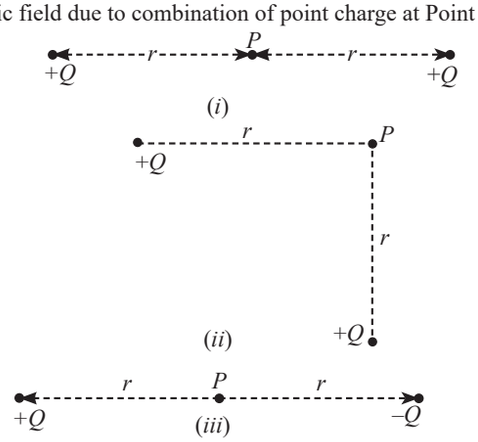
(*d*) Assertion is false and reason is true

118. The electric field inside a conductor in electrostatic equilibrium is zero

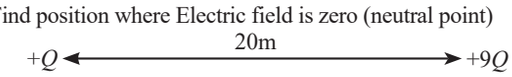
(*a*) True (*b*) False

Combination of Point Charges

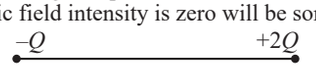
119. Electric field due to combination of point charge at Point *P*



120. Find position where Electric field is zero (neutral point)



121. Charge 2Q and –*Q* are placed as shown in figure. The point at which electric field intensity is zero will be somewhere



(*a*) Between –*Q* and 2*Q*

(*b*) On the left of –*Q*

(*c*) On the right of 2*Q*

(*d*) On the perpendicular bisector of line joining the charges

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122. A point charge of 10 μC is placed at the origin. At what location on the x-axis should a point charge of 40 μC be placed so that the net electric field is zero at x = 2 cm on the x-axis?

(*a*) x = 6 cm (*b*) x = 8 cm

(*c*) x = 4 cm (*d*) x = –4 cm

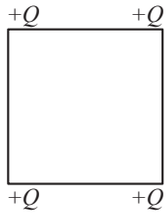
123. Two point charges of +16 μC and –9μC are placed 8 cm apart in air. Determine the position of the point from +16μC charge at which the resultant electric field is zero.

124. The distance between the two charges 25 μC and 36 μC is 11 cm. At what point on the line joining the two charges the intensity will be zero at a distance of

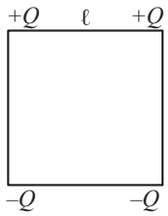
(*a*) 4 cm from 36 μC (*b*) 4 cm from 25 μC

(*c*) 5 cm from 36 μC (*d*) 5 cm from 25 μC

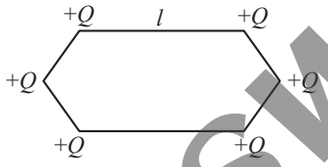
125. Find the electric field at the centre of square.



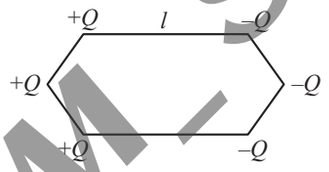
126. Field at centre?



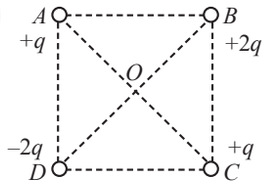
127. Find electric field at the centre.



128. Find electric field at the centre.



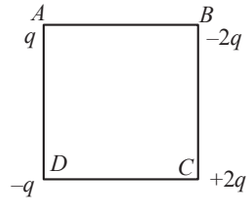
129. Four charges are arranged at the corners of a square $ABCD$, as shown in the adjoining figure. The force on the charge kept at the centre O is:



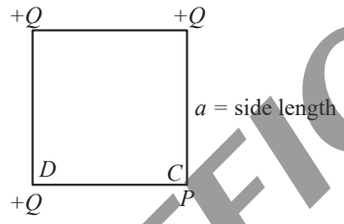
(*a*) Zero (*b*) Along the diagonal AC

(*c*) Along diagonal BD (*d*) Perpendicular to side AB

130. Four charges are placed on corners of a square as shown in figure having side 10 cm. If q is 1 μC then what will be electric field intensity at the centre of the square?



131. Find electric field at 'P'



132. A charge Q is placed at the centre of a square. If electric field intensity due to the charge at the corners of the square is E_1 and the intensity at the mid point of the side of square is E_2, then the ratio of E_1/E_2 will be

(*a*) $\frac{1}{2\sqrt{2}}$ (*b*) $\sqrt{2}$

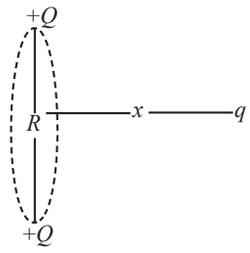
(*c*) $\frac{1}{2}$ (*d*) 2

133. 7 Point charge placed at the corner of cube find electric field at centre of cube.

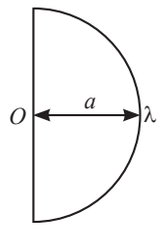
Electric Field Due to Ring

134. Electric field due to ring of radius R on the axis of ring is maximum at a distance of

135. Find value of x so that force on q will be maximum?



136. Electric field at centre O of semicircle of radius a having linear charge density λ given by



(*a*) $\frac{2\lambda}{\varepsilon_0 a}$ (*b*) $\sqrt{2}$

(*c*) $\frac{\lambda}{2\pi\varepsilon_0 a}$ (*d*) $\frac{\lambda}{\pi\varepsilon_0 a}$

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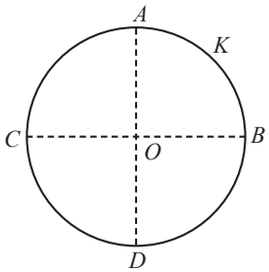
137. A thin conducting ring of radius R is given a charge $+Q$. The electric field at the centre O of the ring due to the charge on the part AKB of the ring is E. The electric field at the centre due to the charge on the part $ACDB$ of the ring is:



(*a*) 3E along OK (*b*) 3E along KO

(*c*) E along OK (*d*) E along KO

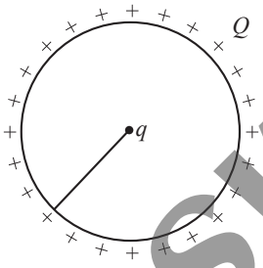
138. A positive charge Q is uniformly distributed along a circular ring of radius R, A small test charge q is placed at the centre of the ring. Then,

(*a*) If $q > 0$ and is displaced away from the centre in the plane of the ring, it will be pushed back towards the centre

(*b*) If $q < 0$ and is displaced away from the centre in the plane of the ring, it will never return to the centre and will continue moving till it hits the ring.

(*c*) If $q < 0$, it will perform SHM for small displacement along the axis.

(*d*) q at the centre of the ring is in an unstable equilibrium within the plane of the ring for $q > 0$.



(*a*) (*a*, *b*, *c*) (*b*) (*a*, *c*, *d*)

(*c*) (*b*, *c*, *d*) (*d*) (*c*, *d*)

Electric Field Lines

139. Field-lines are always perpendicular at the surface of a conductor but they never enter inside the conductor because there is no electrostatic field inside the material of a conductor.

(*a*) True (*b*) False

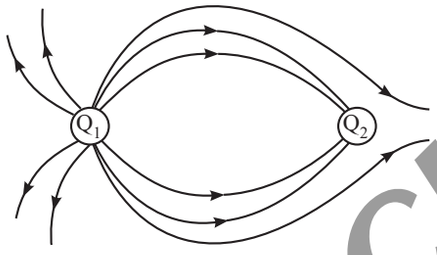
140. The tangent at any point of a field-line gives the direction of the force on a positive charge at that point.

(*a*) True (*b*) False

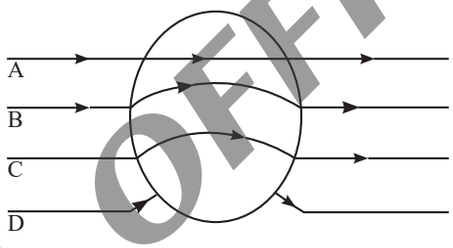
141. Electric field lines always start on positive charges and end on negative charges

(*a*) True (*b*) False

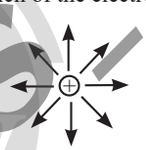
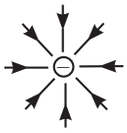
142. Looking at the various electric lines of forces between charges Q_1 and Q_2, find the value of Q_1/Q_2-

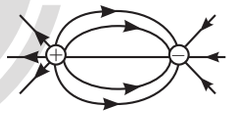


143. A solid metallic sphere is placed in a uniform electric field. Which of the lines A, B, C and D shows the correct path and why?

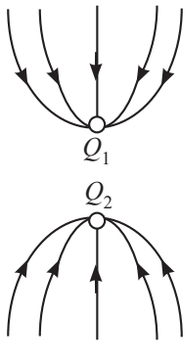


144. Which of the electrostatic lines of forces are correctly drawn ?

(*a*)  (*b*) 

(*c*)  (*d*) All of these

145. The figure shown is a plot of electric field lines due to two charges Q_1 and Q_2. The sign of charges is



(*a*) Both negative

(*b*) Q_1 positive and Q_2 negative

(*c*) Both positive

(*d*) Q_1 negative and Q_2 positive

146. The figure shows electric field lines. If E_A and E_B are electric field at A and B and distance AB is r, then

(*a*) $E_A > E_B$ (*b*) $E_A = E_B/r$

(*c*) $E_A < E_B$ (*d*) $E_A = E_B/r^2$

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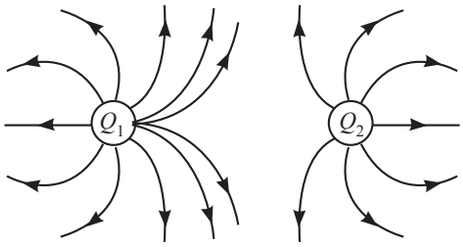
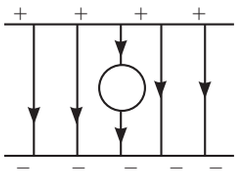
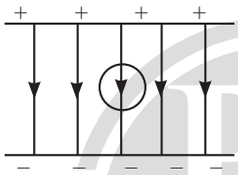
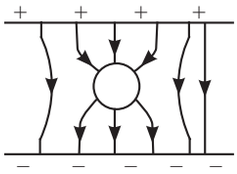
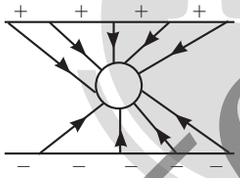
147. Figure shows electric lines of forces due to charges Q_1 and Q_2. Hence



(*a*) Q_1 and Q_2 both are negative
(*b*) Q_1 and Q_2 both are positive
(*c*) $Q_1 > Q_2$
(*d*) Both (*b*) and (*c*)

148. An uncharged sphere of metal is placed in a uniform electric field produced by two oppositely charged plates. The lines of force will appear as

(*a*)

(*b*)

(*c*)

(*d*)


149. Electric field lines are also called electrostatic force line.
(*a*) True (*d*) False

150. **Assertion:** Electric lines of force cross each other.
Reason: The resultant electric field at a point is the superimposition of the electric field at that point.
(*a*) Both assertion and reason are true and reason is the correct explanation of assertion
(*b*) Both assertion and reason are true but reason is not the correct explanation of assertion
(*c*) Assertion is true but reason is false
(*d*) Assertion is false and reason is true

151. If the number of electric lines of force emerging out of a closed surface is 1000, then the charge enclosed by the surface is
(*a*) 8.854×10^{-9} C (*b*) 8.854×10^{-4} C
(*c*) 8.854×10^{-1} C (*d*) 8.854 C

Motion of Charged Particle in Uniform Electric Field

152. When charge particle moves in the direction of electric field its speed will Increase?
(*a*) True (*b*) False

153. A proton of mass '*m*' charge '*e*' is released from rest in a uniform electric field of strength '*E*'. The time taken by it to travel a distance '*d*' in the field is
(*a*) $\sqrt{\frac{2de}{mE}}$ (*b*) $\sqrt{\frac{2dm}{Ee}}$
(*c*) $\sqrt{\frac{2dE}{me}}$ (*d*) $\sqrt{\frac{2Ee}{dm}}$

154. An electron falls from rest through a vertical distance *h* in a uniform and vertically upward directed electric field *E*. The direction of electric field is now reversed, keeping its magnitude the same. A proton is allowed to fall from rest in it through the same vertical distance *h*. The time of fall of the electron, in comparison to the time of fall of the proton is
(*a*) Smaller (*b*) 5 times greater
(*c*) Equal (*d*) 10 times greater

155. If electron and proton released in electric field find ratio of momentum after time '*t*'.

156. Deuteron and alpha particle thrown in opposite direction of electric field with same momentum at same time then find ratio of time when they will stop.
(*a*) 1 : 1 (*b*) 2 : 1
(*c*) 1 : 2 (*d*) 4 : 1

157. If electron and proton are released in electric field then find ratio of K.E. after distance *x*

158. A particle of mass m and charge *q* is placed at rest in a uniform electric field *E* and then released. The kinetic energy attained by the particle after moving *a* distance *y* is
(*a*) qEy (*b*) qE^2y
(*c*) qEy^2 (*d*) q^2Ey

159. A mass m carrying a charge *q* is suspended from a string and placed in a uniform horizontal electric field of intensity *E*. The angle made by the string with the vertical in the equilibrium position is
(*a*) $\theta = \tan^{-1}\frac{mg}{Eq}$ (*b*) $\theta = \tan^{-1}\frac{m}{Eq}$
(*c*) $\theta = \tan^{-1}\frac{Eq}{m}$ (*d*) $\theta = \tan^{-1}\frac{Eq}{mg}$

160. A positively charged pendulum is oscillating in a uniform electric field pointing upwards. Its time period as compared to that when it oscillates without electric field
(*a*) Is less (*b*) Is more
(*c*) Remains unchanged (*d*) Starts fluctuating

161. A particle of mass m and charge *q* is thrown at a speed *u* against a uniform electric field *E*. How much distance will it travel before coming to rest?
(*a*) $mu^2/2qE$ (*b*) $2mu^2/qE$
(*c*) $mqE/2u^2$ (*d*) mu/qE

162. A toy car with charge *q* moves on a frictionless horizontal plane surface under the influence of a uniform electric field $\vec{E}$. Due to the force $q\vec{E}$, its velocity increases from 0 to 6 m/s in one second duration. At that instant the direction of the field is reversed The car continues to move for two more seconds under the influence of this field. The average velocity and the average speed of the toy car between 0 to 3 seconds are respectively
(*a*) 2 m/s, 4 m/s (*b*) 1m / s, 3 m/s
(*c*) 1.5m / s 3 m/s (*d*) 1 m/s, 3.5 m/s

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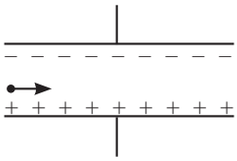
163. In a uniform electric field if a charge is fired in a direction different from the line of electric field then the trajectory of the charge will be a

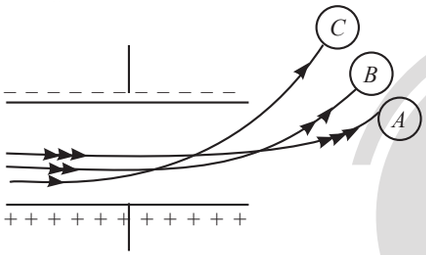
(*a*) Straight line (*b*) Circle
(*c*) Parabola (*d*) Ellipse

164. A proton and an α particle having equal kinetic energy are projected in a uniform transverse electric field as shown in figure



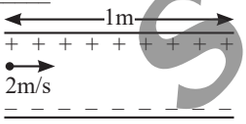
(*a*) Proton trajectory is more curved
(*b*) α particle trajectory is more curved
(*c*) Both trajectories are equally curved but in opposite direction
(*d*) Both trajectories are equally curved and in same direction

165. Three particles are projected in a uniform electric field with same velocity perpendicular to the field as shown. Which particle has highest charge to mass ratio?



(*a*) A
(*b*) B
(*c*) C
(*d*) All have same charge to mass ratio

166. A uniform electric field $E = (8m / e)$ V/m is created between two parallel plates of length 1 m as shown in figure, (where m = mass of electron and e = charge of electron). An electron enters the field symmetrically between the plates with a speed of 2 m/s. The angle of the deviation (θ) of the path of the electron as it comes out of the field will be_____.



(*a*) $\tan^{-1}(4)$ (*b*) $\tan^{-1}(2)$
(*c*) $\tan^{-1}(1/3)$ (*d*) $\tan^{-1}(3)$

167. Proton, deuteron and α-particle projected in electric field. Perpendicular to it, then find ratio of deviation if:

(*i*) Velocity of projection is same
(*ii*) K.E. of projection same
(*iii*) Projected with same momentum

168. A proton is kept at rest. A positively charged particle is released from rest at a distance S in its field. Consider two experiments; one in which the charged particle is also a proton and in another, a positron. In the same time t, the work done on the two moving charged particles is:

(*a*) Same as the same force law is involved in the two experiments
(*b*) Less for the case of a positron, as the positron moves away more rapidly and the force on it weakens
(*c*) More for the case of a positron, as the positron moves a larger distance, away
(*d*) Same as the work is done by a charged particle on the stationary proton

169. An electron enters an electric field with its velocity in the direction of the electric lines of force. Then:

(*a*) the path of the electron will be a circle
(*b*) the path of the electron will be a parabola
(*c*) the velocity of the electron will decrease
(*d*) the velocity of the electron will increase

170. A charge particle is free to move in an electric field. It will travel:

(*a*) Always along a line of force
(*b*) Along a line of force, if its initial velocity is zero
(*c*) Along a line of force, if it has some initial velocity in the direction of an acute angle with the line of force
(*d*) None of the above

171. Electric field line always along the path taken or travelled by the charge placed in electric field.

(*a*) Ture (*b*) False

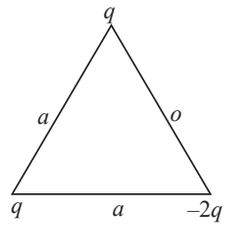
172. Two equal positive charges Q are fixed at points $(a, 0)$ and $(-a, 0)$ on the x-axis. An opposite charge –9 at rest is released from point $(0, a)$ on the y-axis. The charge –9 will

(*a*) Move to infinity
(*b*) Move to origin and rest there
(*c*) Undergo SHM about the origin
(*d*) Execute oscillatory periodic motion but not SHM

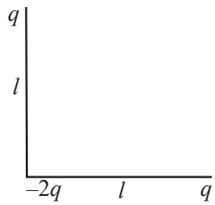
Electric Dipole

173. Find electric dipole moment of system?

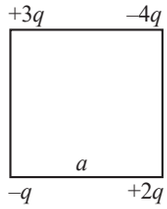
(*i*)



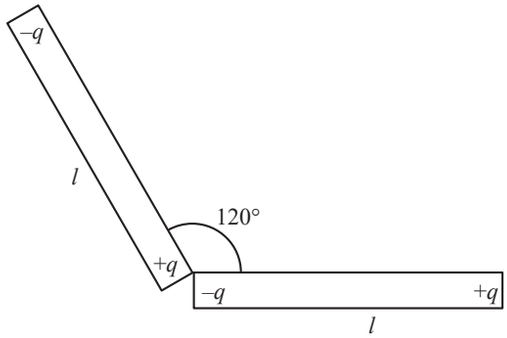
(*ii*)



(*iii*)



174. Find net electric dipole moment?



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175. An electric dipole is kept in non-uniform electric field. It generally experiences

(*a*) A force and torque (*b*) A force but not a torque

(*c*) A torque but not a force (*d*) Neither a force nor a torque

176. Three point charges *q, q* and -2*q* are located at (0, -1, 1), (0, 1, 1) and (0, 0, -1) respectively. The magnitude of electric dipole moment of this charge distribution is :

(*a*) Zero (*b*) q

(*c*) 2q (*d*) 2q

177. .....Will act on an electric dipole if it is placed in a uniform electric field.

(*a*) Force only (*b*) Both torque and force

(*c*) No force but torque (*d*) None of these

178. Which among the following is the dimensional formula of dipole moment?

(*a*) [LTI] (*b*) [L1 T l2]

(*c*) [M2 L2 T 12] (*d*) [L2 T2 1-2]

179. The nature of electric flux from the cube surface, if an electric dipole is placed inside a cube will be?

(*a*) The electric flux will be releasing out of the surface

(*b*) The electric flux will be coming into the surface

(*c*) There will be no flux at all

(*d*) None of these

180. 3 C and -3 C are two equal charges separated by a distance of 4 cm, then calculate the dipole moment of a dipole.

(*a*) 0.12 (*b*) 0.14

(*c*) 0.16 (*d*) 0.18

Electric Field Due to Electric Dipole

181. The electric field due to a short dipole at a distance r, on the axial line, from its mid point is the same as that of electric field at a distance *r*', on the equatorial line, from its mid-point. Determine the ratio *r*/*r*.

182. Two charges of $+25 \times 10^{-9}$ coulomb and -25×10^{-9} coulomb are placed 6 m apart. Find the electric field intensity ratio at points 4 m from the centre of the electric dipole (i) on axial line (ii) on equatorial line

(*a*) $\frac{1000}{49}$ (*b*) $\frac{49}{1000}$

(*c*) $\frac{500}{49}$ (*d*) $\frac{49}{500}$

183. Electric field due to dipole on axial and equatorial line is perpendicular.

(*a*) Ture (*b*) False

184. Find angle from the dipole moment where electric field is perpendicular to the dipole moment.

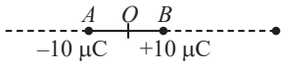
185. Electric field on the axis of dipole must be parallel to electric dipole moment

(*a*) Ture (*b*) False

186. Electric field on the equatorial line must be opposite to the electric dipole moment

(*a*) Ture (*b*) False

187. Two charges ±10 μC are placed 5.0 mm apart. The electric field at a point P on the axis of the dipole 15 cm away from its centre O on the side of the positive charge, as shown in the figure is:



(*a*) 2.7×10^5 NC^{-1} (*b*) 4.13×10^6 NC^{-1}

(*c*) 3.86×10^6 NC^{-1} (*d*) 1.33×10^5 NC^{-1}

188. Two ideal dipoles A and B, having their dipole moment P_1 and P_2 respectively are placed on a plane with their centres at *O* as shown in figure. At point *C* on axis of dipole *A*, resultant electric field is making angle of 37º with axis. Ratio of dipole moment of *A* and *B*, $\frac{P_1}{P_2}$ is:

(*a*) $\frac{3}{8}$ (*b*) $\frac{3}{2}$

(*c*) $\frac{2}{3}$ (*d*) $\frac{4}{3}$

Force Between Two Dipoles

189. The force of interaction between two co-axial short electric dipoles whose centres are *R* distance apart varies as:

(*a*) $1/R$ (*b*) $1/R^2$

(*c*) $1/R^3$ (*d*) $1/R^4$

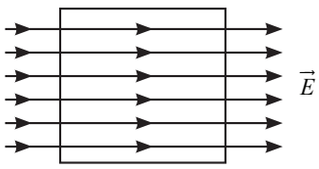
Force Between Point Charge and Electric Dipole

190. The electric force on a point charge situated on the axis of a short dipole is *F*. If the charge is shifted along the axis to double the distance, the electric force acting will be

(*a*) $4F$ (*b*) $\frac{F}{2}$

(*c*) $\frac{F}{4}$ (*d*) $\frac{F}{8}$

191. A square surface of side L metre is in the plane of the paper. A uniform electric field $\vec{\ }$ (volt/m), also in the plane of the paper, is limited only to the lower half of the square surface (see figure). The electric flux in SI units associated with the surface is



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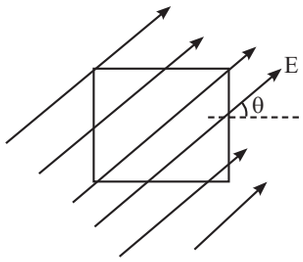
192. A square surface of side L meter in the plane of the paper is placed in a uniform electric field E (volt/m) acting along the same plane at an angle θ with the horizontal side of the square as shown in figure. The electric flux linked to the surface, in units of volt-m, is



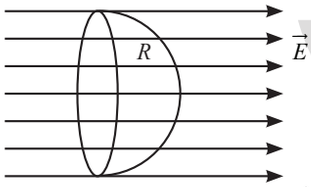
(*a*) Zero (*b*) EL^2
(*c*) $EL^2 \cos\theta$ (*d*) $EL^2 \sin\theta$

193. If an electric field is given by $10\hat{i}+3\hat{j}+4\hat{k}$, calculate the electric flux through a surface of area 10 units lying in *yz*-plane

(*a*) 100 units (*b*) 10 units
(*c*) 30 units (*d*) 40 units

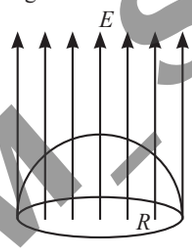
194. Find incoming and outgoing flux through cylinder.

195. The flux through the hemispherical surface in the figure shown below is



(*a*) $\pi R^2 E$ (*b*) $2\pi R^2 E$
(*c*) πRE (*d*) Zero

196. A hemispherical surface of radius R is kept in a uniform electric field E as shown in figure. The flux through the curved surface is



(*a*) $E2\pi R^2$ (*b*) $E\pi R^2$
(*c*) $E4\pi R^2$ (*d*) Zero

197. A cylinder of radius R and length L is placed in a uniform electric field E perpendicular to the cylinder axis. The outward flux over the surface of the cylinder is given by

(*a*) $2\pi R^2 E$ (*b*) $R^2E/2$
(*c*) $2\,RLE$ (*d*) $\pi R^2 E$

198. A rectangular surface of sides 10 cm and 15 cm is placed inside a uniform electric field of 25 V/m, such that the surface makes an angle of 30° with the direction of electric field. Find the flux of the electric field through the rectangular surface

(*a*) 0.1675 N/m² C (*b*) 0.1875 Nm^2/C
(*c*) Zero (*d*) 0.1075 Nm^2/C

199. There is uniform electric field of $8\times10^3\hat{i}$ N/C. What is the net flux (in SI units) of the uniform electric field through a cube of side 0.3 m oriented so that its faces are parallel to the coordinate plane?

(*a*) $2 \times 8 \times 10^3$ (*b*) $0.3 \times 8 \times 10^3$
(*c*) Zero (*d*) $8 \times 10^6 \times 6$

200. An electric field is given by $(6\hat{i}+5\hat{j}+3\hat{k})$ N/C. The electric flux through a surface area $30\hat{i}\ m^2$ lying in *YZ*-plane (in SI unit) is:

(*a*) 60 (*b*) 90
(*c*) 180 (*d*) 150

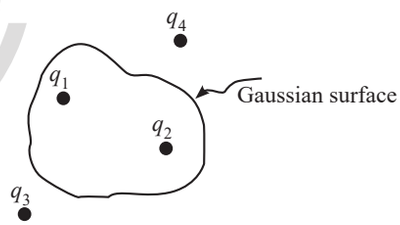
201. Electric flux does not depends on shape of gaussian surface and location of charge inside gaussian surface

(*a*) True (*b*) False

Gauss Law

202. **Assertion A:** Four point charges q_1, q_2, q_3 and q_4 are placed as shown in figure. Flux over the Gaussian surface depends only on q_1 and q_2.

Reason R: Electric field at all points on given Gaussian surface depends on q_1 and q_2 and hence flux also depends only on q_1 and q_2.



(*a*) A is true but R is false
(*b*) A is false but R is true
(*c*) Both A and R are true but R is not the correct explanation of A
(*d*) Both A and R are true and R is the correct explanation of A

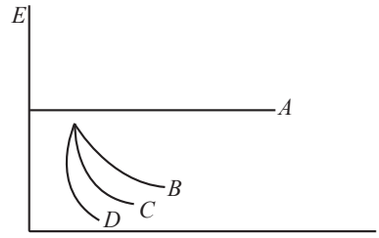
203. Gauss law is always applicable to find electric field.

(*a*) True (*b*) False

204. Surface charge density of sphere is σ then electric field at surface is σ/ε_0.

(*a*) True (*b*) False

205. The graph shown illustrates the variation of the electric field (E) as a function of distance (r) for different types of charge distributions. Four curves are labelled as A, B, C, and D, which correspond to different sources of the electric field. Identify the source of electric field.



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206. If there were only one type of charge in the universe, then:

(*a*) $\oint s\ E.dS \neq 0$ on any surface

(*b*) $\oint s\ E.dS = 0$ if the charge is outside the surface!

(*c*) $\oint s\ E.dS$ could not be defined.

(*d*) $\oint s\ E.dS = \frac{q}{\varepsilon_0}$ if charges of magnitude q were inside the surface.

Choose the correct statement(s).

(*a*) (*a*) and (d) (*b*) (*a*) and (c)

(*c*) (*b*) and (d) (*d*) (*c*) and (d)

207. If flux passing through any closed surface is zero then electric field must be zero inside the surface

(*a*) True (*b*) False

208. If charge enclosed by the surface is zero then electric field inside surface must be zero

(*a*) True (*b*) False

209. If charge enclosed by the surface is zero then flux passing through surface must be zero

(*a*) True (*b*) False

210. If $\oint s\vec{E}.\vec{dS} = 0$ over a surface, then :

(*a*) The electric field inside the surface is necessarily uniform

(*b*) The number of flux lines entering the surface must be equal to the number of flux lines leaving it

(*c*) The magnitude of electric field on the surface is constant

(*d*) All the charges must necessarily be inside the surface

211. Is Gauss law is valid for both Gaussian surface?

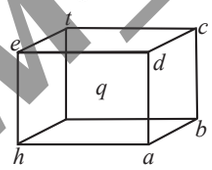
(*a*) Yes (*b*) No

(*c*) can't say

212. Angle between electric field and gaussian surface must be_____ to apply gauss law to find electric field.

213. Gaussian surface can pass through ———— charge distribution and can not pass through ———— charge distribution.

214. Find flux through cube in given situation



215. Charge is at corner of squre plate then find flux passing through square plate.

216. Match the column I with column II.

	Column-I		Column-II
i.	Flux through single surface of cube if q charge is placed at centre of cube	A.	$\frac{q}{6\varepsilon_0}$
ii.	Flux through cube if charge q is placed of centre of one face of cube	B.	$\frac{q}{4\varepsilon_0}$
iii.	Flux through cube if charge q is placed at centre of one edge of cube	C.	$\frac{q}{24\varepsilon_0}$
iv.	Flux through sides of cube that are not in contact with charge q which is placed at one vertex of cube.	D.	$\frac{q}{2\varepsilon_0}$

Choose the correct answer from the options given below:

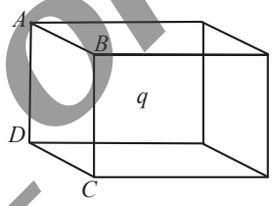
(*a*) (i-A), (ii-D), (iii-B), (iv-C)

(*b*) (i-A), (ii-B), (iii-C), (iv-D)

(*c*) (i-B), (ii-C), (iii-D), (iv-A)

(*d*) (i-B), (ii-D), (iii-A), (iv-C)

217. Charge is inside cube but not at the centre, flux passing through *ABCD*



(*a*) $\frac{q}{\varepsilon_0}$ (*b*) $\phi > \frac{q}{6\varepsilon_0}$

(*c*) $\phi < \frac{q}{6\varepsilon_0}$ (*d*) Both (b) and (c)

218. A point charge is placed at the centre of spherical Gaussian surface. Electric flux ϕ_E changed if

(*a*) The sphere is replaced by a cube of same or different volume?

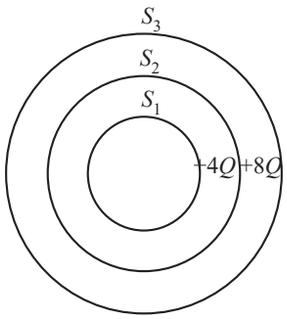
(*b*) The charge is oved off-centre in the original sphere, still remaining inside?

(*c*) The charge is moved just outside the original sphere?

(*d*) A second charge is placed near the outside of the original sphere?

(*e*) A second charge is placed inside the Gaussian surface?

219. S_1, S_2, S_3 are three concentric spherical shells, as shown in figure. S_1 and S_2 have charge $4Q$ and $8Q$ respectively. whereas S_3 is uncharged. Find the ratio of the flux passing through S_1 to that through S_3



(*a*) 1 : 3 (*b*) 1 : 2

(*c*) 2 : 1 (*d*) 1 : 6

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220. A charge q is placed at the centre of the open end of a cylindrical vessel. The flux of the electric field through the surface of the vessel is

(*a*) Zero (*b*) $\frac{q}{\varepsilon_0}$

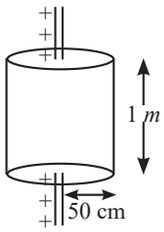
(*c*) $\frac{q}{2\varepsilon_0}$ (*d*) $\frac{2q}{\varepsilon_0}$

221. A hollow cylinder has a charge q coulomb within it. If ϕ is the electric flux in units of voltmetre associated with the curved surface B, the flux linked with the plane surface A in unit of voltmetre will be (charge is symmetrically placed within it)

(*a*) $\frac{q}{\varepsilon_0} - \phi$ (*b*) $\frac{1}{2}\left(\frac{q}{\varepsilon_0} - \phi\right)$

(*c*) $\frac{q}{2\varepsilon_0}$ (*d*) $\frac{\phi}{3}$

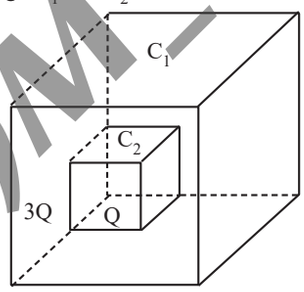
222. Electric charge is uniformly distributed along a long straight wire of radius 1 mm. The charge per cm length of the wire is Q coulomb. Another cylindrical surface of radius 50 cm and length 1 m symmetrically encloses the wire as shown in the figure. The total electric flux passing through the cylindrical surface is:



(*a*) $\frac{Q}{\varepsilon_0}$ (*b*) $\frac{100Q}{\varepsilon_0}$

(*c*) $\frac{10Q}{\pi\varepsilon_0}$ (*d*) $\frac{100Q}{\pi\varepsilon_0}$

223. C_1 and C_2 are two hollow concentric cubes enclosing charges 2Q and 3Q respectively as shown in figure. The ratio of electric flux passing through C_1 and C_2 is:



(*a*) 3 : 2 (*b*) 5 : 2

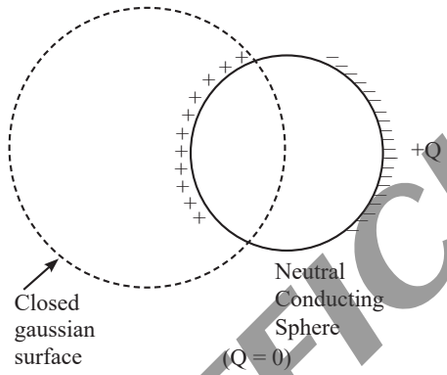
(*c*) 2 : 5 (*d*) 2 : 3

224. Two charges of $5Q$ and $-2Q$ are situated at the points $(3a, 0)$ and $(-5a, 0)$ respectively. The electric flux through a sphere of radius '$4a$' having center at origin is:

(*a*) $2Q/\varepsilon_0$ (*b*) $7Q/\varepsilon_0$

(*c*) $3Q/\varepsilon_0$ (*d*) $5Q/\varepsilon_0$

225. Find flux passing through closed gaussian surface, when $+Q$ point charge placed near to conducting neutral sphere



(*a*) Zero (*b*) +ve

(*c*) –ve (*d*) can't say

226. Given below are two statements: one is labelled as Assertion A and the other is labelled as Reason R.

Assertion A: If an electric dipole of dipole moment 30×10^{-5} Cm is enclosed by a closed surface, the net flux coming out of the surface will be zero.

Reason R: Electric dipole consists of two equal and opposite charges. In the light of above, statements, choose the correct answer from options given below:

(*a*) A is true but R is false

(*b*) A is false but R is true

(*c*) Both A and R are true but R is not the correct explanation of A

(*d*) Both A and R are true and R is the correct explanation of A

227. **Statement-I:** An electric dipole is placed at centre of hollow sphere. The flux of electric field through sphere is zero but the electric field is not zero anywhere in the sphere.

Statement-II: If R is radius of solid metallic sphere and Q be total charge on it. The electric field at any point on spherical surface of radius r ($< R$) is zero but electric flux passing through this closed surface of radius r is not zero.

228. Choose incorrect statement

(1) Electric line of force entering into a gaussian surface provide negative flux.

(2) A charge 'q' is placed at centre of cube. The flux through all faces will be same.

(3) In uniform electric field net flux through closed gaussian surface containing no net charge is zero.

(4) When electric field is parallel to gaussian surface, it provides a finite non- zero flux

(*a*) (3) and (4) only (*b*) (2) and (4) only

(*c*) (4) Only (*d*) (1) and (3) only

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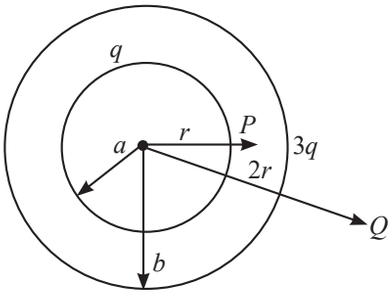
229. The electric field intensity at P and Q, in the shown arrangment, are in the ratio



(*a*) 1 : 2 (*b*) 2 : 1

(*c*) 1 : 1 (*d*) Zero

230. A hollow metal sphere of radius R is uniformly charged. The electric field due to the sphere at a distance r from the centre

(*a*) decreases as r increases for $r < R$ and for $r > R$

(*b*) increases as r increases for $r < R$ and for $r > R$

(*c*) zero as r increases for $r < R$, decreases as r increases for $r > R$

(*d*) zero as r increases for $r < R$, increases as r increases for $r > R$

231. The electric field at a distance 3R/2 from the centre of a charged conducting spherical shell of radius R is E. The electric field at a distance R/2 from the centre of the sphere is

(*a*) Zero (*b*) E

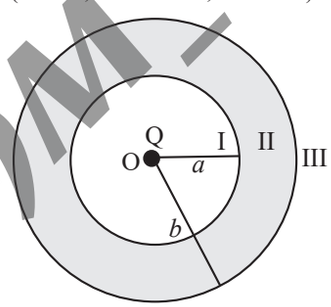
(*c*) $\frac{E}{2}$ (*d*) $\frac{E}{3}$

232. A hollow insulated conduction sphere is given a positive charge of 10μC. What will be the electric field at the centre of the sphere if its radius is 2 metres?

(*a*) 20 μC m^{-2} (*b*) 5 μC m^{-2}

(*c*) zero (*d*) 8 μC m^{-2}

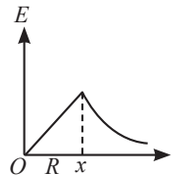
233. As shown in the figure, a point charge Q is placed at the centre of conducting spherical shell of inner radius and outer radius b. The electric field due to charge Q in three different regions I, II and III is given by: (I: $r < a$, II: $a < r < b$, III : $r > b$)

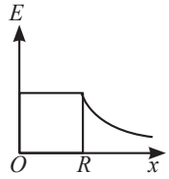


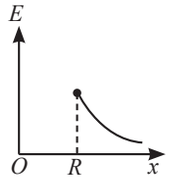
(*a*) $E_1 = 0, E_{11} = 0, E_{111} \neq 0$ (*b*) $E_1 \neq 0, E_{11} = 0, E_{111} = 0$

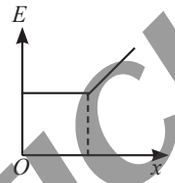
(*c*) $E_{10}, E_{11} = 0, E_{111} \neq 0$ (*d*) $E_1 = 0, E_{11} = 0, E_{111} = 0$

234. An isolated solid metal sphere of radius R is given an electric charge. Which of the graphs below best shows the way in which the electric field E varies with distance x from the centre of the sphere.

(*a*)


(*b*)


(*c*)


(*d*)


235. A non conducting solid sphere of radius R is uniformly charged. The electric field due to the sphere at a distance r from the centre

(*a*) decreases as r increases for $r < R$ and for $r > R$

(*b*) increases as r increases for $r < R$ and decreases as r increases for $r > R$

(*c*) zero as r increases for $r < R$ decreases as r increases for $r > R$

(*d*) zero as r increases for $r < R$ increases as r increases for $r > R$

236. Consider an atom with atomic number Z as consisting of a positive point charge at the centre and surrounded by a distribution of negative electricity uniformly distributed within a sphere of radius R. The electric field at a point inside the atom at a distance r from the centre is

(*a*) $\frac{Ze}{4\pi\varepsilon_0}\left[\frac{1}{r^2} - \frac{r}{R^3}\right]$ (*b*) $\frac{Ze}{4\pi\varepsilon_0}\left[\frac{1}{r^2} + \frac{r}{R^3}\right]$

(*c*) $\frac{2Ze}{4\pi\varepsilon_0 r^2}$ (*d*) Zero

237. A spherical conductor of radius 10 cm has a charge of 3.2 × 10^{-7}C distributed uniformly. What is the magnitude of electric field at a point 15 cm from the centre of the sphere? $\left(\frac{1}{4\pi\varepsilon_0} = 9\times10^9\ N\,m^2/C^2\right)$

(*a*) 1.28 × 10^4 × N/C (*b*) 1.28 × 10^5 × N/C

(*c*) 1.28 × 10^6 × N/C (*d*) 1.28 × 10^7 × N/C

238. A solid metallic sphere has a charge +3Q. Concentric with this sphere is a conducting spherical shell having charge –Q. The radius of the sphere is a and that of the spherical shell is b(b > a). What is the electric field at a distance $R(a<R<b)$ from the centre:

(*a*) $\frac{Q}{2\pi\varepsilon_0 R}$ (*b*) $\frac{3Q}{2\pi\varepsilon_0 R}$

(*c*) $\frac{3Q}{4\pi\varepsilon_0 R}$ (*d*) $\frac{4Q}{4\pi\varepsilon_0 R}$

239. Consider the uniformly charged spherical shell of Radius R carrying charge Q and charge 'q' placed at distance r from the centre of shell. If charge q is experiencing a force F, then identify the correct statement from following.

(*a*) $\frac{1}{4\pi\varepsilon_0}\frac{qQ}{R^2} > f > 0$ for $r < R$ (*b*) $f = \frac{1}{4\pi\varepsilon_0}\frac{qQ}{r^2}$ for $r < R$

(*c*) $f = \frac{1}{4\pi\varepsilon_0}\frac{qQ}{r^2}$ for all r (*d*) $f = \frac{1}{4\pi\varepsilon_0}\frac{qQ}{r^2}$ for $r < R$

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240. **Assertion:** If two spherical conductors of different radii have the same surface charge densities, then their electric field intensities will be equal.

Reason: Surface charge density = Total charge/Area

(*a*) Both assertion and reason are true and reason is the correct explanation of assertion

(*b*) Both assertion and reason are true but reason is not the correct explanation of assertion

(*c*) Assertion is true but reason is false

(*d*) Assertion is false and reason is true

241. A dipole with an electric moment $\vec{p}$ is located at a distance r from a long thread charged uniformly with a linear charge density λ. Find the force F acting on the dipole if the vector $\vec{p}$ is oriented along the thread.

(*a*) $\frac{p\lambda}{2\pi\varepsilon_0 r^2}$ (*b*) $\frac{p\lambda}{2\pi\varepsilon_0 r}$

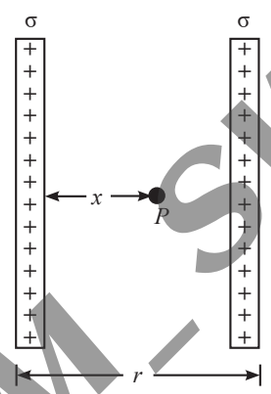
(*c*) $\frac{p}{2\pi\varepsilon_0 r\lambda}$ (*d*) Zero

242. Two parallel infinite line charges with linear charge densities +λC/m and –λC/m are placed at a distance of 2R in free space. What is the electric field mid-way between the two line charges?

(*a*) $\frac{\lambda}{2\pi\varepsilon_0 R} N/C$ (*b*) Zero

(*c*) $\frac{2\lambda}{\pi\varepsilon_0 R} N/C$ (*d*) $\frac{\lambda}{\pi\varepsilon_0 R} N/C$

243. For two infinitely long charged parallel sheets, the electric field at P will be



(*a*) $\frac{\sigma}{2x} - \frac{\sigma}{2(r-x)}$ (*b*) $\frac{\sigma}{2\varepsilon_0 x} - \frac{\sigma}{2\pi(r-x)\varepsilon_0}$

(*c*) $\frac{\sigma}{\varepsilon_0}$ (*d*) Zero

244. If a small sphere of mass m and charge q is hung from a silk thread at an angle θ with the surface of a vertical charged conducting plate, then for equilibrium of sphere, the surface charge density of the plate is

(*a*) $\varepsilon_0\left(\frac{mg}{q}\right)\tan\theta$ (*b*) $\varepsilon_0\left(\frac{2mg}{q}\right)\tan\theta$

(*c*) $\varepsilon_0(mgq)\tan\theta$ (*d*) $\varepsilon_0\left(\frac{mg}{3q}\right)\tan\theta$

245. Same charge Q given on both the plate conducting and Nonconducting of Area 'A' then find Ratio of electric field very near to both the plates.

246. Ratio of electric field due to conducting and non-conducting sheet having equal charge density is 2: 1. [True/False

(*a*) True (*b*) False

247. An electron is rotating around an infinite positive linear charge in a circle of radius 0.1 m, if the linear charge density is 1 μC/m, then the velocity of electron in m/s will be

(*a*) 0.562×10^7 (*b*) 5.62×10^7

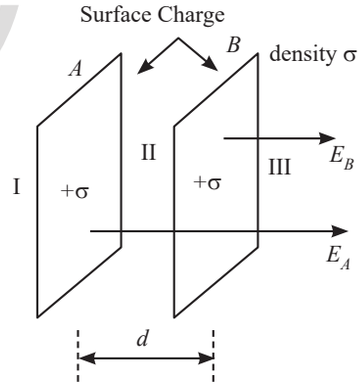
(*c*) 562×10^7 (*d*) 0.0562×10^7

248. Two long thin charged rods with charge density λ each are placed parallel to each other at a distance d apart. The force per unit length exerted on one 1 rod by the other will be

(*a*) $\frac{k2\lambda}{d}$ (*b*) $\frac{k2\lambda^2}{d}$

(*c*) $\frac{k2\lambda}{d^2}$ (*d*) $\frac{k2\lambda^2}{3d^2}$

249. Let s be the uniform surface charge density of two infinite thin plane sheets shown in figure. Then the electric field in three different region E_1, E_{11} and E_{111} are:



(*a*) $\vec{E}_1 = 0, \vec{E}_{11} = \frac{\sigma}{\varepsilon_0}\hat{n}, E_{111} = 0,$

(*b*) $\vec{E}_1 = \frac{\sigma}{2\varepsilon_0}\hat{n}, \vec{E}_{11} = 0, E_{111} = \frac{\sigma}{2\varepsilon_0}\hat{n}$

(*c*) $\vec{E}_1 = \frac{-\sigma}{\varepsilon_0}\hat{n}, \vec{E}_{11} = 0, E_{111} = \frac{\sigma}{\varepsilon_0}\hat{n}$

(*d*) $\vec{E}_1 = \frac{2\sigma}{\varepsilon_0}\hat{n}, \vec{E}_{11} = 0, E_{111} = \frac{2\sigma}{\varepsilon_0}\hat{n}$

250. Two parallel metal plates having charges +Q and –Q faces each other at a certain distance between them. If the plates are now dipped in kerosene oil tank, the electric field between the plates will:

(*a*) become zero (*b*) increase

(*c*) decrease (*d*) remain same

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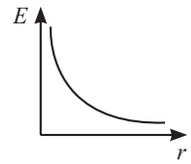
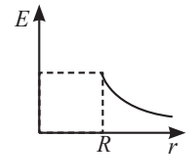
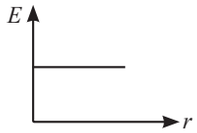
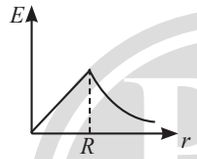
251. Match the Column-I with Column-II.

Column-I		Column-II	
(i)	Electric field due to solid conducting sphere	A.	
(ii)	Electric field due to infinite line charge.	B.	
(iii)	Electric field due to solid non-conducting sphere.	C.	
(iv)	Electric field due to infinite thin plate.	D.	

Choose the correct answer from the options given below:

(*a*) (i-B), (ii-A), (iii-D), (iv-C) (*b*) (i-A), (ii-B), (iii-C), (iv-D)

(*c*) (i-B), (ii-C), (iii-D), (iv-A) (*d*) (i-B), (ii-D), (iii-A), (iv-C)

252. An electric dipole consists of two opposite charges each of magnitude 1μC separated by a distance of 2 cm. The dipole is placed in an external field of 10^5 N/C. The maximum torque on the dipole is

(*a*) 2×10^{-4} Nm (*b*) 2×10^{-3} Nm

(*c*) 4×10^{-3} Nm (*d*) 10^{-3} Nm

253. The torque τ acting on an electric dipole of dipole moment in an electric field $\vec{E}$ is

(*a*) $\vec{\tau} = \vec{p} \cdot \vec{E}$ (*b*) $\vec{\tau} = \vec{p} \times \vec{E}$

(*c*) $\vec{\tau} = p\vec{E}$ (*d*) $\vec{\tau} = \vec{p}E$

254. An electric dipole is placed at an angle of 30° with an electric field of intensity 10^7 NC^{-1}. It experiences a torque equal to 15×10^2 N-m. What will be magnitude of charge on dipole if it is 5cm long?

(*a*) 1 mC (*b*) 2 mC

(*c*) 6 mC (*d*) None

255. The frequency of oscillation of an electric dipole moment having dipole moment *p* and rotational inertia *I*, oscillating in a uniform electric field *E* is given

(*a*) $(1/2\pi)\sqrt{I/pE}$ (*b*) $(1/2\pi)\sqrt{pE/I}$

(*c*) $(2\pi)\sqrt{pE/I}$ (*d*) $(2\pi)\sqrt{I/pE}$

256. An electric dipole is placed at an angle of 30° with an electric field intensity 2×10^5 N/C. It experiences a torque equal to 4 N m. The charge on the dipole, if the dipole length is 2 cm, is

(*a*) 8 *mC* (*b*) 2 *mC*

(*c*) 5 *mC* (*d*) 7 *mC*

Potential Energy Stored in the Dipole

257. An electric dipole when placed in a uniform electric field E will have minimum potential energy, when the angle made by dipole moment with field E is

(*a*) π (*b*) $\frac{3\pi}{2}$

(*c*) Zero (*d*) $\frac{\pi}{2}$

258. Dipole can be in equilibrium in two orientation in electric field one is stable and other is unstable

(*a*) True (*b*) False

259. Path of charge particle in electric field may be circle

(*a*) True (*b*) False

Work Done in Rotating a Dipole in Uniform Electric Field

260. An electric dipole moment is lying along a uniform electric field E. The work done in rotating the dipole by 90° is

(*a*) $\sqrt{2}pE$ (*b*) $\frac{pE}{2}$

(*c*) $2pE$ (*d*) pE

261. An electric dipole of moment p is lying along a uniform electric field *E*. The work done in rotating the dipole by 180° is

(*a*) pE (*b*) $+2\,pE$

(*c*) $+2\,pE$ (*d*) $\frac{\phi E}{\sqrt{2}}$

262. An electric dipole placed in a uniform electric field experiences maximum moment of couple when the dipole is placed

(*a*) Against the direction of the field

(*b*) Towards the electric field

(*c*) Perpendicular to the direction of the field

(*d*) At 135° to the direction of the field

263. Work done by electric field (*E*) to rotate the dipole of dipole moment ϕ from Stable to unstable equilibrium ?

264. work done to rotate the dipole from unstable equilibrium to 60° is √3 J then, find external torque required to keep the dipole at this position ?

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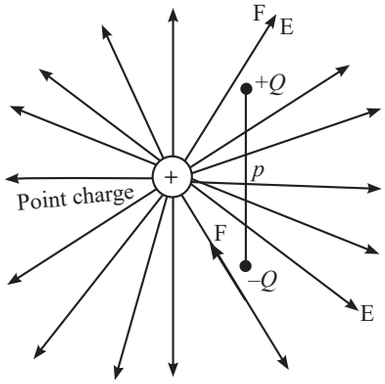
Dipole Placed in Non-Uniform Electric Field

265. Dipole is placed in non-uniform electric filed due to point charge as shown in figure

Direction of net force

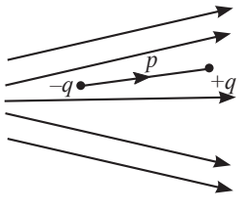


(*a*) along +*x* axis (*b*) along –*x* axis

(*c*) along +*y* axis (*d*) along +*y* axis

(*e*) along +*y* axis

266. The figure shows electric field lines in which an electric dipole p is placed as shown. Which of the following statements is correct?



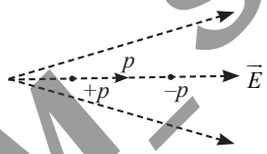
(*a*) The dipole will not experience any force

(*b*) The dipole will experience a force towards the right

(*c*) The dipole will experience a force towards the the left

(*d*) The dipole will experience a force upwards

267. A dipole is placed in an electric field as shown. In which direction will it move?



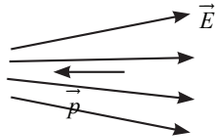
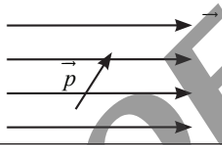
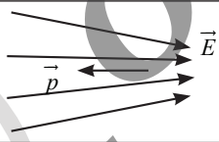
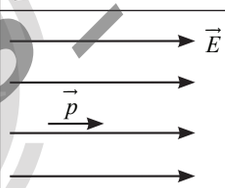
(*a*) Towards the left as its potential energy will decrease

(*b*) Towards the right as its potential energy will increase

(*c*) Towards the left as its potential energy will increase

(*d*) Towards the right as its potential energy will decrease

268. Match the column-I with column-II.

Column-I		Column-II	
I.		A.	Dipole is in Translational as well as in rotational equilibrium
II.		B.	Dipole is not in equilibrium and it moves towards left side.
III.		C.	Dipole is in translational equilibrium but not in rotational equilibrium.
IV.		D.	Dipole is not in equilibrium and it moves towards right side.

Polar & Non-Polar Molecules

269. Polar molecules are the molecules

(*a*) That acquires a dipole moment only when the magnetic field is absent

(*b*) Has a permanent electric dipole moment

(*c*) Has zero dipole moment

(*d*) That acquire a dipole moment only in the presence of an electric field due to displacement of charges

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1. Match the facts given in Column I with the Column II:

Column-I		Column-II	
I.	Charge cannot exist	a.	Without charge
II.	Mass can exist	b.	Without mass
III.	Charge is	c.	Not conserved
IV.	Mass is	d.	Conserved

(*a*) I-b, II-a, III-d, IV-c (*b*) I-b, II-a, III-c, IV-d
(*c*) I-b, II-d, III-a, IV-c (*d*) I-b, II-c, III-d, IV-a

2. A uniformly charged ring is placed in x - z plane as shown in figure. A point charge (+q is placed on y-axis and it is in equilibrium. Choose the correct statement.

(*a*) If $y = \frac{R}{\sqrt{2}}$, nature of equilibrium is stable

(*b*) If $y > \frac{R}{\sqrt{2}}$, nature of equilibrium is unstable

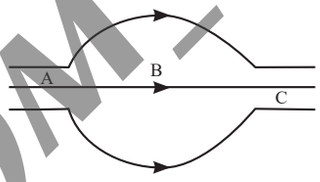
(*c*) If $y < \frac{R}{\sqrt{2}}$, nature of equilibrium is unstable

(*d*) Is $y = \frac{R}{\sqrt{2}}$, is the position where electric force experienced by + q is minimum

3. Two equal point charges A and B are R distance apart. A third point charge placed on the perpendicular bisector at a distance 'x' from the centre. They experience maximum electrostatic force when:

(*a*) $x = \frac{R}{2\sqrt{2}}$ (*b*) $x = \frac{R}{\sqrt{2}}$
(*c*) $x = R\sqrt{2}$ (*d*) $x = 2\sqrt{2}R$

4. Given figure shows some of the electric field lines corresponding to an electric field. The figure suggests that electric field strength at A point is____as compared to point C but it is_____as compared to point B



5. **Statement I:** The net force on the dipole due to electric field generated by point change may be Zero.

Statement II: Net torque on dipole in a electric field generated by infinite large rod must be zero when dipole is placed perpendicularly to rod.

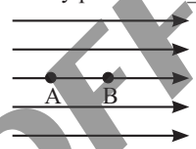
6. The _____ acting on A proton and an electron placed in uniform electric field will be repel.

(*a*) Acceleration
(*b*) Magnitude of their acceleration
(*c*) Magnitude of the force
(*d*) Electric forces

7. The _____ of the universe is constant.

(*a*) Total number of charged particles.
(*b*) Total negative charge.
(*c*) Total charge
(*d*) Total positive

8. A point charge is brought in an uniform electric field at point A. The electric field at nearly print B will_____.

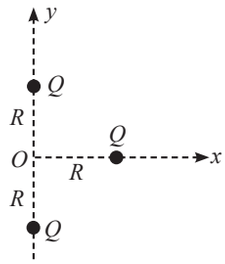


(*a*) Must increase
(*b*) Must decrease
(*c*) Increase if point charge is negative.
(*d*) Increase if point charge is positive.

9. If a _____ charge is shifted from a low-potential region to a high-potential region, the electric potential energy increases.

(*a*) Negative
(*b*) May be Positive of Negative
(*c*) Positive
(*d*) Electric Potential Energy cannot increase whatever charge May be

10. Find magnitude of net electric force on charge Q placed on X-axis:



(*a*) $\frac{\sqrt{2}Q^2}{8\pi \epsilon_0 R^2}$ (*b*) $\frac{\sqrt{2}Q^2}{4\pi \epsilon_0 R^2}$
(*c*) $\frac{\sqrt{2}Q^2}{8\pi \epsilon_0 R}$ (*d*) $\frac{2\sqrt{2}Q^2}{8\pi \epsilon_0 R^2}$

11. **Assertion (A):** If a spherical cavity is made inside a uniformly charged sphere, then electric field inside the cavity is uniform.

Reason (R): The electric field inside the cavity is independent of radius of cavity, but depends on radius of sphere.

(*a*) Both (A) and (R) are true and (R) is the correct explanation of (A).
(*b*) Both (A) and (R) are true and (R) is NOT the correct explanation of (A).
(*c*) (A) is true but (R) is false
(*d*) (A) is false but (R) is true.

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12. The electric field at the origin is along the _____. A small circle is drawn with the centre at the origin cutting the axes at point *A (a,o), B(O, a), C(-a, 0)* and *D (0,-a)*. Out of the points on periphery of circle potential is minimum at A and Maximum at point C

(*a*) negative *x* axis (*b*) negative *y* axis

(*c*) positive *y* axis (*d*) Positive *x* axis

13. A charge $+Q$ is placed at Origin. The work done in taking *a* point charge (q) from point P ($3a$, 0) to point A (a, 0) is W_A and from point P to point B (0, a) is W_B and from point P to point C ($-a$, 0) is W_C then.

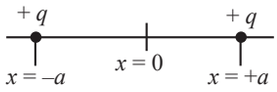
(*a*) $W_A < W_B < W_C$ (*b*) $W_A > W_B > W_C$

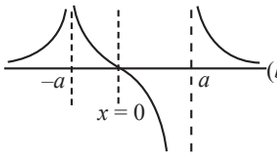
(*c*) $W_A = W_B = W_C$ (*d*) $W_C > W_A > W_B$

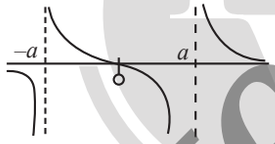
14. **Statement I:** Potential energy of two charge system do not depend on choice of zero potential or zero potential energy.

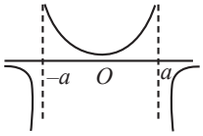
Statement II: Change in potential energy of two charge system does depend on choice of zero potential

15. Consider the charge configuration shown in the figure. Variation of electric field along *x*-axis is



(*a*) 

(*b*) 

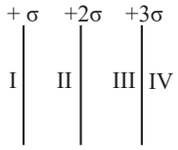
(*c*) 

(*d*) None of these

16. **Statement I:** A change Q is uniformly distributed over a large plastic plate. The electric field at a point P close to the centre of plate is 10 Vm^{-1}. If the plastic plate is replaced by copper plate of same geometrical dimensions & carrying same charge Q. The electric field at point P will remain same.

Statement II: A Metallic particle having no net change is placed near a finite metal plate carrying a positive charge. The electric force on particle will be zero

17. Three large non-conducting plane sheets of charge with charge densities σ, 2σ and 3σ are arranged as shown. The net electric field in region III will be

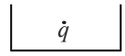


(*a*) $\frac{3\sigma}{\varepsilon_0}$ (towards left) (*b*) $\frac{2\sigma}{\varepsilon_0}$ (towards left)

(*c*) 0 (*d*) $\frac{3\sigma}{\varepsilon_0}$ (towards right)

18. **Statement I:** Electric changes are distributed in small volume. The flux of the electric field through a spherical surface of radius 10 cm. Surrounding the total charge is 25 Vm. The flux over a concentric sphere of radius 20cm will be 50 Vm.

Statement II: A charge q is placed at the centre of the open end of a cylindrical vessel as shown in figure. The flux of electrical field through surface of the vessel will be zero as gauss law is only valid for closed surfaces.



19. **Statement-I:** Coulombic force follows the principle of superposition.

Statement-II: Coulombic force is directly proportional to the charges on both particle

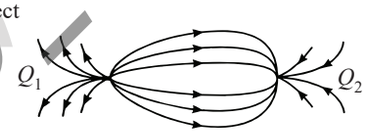
(*a*) Statement-I is true, statement-II is true and statement-II is correct explanation for statement-I.

(*b*) Statement-I is true, statement-II is true and statement-II is NOT the correct explanation for statement-I

(*c*) Statement-I is true, statement-II is false.

(*d*) Statement-I is false, statement-II is true.

20. A few electric field lines for a system of two charges Q_1 and Q_2 fixed at two different points on their axis are shown in the figure. With the figure what information about charges and electric field is incorrect



(*a*) $|Q_1|>|Q_2|$ (*b*) $Q_1 \rightarrow +ve,\ Q_2 \rightarrow -ve$

(*c*) At a finite distance to the left of Q_1 the electric field is zero

(*d*) At a finite distance to the right of Q_2 the electric field is zero

21. **Statement I:** Gauss's law is valid only for symmetrical charge distributions.

Statement II: Gauss law is valid only for charges placed in vacuum.

22. Two identical charged spheres suspended from a common point by two mass-less strings of length *l* are initially at a distance *d* ($d << l$) apart because of their mutual repulsion. The charge begins to leak from both the spheres at a constant rate. As a result the charge approach each other with a velocity *v*. Then as a function of distance *x* between them.

(*a*) $v \propto x^{-1}$ (*b*) $v \propto x^{\frac{1}{2}}$

(*c*) $v \propto x$ (*d*) $v \propto x^{-\frac{1}{2}}$

23. **Statement-I:** In a given situation of arrangement of charges, an extra charge is placed outside the Gaussian surface. In the Gauss Theorem

$$\oint \vec{E}.d\vec{s} = \frac{Q_{in}}{\epsilon_0}$$

Q_{in} remains unchanged where as electric field at the site of the element is changed.

Statement-II: Electric field E at any point on the Gaussian surface is due to inside charge only.

(*a*) **Statement-I** is true, statement-II is true and statement-II is correct explanation for statement-1

(*b*) **Statement-I** is true, statement-II is true and statement-II is NOT the correct explanation for statement-I

(*c*) **Statement-I** is true, statement-II is false

(*d*) **Statement-I** is false, statement-II is true.

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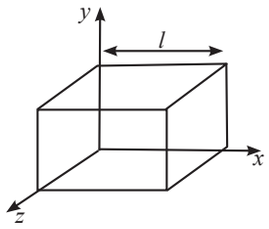
24. **Statement I:** The flux of electric field through closed surface due to all charges is equal to flux due to charges enclosed by surface.

Statement II: The electric field calculated by gauss's law, is field due to the charges inside the gaussian surface.

25. Electric field of a region varies as $\vec{E} = bx\,\hat{i}\ NC^{-1}$. Find the net charge enclosed by the cube as shown in figure



(*a*) $\frac{bl^3}{2\varepsilon_0}$ (*b*) $\frac{bl^3}{3\varepsilon_0}$

(*c*) $bl^3\varepsilon_0$ (*d*) $\frac{bl^3\varepsilon_0}{2}$

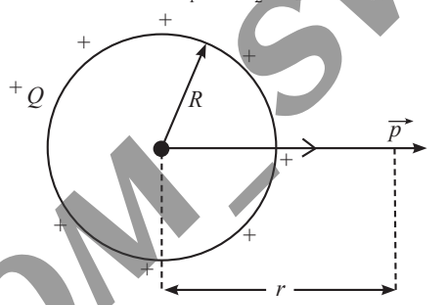
26. **Statement I:** If a positive point charge Q is brought near an isolated metal cube, then the interior of cube becomes positively charged and the surface becomes negatively charged.

Statement II: If A positive point charge Q is brought near an isolated metal cube, then interior remains charge free and surface gets non uniform charge distribution.

27. **Statement I:** If flux of electric field through a closed surface is zero, the electric field may be zero everywhere on the surface.

Statement II: If flux of electric field through a closed surface is zero, then the change in the vicinity of surface must be zero.

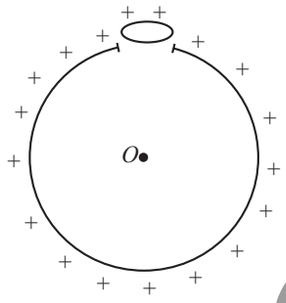
28. A short electric dipole is placed along a radial line of a uniformly charged sphere as shown. If the force experienced by dipole at $r = 2R$ and $r = 4R$ are F_1 and F_2 respectively, then F_2/F_1 is



(*a*) 1/8 (*b*) 1/4

(*c*) 1/16 (*d*) 1/32

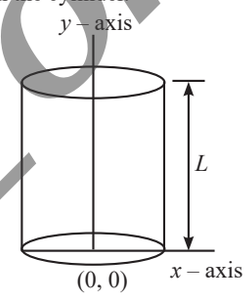
29. A conducting charged spherical shell has a tiny hole cut into its surface. If surface charge density near the hole is σ then electric field in the hole is:-



(*a*) $\frac{\sigma}{\epsilon_0}$, directed inwards (*b*) $\frac{\sigma}{\epsilon_0}$, directed outwards

(*c*) $\frac{\sigma}{2\epsilon_0}$, directed inwards (*d*) $\frac{\sigma}{2\epsilon_0}$, directed outwards

30. A long charged wire is kept on +*y*-axis, with one end at origin. Its linear charge density is given as $\lambda = \lambda_0 y$. Calculate electric flux passing through the cylinder.

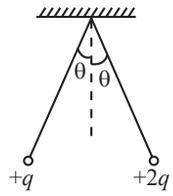


(*a*) $\frac{\lambda_0 L_0}{\epsilon_0}$ (*b*) $\frac{\lambda_0 L^2}{2\epsilon_0}$

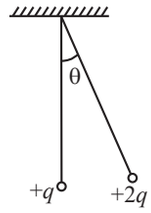
(*c*) $\frac{2\lambda_0 L^2}{\epsilon_0}$ (*d*) None

31. Two metal spheres of same mass are suspended from a common point by a light insulating string. The length of each string is same. The spheres are given electric charges +*q* on one and +2*q* on the other. Which of the following diagram best shows the resulting positions of spheres?

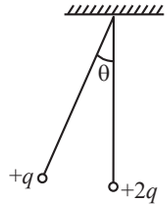
(*a*)



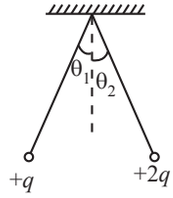
(*b*)



(*c*)



(*d*)



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Answer Key

1. (*a*) **2.** (*a*) **3.** (*c*) **4.** (*a*) **5.** (*c*) **6.** (*d*) **7.** (*d*) **8.** (*b*) **9.** (*b*) **10.** (b)

11. (*b*) **12.** $S_{neutron} = 0$, $S_{proton} = 2\ (S_{\alpha\ particle})$ **13.** (*c*) **14.** (*a, b, d*) **15.** (*a, d*) **16.** (*c*) **17.** $Q = 16 \times 10^{-19}$ C

18. (*c*) **19.** $n = 6.25 \times 10^{18}$ **20.** (*a*) **21.** 12 **22.** (*d*) **23.** 56.8×10^{-25} kg **24.** 6.25×10^{8} seconds

25. 2.76×10^{-10} C **26.** 5.49×10^{30}C **27.** (*d*) **28.** (*b*) **29.** (*d*) **30.** (*d*) **31.** (*c*) **32.** (*d*)

33. (*c*) **34.** (*c*) **35.** (*d*) **36.** 8C **37.** (*b*) **38.** (*a*) **39.** (*d*) **40.** (*b*) **41.** (*d*) **42.** (*a*)

43. (*a*) **44.** (*c*) **45.** (*b*) **46.** (*c*) **47.** (*a*) **48.** (*a*) **49.** (*c*) **50.** (*c*) **51.** 2.3×10^{-28} N

52. $\simeq 10^{36}$ **53.** (*d*) **54.** 16 Newton **55.** (a) **56.** 10^{-5} Newton **57.** (*d*) **58.** (*a*) **59.** (*a*)

60. (c) **61.** Zero **62.** (*b*) **63.** 16 : 9 **64.** $\frac{3F}{4}$ **65.** (*d*) **66.** (*b*) **67.** (*c*) **68.** (*a*)

69. $v = \sqrt{\frac{q^2}{16\pi\varepsilon_0 mr}}$ **70.** (*c*) **71.** (*b*) **72.** $F = kq\lambda\left[\frac{1}{a} - \frac{1}{a+L}\right]$ **73.** (*a*) **74.** (*a*) **75.** (*a*)

76. (*c*) **77.** (*d*) **78.** 0 **79.** $\frac{20kqQ}{l^2}$ **80.** $\frac{4\sqrt{2}kQq}{l^2}$ **81.** (*b*) **82.** $\frac{kQ^2}{\ell^2}\left(\frac{2\sqrt{2}+1}{2}\right)$ **83.** (*b*)

84. (*c*) **85.** $q = \frac{-Q}{2\sqrt{2}}$ **86.** $\frac{-q\left(2\sqrt{2}+1\right)}{4}$ **87.** $\frac{4kq_0q}{3}$ **88.** $\frac{4}{5}kqq_0$ **89.** (*a*)

90. $\frac{2kQqr}{(a^2+r^2)^{3/2}}$ **91.** (*a*) **92.** $\frac{9\times10^9\times10[3\hat{i}+4\hat{j}+5\hat{k}]}{(5\sqrt{2})^3}$ **93.** $\frac{108\times10^9(3\hat{i}+4\hat{j})}{125}$ **94.** (*b*) **95.** (*b*)

96. (*a*) **97.** (*a*) **98.** $\frac{r}{\sqrt{n}-1}$ **99.** (*a*) **100.** $\left(\frac{r}{\sqrt{n}+1}\right)$

101. (i) 2m from Q, (ii) 7.5m form 3Q, (iii) $\frac{80}{9}m$ from 16 Q, (iv) $\frac{10}{\sqrt{2}+1}$ from –4Q **102.** 15 m from 25 Q

103. (i) $\frac{10}{3}m$ from -*Q*, (ii) 20 m form +8Q **104.** (*b*) **105.** Unstable equilibrium along *x*–axis

106. Stable equilibrium along *y* – axis **107.** (*c*) **118.** (*c*) **119.** (*a*) **110.** (*b*) **111.** (*a*) **112.** (*b*) **113.** (*b*)

114. (*b*) **115.** (*d*) **116.** (*d*) **117.** (*d*) **118.** (*a*) **119.** (*i*) 0, (*ii*) $\frac{\sqrt{2}KQ}{r^2}$, (*iii*) $\frac{2KQ}{r^2}$ **120.** 5m from + Q

121. (*b*) **122.** (*a*) **123.** 32cm **124.** (*d*) **125.** Zero **126.** $\frac{4\sqrt{2}kQ}{\ell^2}$ **127.** 0 **128.** $\frac{Q}{\pi\varepsilon_0\ell^2}$

129. (*c*) **130.** $\frac{2\sqrt{2}kq}{\ell^2}$ **131.** $\frac{KQ}{a^2}\frac{\left(2\sqrt{2}+1\right)}{2}$ **132.** (*c*) **133.** $4kq/3a^2$ **134.** $R/\sqrt{2}$

135. $x = \frac{R}{2\sqrt{2}}$ **136.** (*c*) **137.** (*c*) **138.** (*d*) **139.** (*a*) **140.** (*a*) **141.** (*a*) **142.** $\frac{-5}{2}$ **143.** D

144. (*d*) **145.** (*a*) **146.** (*a*) **147.** (*d*) **148.** (*c*) **149.** (*a*) **150.** (*d*) **151.** (*a*) **152.** (*b*) **153.** (*b*)

154. (*a*) **155.** 1:1 **156.** (*b*) **157.** 1:1 **158.** (*a*) **159.** (*d*) 60. (*b*) **161.** (*a*) **162.** (*b*) **163.** (*c*)

164. (*b*) **165.** (c) **166.** (*b*) **167.** (*i*) 2 : 1 : 1, (*ii*) 1 : 1 : 2, (*iii*) 1 : 2 : 8 **168.** (*c*) **169.** (*c*) **170.** (*d*)

171. (*b*) **172.** (*d*) **173.** (*i*) $\sqrt{3}qa$, (*i*) $P = \sqrt{2}ql$, (*iii*) $\sqrt{5}qa$ **174.** $\sqrt{3}ql$ **175.** (*a*) **176.** (*d*) **177.** (*c*) **178.** (*a*)

179. (*c*) **180.** (*a*) **181.** $2^{\frac{1}{3}}:1$ **182.** (*a*) **183.** (*b*) **184.** $\theta = \tan^{-1}(\sqrt{2})$ **185.** (*b*) **186.** (*a*)

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187. (*a*) **188.** (*c*) **189.** (*d*) **190.** (*d*) **191.** Zero **192.** (*a*) **193.** (*a*) **194.** $\phi_{in} = -E\pi R^2$, $\phi_{out} = E\pi R^2$

195. (*a*) **196.** (*b*) **197.** (*c*) **198.** (*b*) **199.** (*c*) **200.** (*c*) **201.** (*a*) **202.** (*a*) **203.** (*b*) **204.** (*a*)

205. A = Due to infinite Sheet, B = Due to infinite Rod, C = Charged Particle (Point Charge), D = Dipole **206.** (*c*) **207.** (*b*)

208. (*b*) **209.** (*a*) **210.** (*b*) **211.** (*a*) **212.** [0°, 180° or 90°] **213.** [Continuous, Discretel] **214.** $\phi = \frac{q}{\varepsilon_0}$

215. Zero **216.** (*a*) **217.** (*c*) **218.** (*c,e*) **219.** (*a*) **220.** (*c*) **221.** (*b*) **222.** (*b*) **223.** (*c*) **224.** (*d*)

225. (*b*) **226.** (*d*) **227.** I = True, II = False **228.** (*c*) **229.** (*b*) **230.** (*c*) **231.** (*a*) **232.** (*c*) **233.** (*c*)

234. (*c*) **235.** (*b*) **236.** (*a*) **237.** (*b*) **238.** (*c*) **239.** (*b*) **240.** (*b*) **241.** (*d*) **242.** (*d*) **243.** (*d*)

244. (*a*) **245.** 1:1 **246.** (*a*) **247.** (b) **248.** (*b*) **249.** (*c*) **250.** (*b*) **251.** (*a*) **252.** (*a*) **253.** (*b*)

254. (*c*) **255.** (*b*) **256.** (*b*) **257.** (*c*) **258.** (*a*) **259.** (*b*) **260.** (*d*) **261.** (*d*) **262.** (*c*)

263. 2pE **264.** $\tau = -1$ N.m **265.** (*c*) **266.** (*c*) **267.** (*d*) **268.** [1-D, 2-C, 3-B, 4-A] **269.** (*b*)

MR* CORNER

1. (*a*) **2.** (*c*) **3.** (*a*) **4.** Equal, Greater **5.** I. - False, II. - True **6.** (*c*) **7.** (*c*) **8.** (*d*)
9. (*c*) **10.** (*c*) **11.** (*c*) **12.** (*d*) **13.** (*c*) **14.** Both statements are false **15.** (*b*)
16. I. - True, II. - False **17.** (*c*) **18.** I. - False, II. - False **19.** (*d*) **20.** (*d*) **21.** Both false **22.** (*d*)
23. (*c*) **24.** I. True, I. False **25.** (*c*) **26.** I. - False, II. - True **27.** I- True, II. - False **28.** (*a*) **29.** (*d*)
30. (*b*) **31.** (*a*)

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Gravitation

(Practice Questions)

Newton's Law of Gravitation

1. Gravitation is the phenomenon of interaction between

(*a*) Point masses only

(*b*) Any arbitrary shaped masses

(*c*) Planets only

(*d*) None of these

2. The dimensional formula for gravitational constant is:

(*a*) $[M^{-1} L^3 T^{-2}]$ (*b*) $[M^3 L^{-1} T^{-2}]$

(*c*) $[M^{-1} L^2 T^3]$ (*d*) $[M^{-2} L^3 T^1]$

3. Force of gravitation between two masses is found to be F in vacuum. If both the masses are dipped in water at same distance then, new force will be

(*a*) $> F$ (*b*) $< F$

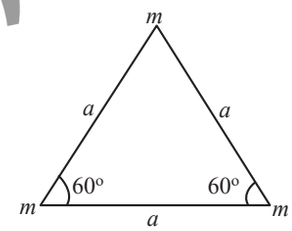
(*c*) F (*d*) Cannot say

4. Two point masses m and 4m are separated by a distance d on a line. A third point mass m_0 is to be placed at a point on the line such that the net gravitational force on it is zero. The distance of that point from the m mass is

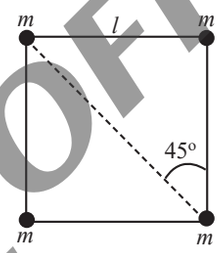
(*a*) $\frac{d}{2}$ (*b*) $\frac{d}{4}$

(*c*) $\frac{d}{3}$ (*d*) $\frac{d}{5}$

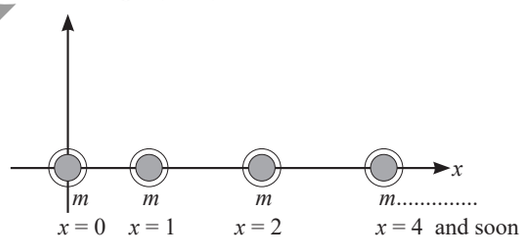
5. Three point masses, each of mass m, are placed at the vertices of an equilateral triangle with side length a. Determine the net gravitational force acting on one of the masses due to the other two point masses.



6. Four point masses, each of mass m, are placed at the corners of a square of side length l. Calculate the net gravitational force acting on one of the masses due to the other three masses.



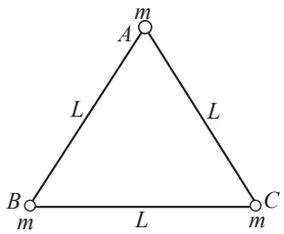
7. A large number of identical point masses m are placed along x-axis, at x = 0 1, 2, 4, ... The magnitude of gravitational force on mass at origin (x = 0), will be:



(*a*) Gm^2 (*b*) $\frac{4}{3}Gm^2$

(*c*) $\frac{2}{3}Gm^2$ (*d*) $\frac{5}{4}Gm^2$

8. Three particles A, B and C each of mass m are lying at the corners of an equilateral triangle of side L. If the particle A is released keeping the particles B and C fixed, the magnitude of instantaneous acceleration of A is



(*a*) $\sqrt{3}\frac{Gm^2}{L^2}$ (*b*) $\sqrt{2}\frac{Gm^2}{L^2}$

(*c*) $\sqrt{2}\frac{Gm}{L^2}$ (*d*) $\sqrt{3}\frac{Gm}{L^2}$

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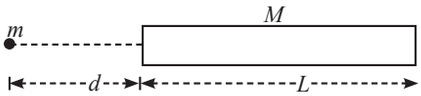
9. Three particles, each of mass m, are kept at the corners of an equilateral triangle of side 'l'. Force exerted by this system on another particle of mass m placed at the midpoint of any side will be :

(*a*) $\frac{5Gm^2}{\ell^2}$ (*b*) $\frac{Gm^2}{2\ell^2}$

(*c*) $\frac{4Gm^2}{3\ell^2}$ (*d*) $\frac{5Gm^2}{3\ell^2}$

10. A particle of mass m is placed at a distance d from one end of a uniform rod with length L nad mass M as shown in the figure. Find the magnitude of the gravitational force on the particle due to the rod.



11. Two particle of equal mass m are moving round a circle of radius r due to their mutual gravitational interaction. Find the time period of each particle

12. Two particles of equal masses 'm' move in a circle of radius r under the action of their mutual gravitational attraction. The speed of each particle will be

(*a*) $\sqrt{\frac{Gm}{2r}}$ (*b*) $\sqrt{\frac{4Gm}{r}}$

(*c*) $\sqrt{\frac{Gm}{r}}$ (*d*) $\sqrt{\frac{Gm}{4r}}$

13. Consider a solid sphere of mass M and radius R. A point mass m is located at a distance r from the center of the sphere, where $r > R$. Find the gravitational force acting on the point mass m due to the solid sphere

14. If the distance between two objects is decreased by 50%, what will be the percentage change in the gravitational force between the objects?

(*a*) 200% (*b*) 300%

(*c*) 100% (*d*) 400%

15. If the distance between two objects is increased by 300%, what will be the percentage change in the gravitational force between the objects?

16. Two bodies of equal masses are some distance apart. If 20% of mass is transferred from the first body to the second body, then the gravitational force between them

(*a*) Increases by 4% (*b*) Increases by 14%

(*c*) Decreases by 4% (*d*) Decreases by 14%

17. Two objects of equal masses placed at certain distance from each other attracts each other with a force of F. If one-third mass of one object is transferred to the other, then the new force will be:

(*a*) 2/9 F (*b*) 16/9 F

(*c*) 8/9 F (*d*) F

18. A mass M is broken into two parts of masses m_1 and m_2. How are m_1 and m_2 related so that force of gravitational attraction between the two parts is maximum?

(*a*) $M = 2m$ (*b*) $M = m/2$

(*c*) $M = 3/2m$ (*d*) $M = m$

19. A mass M is spit into two parts m_0 and M-m_0 These two masses are then separated by a distance D. If the gravitational force between the parts is maximum, then the ratio $\frac{m_0}{M}$ is

(*a*) 0.2 (*b*) 0.4

(*c*) 0.5 (*d*) 0.6

20. Two identical sphere as are placed in contact with each other. If r is the radius of each sphere, then gravitational attraction between the two is proportional to:

(*a*) r^2 (*b*) r^4

(*c*) $1/r^2$ (*d*) $1/r^4$

21. Two masses, 16 kg and 25 kg, are placed 10 meters apart. A third mass m_0 is placed between them. Find the distance from the 25 kg mass at which the third mass m_0 must be placed so that the net gravitational force on it is zero.

22. Four point masses are placed at the corners of a square of side length a. The masses are as follows: m, $3m$, $4m$ and 7m. Calculate the net gravitational force on the point mass m_0 is located at the centre of the square due to the other masses.

23. Six point masses, each of mass m, are placed at the vertices of a regular hexagon with side length a. A seventh mass m_0 is placed at the center of the hexagon. Find the net gravitational force acting on the mass m_0 due to the six masses located at the vertices of the hexagon.

(*a*) zero (*b*) $\frac{3Gm_0m}{a^2}$

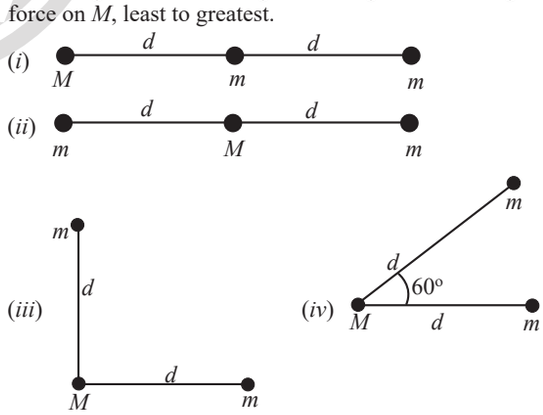
(*c*) $\frac{9Gm_0m}{a^2}$ (*d*) $\frac{25Gm_0m}{a^2}$

24. Find the net gravitational force acting on the mass m_0 placed at the centre of each configuration due to the surrounding equal masses m at each vertex in each of the following configurations:

(i) An equilateral triangle (ii) A square

(iii) A regular pentagon (iv) A regular hexagon

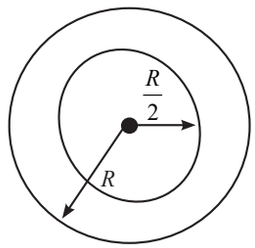
25. Three particles, two with masses m and one with mass M, might be arranged in any of the four configurations shown below. Rank the configuration according to the magnitude of the gravitational force on M, least to greatest.



(*a*) i, ii, iii, iv (*b*) ii, i, iii, iv

(*c*) ii, i, iv, iii (*d*) ii, iii, iv, i

26. Force between a solid sphere (M, R) and m is F as shown in the figure. If a sphere of radius $\frac{R}{2}$ concentric is removed, then find the new force between the remaining part of the sphere and the mass m.



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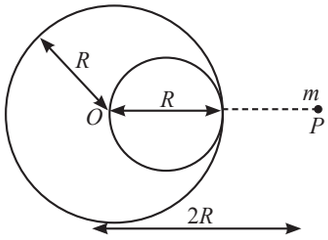
27. A uniform sphere of mass M and radius R exerts a force F on a small mass m situated at a distance of $2R$ from the centre O of the sphere. A spherical portion of diameter R is cut from the sphere as shown in figure. The force of attraction between the remaining part of the sphere and the mass m will be



28. Given below are two statements.

Statement-I: The law of gravitation holds good for any pair of bodies in the universe.

Statement-II: The weight of any person becomes zero when the person is at the centre of the earth.

In the light of the above statements, choose the correct answer from the option given below:

(*a*) Both Statement-I and Statement-II are true

(*b*) Both Statement-I and Statement-II are false

(*c*) Statement-l is true but Statement-II is false

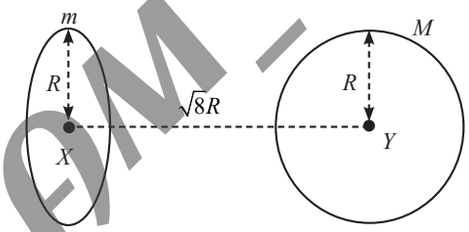
(*d*) Statement-I is false but Statement-II is true

29. Four particles of equal mass are moving round a circle of radius r due to their mutual gravitational attraction. Find the angular velocity of each particle.

(*a*) $\sqrt{\frac{GM}{r^3}\left[\frac{4+\sqrt{2}}{4\sqrt{2}}\right]}$ (*b*) $\sqrt{\frac{GM}{r^3}}$

(*c*) $\sqrt{\frac{GM}{r^3}\left[\frac{2+\sqrt{2}}{\sqrt{2}}\right]}$ (*d*) $\sqrt{\frac{GM}{r^3}\left[\frac{4+\sqrt{2}}{2\sqrt{2}}\right]}$

30. Find the gravitational force of attraction between the ring and sphere as shown in the diagram, where the plane of the ring is perpendicular to the line joining the centres. If $\sqrt{8}R$ is the distance between the centres of a ring (of mass 'm ') and a sphere (mass 'M') where both have equal radius 'R'.



(*a*) $\frac{\sqrt{8}}{9}\cdot\frac{GmM}{R}$ (*b*) $\frac{1}{3\sqrt{8}}\cdot\frac{GMm}{R^2}$

(*c*) $\frac{\sqrt{8}}{27}\cdot\frac{GmM}{R^2}$ (*d*) $\frac{2\sqrt{2}}{3}\cdot\frac{GMm}{R^2}$

31. If there was a reduction in gravitational effect, then which of the following forces do you think would change in some respect?

(*a*) Magnetic force (*b*) Electrostatic force

(*c*) Viscous force (*d*) Archimedes uplift

32. Choose the wrong option.

(*a*) Inertial mass is measure of difficulty of accelerating a body by an external force whereas the gravitational mass is relevant in determining the gravitational force on it by an external mass.

(*b*) That the gravitational mass and inertial mass are equal in an experimental result.

(*c*) That the acceleration due to gravity on earth is the same for all bodies is due to the equality of gravitational mass and inertial mass.

(*d*) Gravitational mass of particle like proton can depend on the presence of neighbouring heavy objects but the inertial mass cannot.

33. Two bodies having same mass m each are placed at at a distance r gravitations force between then is F. If 25% mass of the body is transfer to the second body and separation become half then gravitational force between them is:-

(*a*) 15/4F (*b*) F

(*c*) 4F/ 15 (*d*) 15/16 F

34. A spherical cavity of radius R/2 is made in a sphere of radius R and mass M. the centre of the cavity is at a distance R/2 from the centre of the sphere. The intensity of gravitational field at the centre of cavity is:-

(*a*) 0 (*b*) GM/R^2

(*c*) $Gm/2R^2$ (*d*) $3GM/2R^2$

35. Choose the correct statement(s) from the following:-

(A) The magnitude of the gravitational force between two bodies of mass 1 kg each and separated by a distance of 1 m is 9.8 N

(B) Higher the value of escape velocity for a planet, higher is the abundance of lighter gases in its atmosphere.

(C) Force of friction arises due to gravitational attraction.

(D) The gravitational force of attraction between two bodies of ordinary mass is not noticeable because the value of the gravitational constant is extremely small.:

(*a*) A, B (*b*) B, C, D

(*c*) D (*d*) B, D

Gravitational Field Intensity

36. Two point masses having mass m and $2m$ are placed at distance d. The point on the line joining point masses, where gravitational field intensity is zero will be at distance

(*a*) $\frac{2d}{\sqrt{3}+1}$ From point mass "$2m$"

(*b*) $\frac{2d}{\sqrt{3}-1}$ From point mass "$2m$"

(*c*) $\frac{d}{1+\sqrt{2}}$ From point mass "m"

(*d*) $\frac{d}{1-\sqrt{2}}$ From point mass "m"

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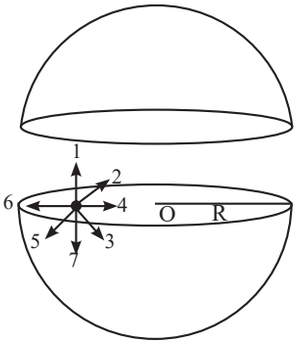
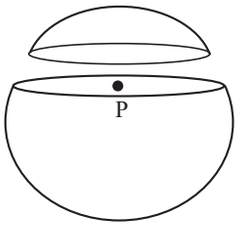
37. Consider a hollow hemispherical shell with mass M and radius R. The diagram shows the gravitational field intensity at various points on the axis of the hemisphere. Which direction will have the strongest gravitational field intensity at the center of the hemisphere?



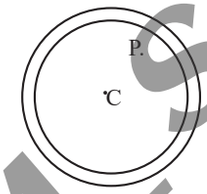
(*a*) Direction 1 (*b*) Direction 2
(*c*) Direction 3 (*d*) Direction 4
(*e*) Direction 7

38. A spherical shell is cut into two pieces along a chord as shown in the figure. 'P' is a point on the plane to the chord. The gravitational field at 'P' due to the upper part is I_1, and that due to the lower part is I_2. What is the relation between them?



(*a*) $I_1 > I_2$ (*b*) $I_2 > I_1$
(*c*) $I_1 = I_2$ (*d*) No definite relation

39. The force between a hollow sphere and a point mass at P inside it as shown in fig.



(*a*) Is attractive and constant
(*b*) Is attractive and depends on the position of the point with respect to center C
(*c*) 10 N
(*d*) 0 N

40. The gravitational force on a body of mass 1.5 *kg* situated at a point is 45 *N*. The gravitational field intensity at that point is

(*a*) 30 *N/kg* (*b*) 67.5 *N/kg*
(*c*) 46.5 *N/kg* (*d*) 43.5 *N/kg*

41. If gravitational field intensity is E at distance $R/2$ outside from the surface of a thin shell of radius R, the gravitational field intensity at distance $R/2$ from its center is

(*a*) Zero (*b*) $2E$
(*c*) $\frac{2E}{3}$ (*d*) $\frac{3E}{2}$

42. Point masses m are placed along the x-axis at coordinates (1,0), (2,0), (4,0), (8,0), and so on, with increasing distances. Find the gravitational field intensity at the origin (0,0) due to these point masses.

	m	m	m	m
0.0	(1,0)	(2,0)	(4,0)	(8,0)

43. A mass M is distributed along a circular arc of radius R subtending an angle θ at the center. Find the gravitational field at the center due to the mass distributed along the arc. Additionally, find the gravitational field when the mass is distributed along a half-ring ($\theta = \pi$).

44. If gravitational field intensity is E at distance $R/2$ outside from then the surface of a thin shell of radius R, the gravitational field intensity at distance $R/2$ from its centre is

(*a*) Zero (*b*) 2E
(*c*) $\frac{2E}{3}$ (*d*) $\frac{3E}{2}$

45. "Gravity-free space" does not necessarily imply "gravitational-free space."

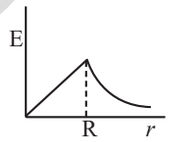
Is this statement True or False?

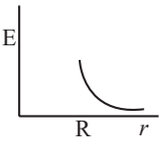
(*a*) True (*b*) False

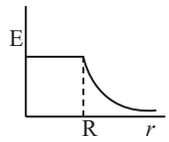
46. Two astronauts are floating in gravitational free space after having lost contact with their spaceship The two will

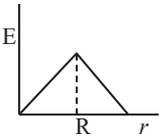
(*a*) Move towards each other
(*b*) Move away from each other
(*c*) Will become stationary
(*d*) Keep floating at the same distance between them

47. Which one of the following plots represents the variation of gravitational field of a particle with distance r du to thin spherical shell of radius R ?

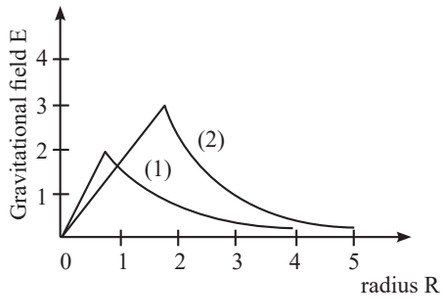
(*a*)


(*b*)


(*c*)


(*d*)


48. Consider two solid spheres of radii $R_1 = 1m$, $R_2 = 2m$ and masses M_1 and M_2, respectively. The gravitational field due to sphere (1) and (2) are shown. The value of $\frac{M_1}{M_2}$ is



(*a*) $\frac{2}{3}$ (*b*) $\frac{1}{3}$
(*c*) $\frac{1}{2}$ (*d*) $\frac{1}{6}$

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49. Let E_1 and E_2 denotes magnitude of gravitational field at distance 'r_1' and 'r_2' from axis of infinitely long solid cylinder of radius 'R'. Which of the following must hold true:

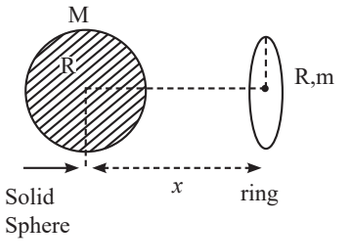
(*a*) $E_1 < E_2$ if $r_1 < r_2 < R$

(*b*) $E_1 > E_2$ if $R < r_1 < r_2$

(*c*) $E_1 > E_2$ if $r_1 = R - E$, $r_2 = R + E$ (E is positive constant < R)

(*d*) All of the above

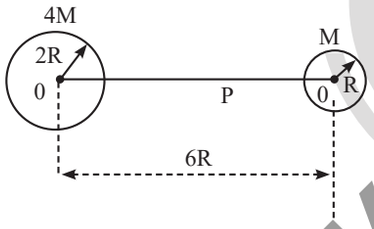
50. The distance between Centre of Mass of solid sphere and ring is x. The force acting on ring due to sphere is.



(*a*) $\frac{GMm}{x^2}$ (*b*) $\frac{GMm}{(x^2+R^2)}$

(*c*) $\frac{GMmx}{(x^2+R^2)^{3/2}}$ (*d*) None of these

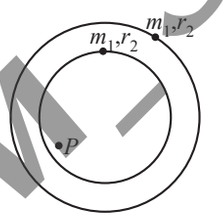
51. Two sphere of mss 4M and M are separated by distance 6R. P is a null point then OP is equal to



(*a*) 3R (*b*) 4R

(*c*) 3R/2 (*d*) 2R

52. The gravitational field due to a system of two concentric thin spherical shells of mass m_1 and m_2 and radii r_1, and r_2 at the point *P*.



(*a*) $\frac{Gm_1}{r_1^2}$ (*b*) $\frac{Gm_2}{r_2^2}$

(*c*) $\frac{G(m_1+m_2)}{r_1^2}$ (*d*) Zero

53. Mass of uniform circular ring is M and its radius is R. Find the maximum intensite of gravitation field on the asis of the ring.

(*a*) $\frac{2}{3\sqrt{3}}\frac{GM}{R^2}$ (*b*) $\frac{GM}{R^2}$

(*c*) $\frac{2GM}{R^2}$ (*d*) $\frac{3}{2\sqrt{2}}\frac{GM}{R^2}$

Acceleration Due to Gravity

54. If density of a planet is double that of the earth and the radius 1.5 times that of the earth, the acceleration due to gravity on the surface of the planet is

(*a*) 3/4 times that on the surface of the earth

(*b*) 3 times that on the surface of the earth

(*c*) 4/3 times that on the surface of the earth

(*d*) 6 times that on the surface of the earth

55. Two planets have same density but different radii. The acceleration due to gravity would be

(*a*) Same on both planets

(*b*) Greater on the smaller planet

(*c*) Greater on the larger planet

(*d*) Dependent on the distance of planet from the sun

56. If mass of object is 12 kg on the surgace of earth then its mass on surface of moon ??

(*a*) 6 kg (*b*) 2 kg

(*c*) 12 kg (*d*) Zero

57. Density of newly discovered planet is twice that of earth. The acceleration due to gravity at the surface of the planets is equal to that at the surface of the earth. If the radius of earth is *R*, then the radius of the planet would be

(*a*) 2R (*b*) 4R

(*c*) R/4 (*d*) R/2

58. At some planet 'g' is 1.96 m sec^2. if it is safe to jump from a height of 2m on earth, then what should be corresponding safe height for jumping on that planet:

(*a*) 5 m (*b*) 2 m

(*c*) 10 m (*d*) 20 m

59. If the radius of earth shrinks by 1.5% mass remaining same. then the value of gravitational acceleration changes by

(*a*) 2% (*b*) -2%

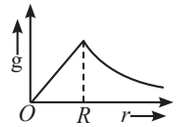
(*c*) 3% (*d*) -3%

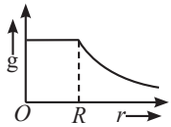
60. When the radius of earth is reduced by 1% without changing the mass, then the acceleration due to gravity will

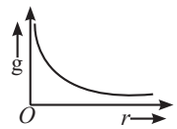
(*a*) Increase by 2% (*b*) Decrease by 1.5%

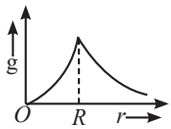
(*c*) Increase by 1% (*d*) Decrease by 1%

61. The variation of acceleration due to gravity (g) with distance (r) from the centre of the earth is correctly represented by: (Given R = radius of earth)

(*a*) 

(*b*) 

(*c*) 

(*d*) 

62. The radii of two planets 'A' and 'B' are 'R' and '4R' and their densities are ρ and ρ/3 respectively. The ratio of acceleration due to gravity at their surfaces ($g_A : g_B$) will be:

(*a*) 1 : 16 (*b*) 3 :16

(*c*) 3 : 4 (*d*) 4 : 3

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63. The moon's radius is 1/4 that of the earth and its mass is 1/80 times that of the earth. If g represents the acceleration due to gravity on the surface of the earth, that on the surface of the moon is-

(*a*) $g/4$ (*b*) $g/5$
(*c*) $g/6$ (*d*) $g/8$

64. Given below are two statements: one is labelled as Assertion A and the other is labeled as Reason *R*.

Assertion (A): A pendulum clock when taken to Mount Everest becomes fast.

Reason (R): The value of g (acceleration due to gravity) is less at Mount Everest than its value on the surface of earth.

In the light of the above statements, choose the most appropriate answer from the options given below

(*a*) Both *A* and *R* are correct but *R* is NOT the correct explanation of *A*

(*b*) Both *A* and *R* are correct and *R* is the correct explanation of *A*

(*c*) *A* is not correct but R is correct

(*d*) *A* is correct but *R* is not correct

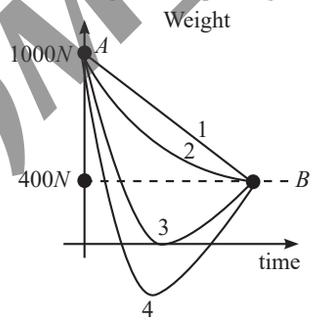
65. Assume there are two identical simple pendulum clocks. Clock -1 is placed on the earth and Clock - 2 is placed on a space station located at a height h above the earth surface. Clock - 1 and Clock - 2 operate at time periods 4*s* and 6*s* respectively. Then the value of h is - (consider radius of earth R_E = 64000km and g on earth 10m/s^2

(*a*) 1200 *km* (*b*) 1600 *km*
(*c*) 3200 *km* (*d*) 4800 *km*

66. Consider a planet in some solar system which has a mass double the mass of earth and density equal to the average density of earth. If the weight of an object on earth is *W*, the weight of the same object on that planet will be:

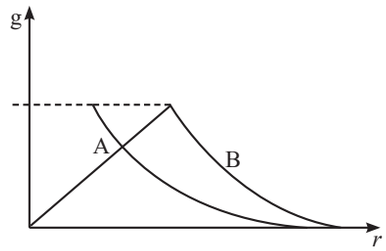
(*a*) 2 *W* (*b*) *W*
(*c*) $\sqrt{2}W$ (*d*) $2^{\frac{1}{3}}W$

67. A person whose mass is 100 kg travels from Earth to Mars in a spaceship. Neglect all other object in sky and take acceleration due to gravity on the surface of the Earth and mars as 10 m/s^2 and 4 m/s^2 respectively. Identify from the. below figures, the curve that fits best for the weight of the passenger as a function of time.



(*a*) (3) (*b*) (1)
(*c*) (2) (*d*) (4)

68. The variations in acceleration due to gravity (g) of two planets A and B are plotted as a function of distance r from its center, Which of the following statements is correct?



(*a*) The planet A has greater mass than B
(*b*) The planet A and B have same mass
(*c*) The planet A is denser than
(*d*) The planet B is smaller in size

Acceleration due to Gravity at a Height

69. If the radius of the earth is R_1 then the height h above the surface of the earth at which the values of g becomes one fourth, will be

(*a*) $R/8$ (*b*) $3R/8$
(*c*) $3R/4$ (*d*) R

70. The height at which weight of the body become $\frac{1}{16}$ its weight on the surface of earth, is

(*a*) 5*R* (*b*) 15 *R*
(*c*) 3*R* (*d*) 4*R*

71. The height at which the acceleration du to gravity becomes $\frac{g}{9}$ (where g = the acceleration due to gravity on the surface of the earth) in terms of *R*, the radius of the earth is:

(*a*) $\frac{R}{2}$ (*b*) $\sqrt{2}R$
(*c*) 2*R* (*d*) $\frac{R}{\sqrt{2}}$

72. A body weighs 144 *N* at the surface of earth. When it is taken to a height of $h = 3R$, where *R* is radius of earth, it would weigh

(*a*) 48 N (*b*) 36 N
(*c*) 16 N (*d*) 9 N

73. At what height above the Earth's surface does the acceleration due to gravity decrease by 2%?

74. At what height above the Earth's surface does the acceleration due to gravity decrease by 75%?

75. Radius of earth is around 6000 km. The weight of body at height of 6000 km from earth surface becomes

(*a*) Half (*b*) One-fourth
(*c*) One third (*d*) No change

76. A body weight *W*, is projected vertically upwards from earth's surface to reach a height above the earth which is equal to nine times the radius of earth. The weight of the body at that height will be:

(*a*) $\frac{W}{91}$ (*b*) $\frac{W}{100}$
(*c*) $\frac{W}{9}$ (*d*) $\frac{W}{3}$

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77. The value of 'g' reduces to half of its value at surface of earth at a height 'h', then:

(*a*) $h = r$ (*b*) $h = 2R$

(*c*) $h = \left(\sqrt{2}-1\right)R$ (*d*) $h = \left(\sqrt{2}-2\right)R$

78. Altitude at which acceleration due to gravity decreases by 0.1% approximately: (Radius of earth-64000km)

(*a*) 3.2 *km* (*b*) 6. 4 *km*

(*c*) 2.4 *km* (*d*) 1.6 *km*

79. Find Height at which acceleration due to gravity decreases to 64% of initial value

(*a*) $\frac{R}{2}$ (*b*) $\frac{R}{4}$

(*c*) $\frac{2R}{3}$ (*d*) $\frac{3R}{2}$

80. The length of a seconds pendulum at a height $h = 2R$ from earth surface will be: (Given R = Radius of earth and acceleration due to gravity at the surface of earth, $g = \pi^2 ms^{-2}$)

(*a*) 2/9 m (*b*) 4/9 m

(*c*) 8 /9 m (*d*) 1/ 9 m

Acceleration due to Gravity at Depth 'd'

81. How much deep inside the earth (radius R) should a man go, so that his weight becomes one-fourth of that on earth's surface?

(*a*) $\frac{R}{4}$ (*b*) $\frac{R}{2}$

(*c*) $\frac{3R}{4}$ (*d*) None of these

82. At what depth below the surface of earth, the value of g is the same as that at a height of 5 *km* ?

(*a*) 1.25 *km* (*b*) 2.5 *km*

(*c*) 10 *km* (*d*) 7.5 *km*

83. At what height from the ground will the value of 'g' be the same as that in 10 km deep mine below the surface of earth-

(*a*) 20 *km* (*b*) 10 *km*

(*c*) 15 *km* (*d*) 5 *km*

84. At what distance from the centre of the earth, the value of acceleration due to gravity g will be half that on the surface (R= Radius of earth)

(*a*) $2R$ (*b*) R

(*c*) $1.414R$ (*d*) $0.414R$

85. An object is placed at a distance of $R/2$ from the centre of earth. Knowing mass is distributed uniformly, acceleration of that object due to gravity at that point is: (g = acceleration due to gravity on the surface of earth and R is the radius of earth)

(*a*) g (*b*) 2g

(*c*) g/2 (*d*) None of these

86. Assuming the earth to be a sphere of uniform mass density, the weight of a body at a depth $d = \frac{R}{2}$ from the surface of earth, if its weight on the surface of earth is 200 N will be:

(*a*) 400 N (*b*) 500 N

(*c*) 300 N (*d*) 100 N

87. The depth at which the value of acceleration due to gravity becomes N times the value at the surface is

(*a*) $\frac{R}{n}$ (*b*) $\frac{R}{n^2}$

(*c*) $\frac{R[n-1]}{n}$ (*d*) $\frac{Rn}{n-1}$

88. If acceleration due to gravity at distance d[< R] from the centre of earth is β, then its value at distance d above the surface of earth will be [where R is radius of earth]

(*a*) $\frac{\beta R^2}{(R+d)^3}$ (*b*) $\frac{\beta R}{2d}$

(*c*) $\frac{\beta d}{(R+d)^2}$ (*d*) $\frac{\beta R^3}{d(R+d)^2}$

89. Given below are two statements:

Statement-I: Acceleration due to gravity is different at different places on the surface of earth.

Statement-II: Acceleration due to gravity increases as we go down below the earth's surface.

In the light of the above statements, chosen the correct answer from the options given below:

(*a*) Both Statement-I and Statement-II are true

(*b*) Both Statement-I and Statement-II are false

(*c*) Statement-I is true but Statement-II is false

(*d*) Statement-I is false but Statement-II is true

90. Given below are two statements:

Statement-I: Acceleration due to earth's gravity decreases as you go 'up' or 'down' from earth's surface.

Statement-II: Acceleration due to earth's gravity is same at a height 'h' and depth 'd' from earth's surface, if $h = d$

In the light of above statement, choose the most appropriate answer from the options given below:

(*a*) Statement-I is incorrect but Statement-II is correct

(*b*) Both Statement-I and Statement-II are incorrect

(*c*) Statement-I is correct but Statement-II is incorrect

(*d*) Both Statement-I and Statement-II are correct

Effect of Rotation on Acceleration due to Gravity

91. Given below are two statements:

Statement-I: Rotation of the earth shows effect on the value of acceleration due to gravity (g).

Statement-II: The effect of rotation of the earth on the value of 'g' at the equator is minimum and that at the pole is maximum.

In the light of the above statements, choose the correct answer

(*a*) Statement-I is false but Statement-II is true

(*b*) Statement-I is true but Statement-II are false

(*c*) Both Statement-I and Statement-II are true

(*d*) Both Statement-I and Statement-II are false

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92. Given below are two statements: One is labelled as Assertion (*A*) and the other is labelled as Reason (*R*).

Assertion (A): If we move from poles to equator, the direction of acceleration due to gravity of earth at any points towards the centre of earth without any variation in its magnitude.

Reason (R): At equator, the direction of acceleration due to the gravity is towards the centre of earth.

In the light of above statements, choose the correct answer

(*a*) Both *A* and *R* are true and *R* is the correct explanation of *A*.
(*b*) Both *A* and *R* are true but *R* is NOT the correct explanation of *A*.
(*c*) *A* is true but *R* is false
(*d*) *A* is false but *R* is true

93. Which of the following statements are true about acceleration due to gravity?

(i) '*g*' decreases in moving away from the centre if $r > R$.
(ii) '*g*' decreases in moving away from the centre if $r < R$
(iii) '*g*' is zero at the centre of earth
(iv) '*g*' decreases if earth stops rotation on its axis

(*a*) (i, ii) (*b*) (i, iii)
(*c*) (ii, iii) (*d*) (i, ii, iv)

94. What will happen to the weight of the body at the south pole if the earth stops rotating about its polar axis?

(*a*) No change (*b*) Increase
(*c*) Decreases but no zero (*d*) Reduces to zero

95. If earth suddenly stop rotating, then the weight of an object of mass *m* at equator will [ω is angular speed of earth and *R* is its radius]

(*a*) Decreases by $m\omega^2R$ (*b*) Increases by $m\omega^2R$
(*c*) Decreases by $m\omega R$ (*d*) Increases by $m\omega R$

96. The radius of earth is 6400 *km* and $g = 9.8 m/sec^2$. If the body placed at the equator has to become weightless the earth should make one complete ration in

(*a*) 12 hour (*b*) 1.4 hour
(*c*) 6 hour (*d*) 24 hour

97. When a body is taken from the equator to the poles, its weight-

(*a*) Remains constant
(*b*) Increases
(*c*) Decreases
(*d*) Increases at N-pole and decreases at S-pole

98. What is the percentage change in the value of '*g*' on shifting from equator to poles on the earth's surface?

(*a*) 4.5 % (*b*) 0.343%
(*c*) 0.05% (*d*) 1.5%

99. What should be the angular speed with which the earth have to rotate on its axis so that *a* person on the equator would weigh $\frac{3}{5}$ the as much as present?

(*a*) $\sqrt{\frac{2g}{5R}}$ (*b*) $\sqrt{\frac{2R}{5g}}$
(*c*) $\frac{2\sqrt{R}}{\sqrt{5g}}$ (*d*) $\frac{2g}{5R}$

100. 1 *kg* sugar is taken from equator to pole then its mass:

(*a*) Will increase (*b*) Will decrease
(*c*) Will remains same (*d*) None of these

101. 1 *kg* sugar is taken from equator to pole then its weight :

(*a*) Will increase (*b*) Will decrease
(*c*) Will remains same (*d*) None of these

102. If earth is supposed to be a sphere of radius *R*, if g_{30} is value of effective acceleration due to gravity at latitude of 30° and g at the equator, the value of $|g - g_{30}|$ is (ω is angular velocity of rotation of earth)

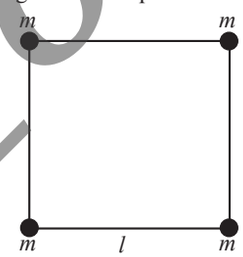
(*a*) $1/4\omega^2R$ (*b*) $3/4\omega^2R$
(*c*) ω^2R (*d*) $1/2\omega^2R$

Gravitational Potential

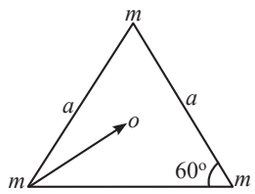
103. The gravitational potential due to a point mass *M* at a distance *r* from the mass is always negative.

(*a*) True (*b*) False

104. Four point masses *m* are placed at the corners of a square with side length *l*. Find the gravitational potential at the center of the square.



105. Three point masses *m* are placed at the corners of an equilateral triangle with side length a. Find the gravitational potential at the centroid of the triangle.



106. Two point mass *M* & *4M* at distance *r*, find gravitational potential. Where gravitational field is zero.

107. If gravitational potential taken to be zero at surface of Solid sphere of mass *m* & radius *R* then find potential of infinity.

(*a*) Zero (*b*) $\frac{-Gm}{R}$
(*c*) $\frac{+Gm}{R}$ (*d*) $\frac{-3}{2}\frac{Gm}{R}$

108. If potential at the surface of earth is assigned zero value, then potential at centre of earth will be (Mass = *M*, Radius = *R*)

(*a*) 0 (*b*) $-\frac{GM}{2R}$
(*c*) $-\frac{3GM}{2R}$ (*d*) $\frac{3GM}{2R}$

109. If *V* is the gravitational potential due to sphere of uniform density on it's surface, then it's value at the center of sphere will be:

(*a*) $3V/2$ (*b*) V
(*c*) $4/3\ V$ (*d*) $V/2$

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110. At what height from the surface of earth the gravitation potential and the value of g are -5.4×10^7 J kg^{-1} and 6.0 $m\ s^{-2}$ respectively? Take the radius of earth as 6400 km

(*a*) 2000 *km* (*b*) 2600 *km*
(*c*) 16000 *km* (*d*) 1400 *km*

111. Inside a uniform spherical shell;

(*a*) The gravitational field is zero
(*b*) The gravitational potential is zero
(*c*) The gravitational field is same everywhere
(*d*) The gravitation potential is same everywhere
(*e*) all the above

Choose the most appropriate answer from the options given below :

(*a*) (E) only (*b*) (A), (C) and (D) only
(*c*) (B), (C) and (D) only (*d*) (A), (B) and (C) only

112. Let V and E represent the gravitational potential and field at a distance r from the centre of a uniform solid sphere. Consider the two statements :

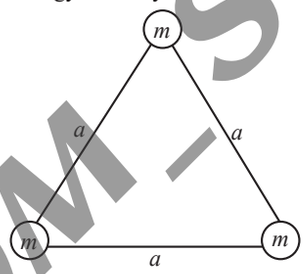
(A) The plot of V against r is discontinuous.
(B) The plot of E against r is discontinuous.
(*a*) Both (*A*) and (*B*) are correct.
(*b*) (*A*) is correct but (*B*) is wrong.
(*c*) (*B*) is correct but (*A*) is wrong.
(*d*) Both (*A*) and (*B*) are wrong.

113. The gravitational field due to mass distribution is $E = \frac{A}{x^2}$ in x-direction. here, A is constant. Taking the gravitational potential to be zero at infinity, potential at x is:

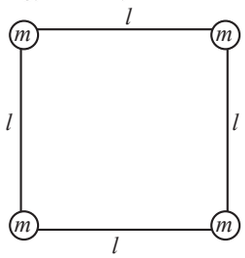
(*a*) $2A/x$ (*b*) $2A/x^3$
(*c*) A/x (*d*) $A/2x^2$

Gravitational Potential Energy

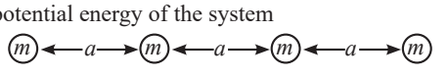
114. Find potential energy of the system



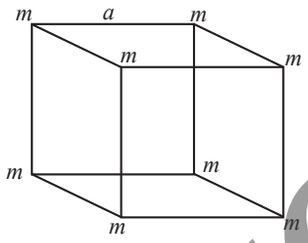
115. Find potential energy of the system



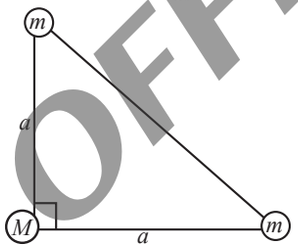
116. Find potential energy of the system



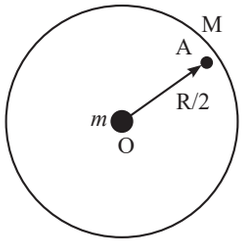
117. Eight point masses, each of mass m, are placed at the corners of a cube with side length a. Calculate the total gravitational potential energy of this system of point masses.



118. Three point masses are arranged in a right angle triangle triangular configuration as shown in the diagram. Calculate the total gravitational potential energy of the system.



119. Isolated uniform hollow sphere of mass M and radius R has a point mass m placed at its centre as shown in figure. Find out the work done in moving the point mass from the centre to a point A



(*a*) Gm M/R (*b*) 2 Gm M/R
(*c*) -2 Gm M/R (*d*) Zero

Gravitational Potential Energy of Earth Mass System

120. Consider the Earth-mass system, where the Earth has a mass M and radius R, and a point mass m is located at a height H above the Earth's surface.

(i) Calculate the gravitational potential energy of the point mass when it is located

(*a*) On the surface of the Earth.
(*b*) At a height H above the Earth's surface

(ii) Determine the change in gravitational potential energy when the point mass m is moved from the Earth's surface to a height H.

121. An object is taken to height $2R$ above the surface of earth, the increase in potential energy if [R is radius of earth]

(*a*) $\frac{mgR}{2}$ (*b*) $\frac{mgR}{3}$
(*c*) $\frac{2mgR}{3}$ (*d*) $2\ mgR$

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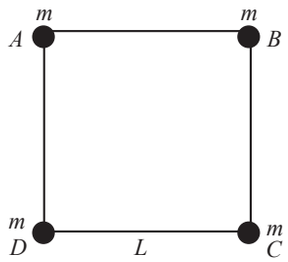
122. The change in potential energy when a body of mass m is raised to height nR from the earth's surface is (R is radius of earth)

(*a*) $\text{mgR}\left(\frac{n}{n-1}\right)$ (*b*) mgR

(*c*) $\text{mgR}\left(\frac{n}{n+1}\right)$ (*d*) $mgR\left(\frac{n^2}{n^2+1}\right)$

123. Find work done in moving three point mass from infinity to corner of equilateral triangle of side a.

124. Four particles *A, B, C* and *D* each of mass m are kept at the corners of a square of side L. Now the particle D is taken to infinity by an external agent keeping the other particles fixed at their respective position. The work done by the gravitational force acting on the particle D during its movement is



(*a*) $2\frac{Gm^2}{L}$ (*b*) $-2\frac{Gm^2}{L}$

(*c*) $\frac{Gm^2}{L}\left(\frac{2\sqrt{2}+1}{\sqrt{2}}\right)$ (*d*) $-\frac{Gm^2}{L}\left(\frac{2\sqrt{2}+1}{\sqrt{2}}\right)$

125. Four identical Particle of mass m placed on the corner of square of side length a_1 then find work to Move 5th Mans M from centre of square to infinity??

126. Three particles of masses m, $2m$ and $3m$ are placed at the corners of an equilateral triangle of side a. Calculate:

(i) The potential energy of the system

(ii) The work done on the system if the side of the triangle is changed from a to $2a$. Assume the potential energy to be zero when the separation is infinity.

127. If potential energy of a body of mass m on the surface of earth is taken as zero then its potential energy at height h above the surface of earth is [R is radius of earth and M is mass of earth]

(*a*) $\frac{-GMm}{R+h}$ (*b*) $\frac{-GMm}{h}$

(*c*) $\frac{GMmh}{R(R+h)}$ (*d*) $\frac{GMmh}{(h+2R)}$

128. A body of mass m is taken from the earth surface to a height h equal to twice the radius of earth (R_e), the increase in potential energy will be: (g = acceleration due to gravity on the surface of Earth)

(*a*) $3\ mgR_e$ (*b*) $1/3\ mgR_e$

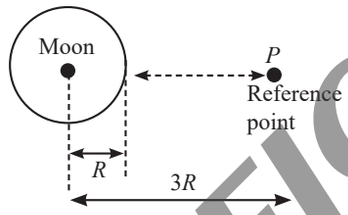
(*c*) $2/3\ mgR_e$ (*d*) $1/2\ mgR_e$

Conservation of Mechanical Energy

129. A point mass m is released from rest at a distance $4R$ from the center of a solid sphere of mass M and radius R. calculate the speed of the point mass m when it reaches the surface of the solid sphere.

130. A point mass m is released from rest on the surface of the Earth (mass M and radius R) into a tunnel that passes through the center of the Earth. Find the speed of the point mass when it reaches the center of the Earth.

131. A stationary object is released from a point P at a distance 3R from the centre of the moon which has radius R and mass M. Which of the following gives the speed of the object on hitting the moon?



(*a*) $\left(\frac{2GM}{3R}\right)^{1/2}$ (*b*) $\left(\frac{4GM}{3R}\right)^{1/2}$

(*c*) $\left(\frac{GM}{3R}\right)^{1/2}$ (*d*) $\left(\frac{GM}{R}\right)^{1/2}$

132. A body of mass m projected vertically upwards with a speed of $\sqrt{\frac{GM}{R}}$ (M is mass and r is radius of earth). The body will attain a height of

(*a*) $\frac{R}{2}$ (*b*) R

(*c*) $\frac{5}{4}R$ (*d*) $\frac{3R}{2}$

133. An object is allowed to fall from a height R above the earth, where R is the radius of earth. Its velocity when it strikes the earth's surface, ignoring air resistance, will be:

(*a*) $2\sqrt{gR}$ (*b*) $\sqrt{gR}$

(*c*) $\sqrt{\frac{gR}{2}}$ (*d*) $\sqrt{2gR}$

134. A rocket has to be launched from earth in such a way that it never returns. If E is the minimum energy delivered by the rocket launcher, what should be the minimum energy that the launcher should be the minimum energy that the launcher should have if the same rocket is to be launched from the surface of the moon? Assume that the density of the earth and the moon are equal and that the earth's volume is 64 times the volume of the moon

(*a*) $\frac{E}{4}$ (*c*) $\frac{E}{32}$

(*b*) $\frac{E}{16}$ (*d*) $\frac{E}{64}$

Escape Velocity

135. The total mechanical energy of an object of mass m projected from surface of earth with escape speed is

(*a*) Zero (*b*) Infinite

(*c*) $-\frac{GMm}{2R}$ (*d*) $-\frac{GMm}{3R}$

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136. The escape velocity of a body from earth is about 11.2 *km/s*. Assuming the mass and radius of the earth to be about 81 and 4 times the mass and radius of the moon, the escape velocity in *km/s* from the surface of the moon will be

(*a*) 0.54 (*b*) 2.48
(*c*) 11 (*d*) 49.5

137. A body is throw with a velocity equal to *n* times the escape velocity (v_e). Velocity of the body at a large distance away will be

(*a*) $v_e\sqrt{n^2-1}$ (*b*) $v_e\sqrt{n^2+1}$
(*c*) $v_e\sqrt{1-n^2}$ (*d*) None of these

138. If *M* is mass of a planet and *R* is its radius then in order to become black hole [*c* is speed of light]

(*a*) $\sqrt{\frac{GM}{R}} \le c$ (*b*) $2\sqrt{\frac{GM}{2R}} \ge c$
(*c*) $\sqrt{\frac{2GM}{R}} \ge c$ (*d*) $\sqrt{\frac{2GM}{R}} \le c$

139. The atmosphere on a planet is possible only if [where v_{rms} is root mean square speed of gas molecules on planet and v_e is escape speed on its surface]

(*a*) $V_{rms} = V_e$ (*b*) $V_{rms} > V_e$
(*c*) $V_{rms} \le V_e$ (*d*) $V_{rms} < V_e$

140. A black hole is an object whose gravitational field is so strong that even light cannot escape from it. To what approximate radius would earth (mass = 5.98×10^{24} kg) have to be compressed to be a black hole?

(*a*) 10^{-9} *m* (*b*) 10^{-6} *m*
(*c*) 10^{-2} *m* (*d*) 100 *m*

141. The ratio of escape velocity at earth (v_e) to the scape velocity at a planet (v_p) whose radius and mean density are twice as that of earth is ??

(*a*) $1:\sqrt{2}$ (*b*) 1 : 2
(*c*) $1:2\sqrt{2}$ (*d*) 1 : 4

142. The radius of a planet is twice the radius of earth. Both have almost equal average mass-densities. V_P and V_E are escape velocities of the planet and the earth, respective!)' then

(*a*) $V_P = 1.5\ V_E$ (*b*) $V_P = 2V_E$
(*c*) $V_E = 3\ V_P$ (*d*) $V_E = 1.5\ V_P$

143. A body is projected vertically upward from the surface of earth with a velocity equal to one third of escape velocity. The maximum height attained by the body will be: (Take radius of earth = 64000 *km* and $g = 10ms^{-2}$)

(*a*) 800 *km* (*b*) 1600 *km*
(*c*) 2133 *km* (*d*) 48000 *km*

144. A particle of mass '*m*' is kept at rest at a height 3*R* from the surface of earth, where '*R*' is radius of earth and '*M*' is mass of earth. The minimum speed with which it should be projected, so that it does not return back, is (*g* is acceleration due to gravity on the surface of earth)

(*a*) $\left(\frac{GM}{R}\right)^{1/2}$ (*b*) $\left(\frac{GM}{2R}\right)^{1/2}$
(*c*) $\left(\frac{gM}{4}\right)^{1/2}$ (*d*) $\left(\frac{2g}{R}\right)^{1/2}$

145. Let escape velocity of a body kept at surface of a planet is *u*. If it is projected at a speed of 200% more than the escape speed, then its speed in interstellar space will be

(*a*) *u* (*b*) $\sqrt{3}u$
(*c*) 2*u* (*d*) $2\sqrt{2}$

146. When speed of *a* satellite is increased by *x* percentage, it will escape from its orbit, where the value of *x* is

(*a*) 11.2% (*b*) 41.4%
(*c*) 27.5% (*d*) 34.4%

147. If earth has a mass nine times and radius twice that of a planet *P*. Then $\frac{v_e}{3}\sqrt{x}\ \text{ms}^{-1}$ will be the minimum velocity required by a rocket to pull out of gravitational force of *P*, where v_e is escape velocity on earth. The value of *x* is:

(*a*) 2 (*b*) 3
(*c*) 18 (*d*) 1

148. Given below are two statements: one is labelled as Assertion A and the other is labelled as Reason *R* .

Assertion (A) : Earth has atmosphere whereas moon doesn't have any atmosphere.

Reason (R): The escape velocity on moon is very small as compared to that on earth. In the light of the above statement, choose the correct answer from the options given below:

(*a*) *A* is true but *R* is false
(*b*) *A* is false but *R* is true
(*c*) Both a and *R* are correct but *R* is NOT the correct explanation of *A*
(*d*) Both *A* and *r* are correct and *R* is correct explanation of *A*

149. Given below are two statements: one is labelled as Assertion *A* and the other is labelled as Reason *R*.

Assertion (A): The escape velocities of planet A and *B* are same. But *A* and *B* are of unequal mass.

Reason (R): The product of their mass and radius must be same. $M_1R_1 = M_2R_2$.

In the light of the above statements, choose the most appropriate answer from the options given below:

(*a*) A is correct but *R* is not correct
(*b*) Both *A* and *B* Rare correct but *R* is NOT the correct explanation of *A*
(*c*) Both A and *R* are correct and *R* is the correct explanation of *A*
(*d*) *A* is not correct but *R* is correct

150. An object is projected horizontally with speed $\frac{1}{2}\sqrt{\frac{GM}{R}}$, from a point at height 3*R* [where *R* is radius and *M* is mass of earth, then object will]

(*a*) Fall back on surface of earth by following parabolic path
(*b*) Fall back on surface of earth by following hyperbolic path
(*c*) Start rotating around earth in a circular orbit
(*d*) Escape from gravitational field of earth

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151. Given below are two statements :

Statement-I: For a planet, if the ratio of mass of the planet to its radius increases, the escape velocity from the planet also increases.

Statement-II: Escape velocity is independent of the radius of the planet.

In the light of above statements, choose the most appropriate answer from the options given below

(*a*) Both Statement-I and Statement-II are incorrect
(*b*) Statement-I is correct but Statement-II is incorrect
(*c*) Statement-I is incorrect but Statement-II is correct
(*d*) Both Statement-I and Statement-II are correct

152. The escape velocity form the equilibrium point of uniform ring of mass M and radius R is:

(*a*) $\sqrt{\frac{2GM}{R}}$ (*b*) $\sqrt{\frac{GM}{R}}$
(*c*) $\sqrt{\frac{GM}{2R}}$ (*d*) $2\sqrt{\frac{GM}{R}}$

Orbital Velocity

153. A small satellite is revolving near earth's surface. Its orbital velocity will be nearly

(*a*) 8 *km/s* (*b*) 4 *km/s*
(*c*) 11.2 *km/s* (*d*) 6 *km/s*

154. Two satellites of mass *m* and 2 *m* are revolving in two circular orbits of radii *r* and 2*r* around an imaginary planet, on the surface of with gravitational force is inversely proportional to distance from its centre. The ratio of orbital speed of satellites is

(*a*) 1 : 1 (*b*) 1 : 2
(*c*) 2 : 1 (*d*) $1:\sqrt{2}$

155. If the gravitational force between two objects were proportional to $1/R$ (and not as $1/R^2$), where *R* is the distance between them, then a particle in a circular path (under such a force) would have its orbital speed *V*, proportional to

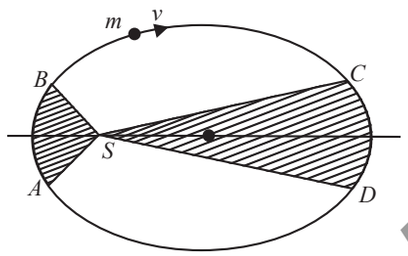
(*a*) R (*b*) R^0 (independent of *R*)
(*c*) $\frac{1}{R^0}$ (*d*) $\frac{1}{R}$

Kepler's Law

156. According to Kepler, planets move in

(*a*) Circular orbits around the sun
(*b*) Elliptical orbits around the sun with sun at exact centre
(*c*) Straight lines with constant velocity
(*d*) Elliptical orbits around the sun with sun at one of its foci.

157. The figure shows elliptical orbit of a planet *m* about the sun *S*. The shaded area *SCD* is twice the shaded area *SAB*. If t_1 is the time for the planet to move from *C* to *D* and t_2 is the time to move from *A* to *B* then



(*a*) $t_1 = 4t_2$ (*b*) $t_1 = 2t_2$
(*c*) $t_1 = t_2$ (*d*) $t_1 = t_2$

158. The minimum and maximum distances of a planet revolving around sun are *r* and *R*. If the minimum speed of planet on its trajectory is v_0 , its maximum speed will be

(*a*) $\frac{v_0 R}{r}$ (*b*) $\frac{v_0 r}{R}$
(*c*) $\frac{v_0 R^2}{r^2}$ (*d*) $\frac{v_0 r^2}{R^2}$

159. A planet of mass *m* moves around the sun of mass *M* in an elliptical orbit. The maximum and minimum distances of the planet from the sun are r_1 and r_2 respectively. The time period of the planet is proportional to

(*a*) $r_1^{3/2}$ (*b*) $r_2^{3/2}$
(*c*) $(r_1 + r_2)^{3/2}$ (*d*) $(r_1 - r_2)^{3/2}$

160. The time period of a satellite in a circular orbit of radius *R* is *T*. The period of another satellite in a circular orbit of radius 4 *R* is

(*a*) 4*T* (*b*) $\frac{T}{2}$
(*c*) 8*T* (*d*) $\frac{T}{8}$

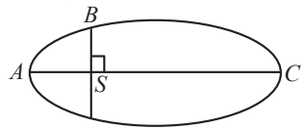
161. The time period of a satellite of earth is 24 hours. If the separation between the earth and the satellite is decreased to one fourth of the previous value, then its new time period will be

(*a*) 4 hours (*b*) 6 hours
(*c*) 12 hours (*d*) 3 hours

162. The time period of a geostationary satellite is 24 *h*, at a height 6*R R* is radius of earth) from surface of earth. The time period of another satellite whose height is 2.5*R* from surface will

(*a*) $\frac{12}{2.5}h$ (*b*) $6\sqrt{2}h$
(*c*) $12\sqrt{2}h$ (*d*) $\frac{24}{2.5}h$

163. The kinetic energies of a planet in an elliptical orbit about the Sun, at positions *A, B* and *C* are K_A' K_B and K_C respectively. *AC* is the major axis and *SB* is perpendicular to *AC* at the position of the sun *S* as shown in the figure. Then



(*a*) $K_A < K_B < K_C$ (*b*) $K_A > K_B > K_C$
(*c*) $K_B > K_A > K_C$ (*d*) $K_B < K_A < K_C$

164. The torque on a planet about the centre of sun is

(*a*) Zero (*b*) Negative
(*c*) Positive (*d*) Depend on mass of planet

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165. A satellite A of mass m is at a distance of r from the centre of the earth. Another satellite B of mass $2m$ is at a distance of $2r$ from the earth's centre. Their time periods are in the ratio of

(*a*) 1:2 (*b*) 1:16

(*c*) 1:32 (*d*) $1:2\sqrt{2}$

166. The angular momentum of a planet of mass M moving around the sun in an elliptical orbit is $\vec{L}$. The magnitude of the areal velocity of the planet is

(*a*) $\frac{2L}{M}$ (*b*) $\frac{L}{2M}$

(*c*) $\frac{4L}{M}$ (*d*) $\frac{L}{M}$

167. Every planet revolves around the sun in an elliptical orbit:

A. The force acting on a planet is inversely proportional to square of the distance from the sun.

B. Force acting on a planet is inversely proportional to the product of the masses of the planet and the sun C.

C. The centripetal force acting on the planet is directed away from the sun.

D. The square of time period of revolution of planet around sun is directly proportional to cube of semi-major axis of elliptical orbit.

Choose the correct answer from the options given below:

(*a*) A and D only (*b*) C and D only

(*c*) B and C only (*d*) A and C only

168. A planet revolving in elliptical orbit has :

A. a constant velocity of revolution.

B. has the least velocity when it is nearest to the sun.

C. its areal velocity is directly proportional to its velocity.

D. areal velocity is inversely proportional to its velocity.

E. To follow a trajectory such that the areal velocity is constant.

Choose the correct answer from the options given below:

(*a*) C only (*b*) A only

(*c*) D only (*d*) E only

169. Kepler's second law is based on:

(*a*) Newton's first law

(*b*) Newton's second law

(*c*) Special theory of relativity

(*d*) Conservation of angular momentum

170. Match the **Column-I** with **Column-II** and select the correct option.

Column-I		Column-II	
(A)	Kepler's 1st law	(P)	Law of area = const. $\frac{dA}{dt}=\frac{L}{2m}$
(B)	Kepler's 2nd law	(Q)	Law of period $T \propto r^{3/2}$
(C)	Kepler's 3rd law	(R)	Planet revolves around Sun in elliptical orbit

	A	B	C
(*a*)	R	P	Q
(*b*)	R	Q	P
(*c*)	Q	P	R
(*d*)	Q	R	P

171. **Assertion:** Kepler's second law can be understood by conservation of angular momentum principle.

Reason: Kepler's second law is related with areal velocity which can further be proved to be based on conservation of angular momentum as $\left(\frac{dA}{dt}\right)=\frac{\left(r^2\omega\right)}{2}$.

(*a*) Both Assertion and Reason are correct and Reason is the correct explanation for Assertion.

(*b*) Both Assertion and Reason are correct and Reason is not the correct explanation for Assertion.

(*c*) Assertion is correct but Reason is incorrect.

(*d*) Assertion is incorrect but Reason is correct.

172. Both earth and moon are subject to the gravitational force of the sun. As observed from the sun, the orbit of the moon :

(*a*) Will be elliptical

(*b*) Will not be strictly elliptical because the total gravitational force on it is not central

(*c*) Is not elliptical but will necessarily be a closed curve

(*d*) Deviates considerably from being elliptical due to influence of planets other than earth

173. The tidal waves in the seas are primarily due to :

(*a*) The gravitational effect of the sun on the earth

(*b*) The gravitational effect of the moon on the earth

(*c*) The rotation of the earth

(*d*) The atmospheric effect of the earth itself

174. Linear momentum of planet :

(*a*) Conserve

(*b*) Not conserve

(*c*) Different for different point of the orbit

(*d*) None of these

Satellite Motion

175. An artificial satellite revolves around *a* planet for which gravitational force (F) varies with distance r from its centre as $F \propto r^2$. If v_0 its orbital speed, then

(*a*) $v_0 \propto r^{8/3}$ (*b*) $v_0 \propto r^{3/2}$

(*c*) $v_0 \propto r^{5/2}$ (*d*) $v_0 \propto r$

176. Assume that the force of gravitation $F \propto \frac{1}{r^n}$ Then

(i) the orbital speed in a circular orbit of radius r is proportional to

(ii) Time period is proportional to

177. If a satellite of mass 400 kg revolves around the earth in an orbit with speed 200 *m/s* then its potential energy is

(*a*) –1.2 *MJ* (*b*) –8.0 *MJ*

(*c*) –16 *MJ* (*d*) –2.4 *MJ*

178. Calculate the energy required to put a satellite of mass m from earth surface into a orbit of radius, $4R_E$, where R_E is radius of earth. ??

179. An artificial satellite is moving around earth in a circular orbit with speed equal to one fourth the escape speed of a body from the surface of earth. The height of satellite above earth's surface is (R is radius of earth)

(*a*) $3R$ (*b*) $5R$

(*c*) $7R$ (*d*) $8R$

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180. When energy of a satellite-planet system is positive then satellite will

(*a*) Move around planet in circular orbit

(*b*) Move around planet in elliptical orbit

(*c*) Escape out with minimum speed

(*d*) Escape out with speed greater than escape velocity

181. The orbital speed of a satellite revolving around a planet in a circular orbit is v_0. If its speed is increased by 10%, then

(*a*) It will escape from its orbit

(*b*) At will start rotating in an elliptical orbit

(*c*) It will continue to move in the same orbit

(*d*) It will move in a circular orbit of radius 20% more than radius of initial orbit

182. A satellite *S* is moving in an elliptical orbit around the earth. The mass of the satellite is very small compared to the mass of the earth. Then

(*a*) The acceleration of *S* is always directed towards the centre of the earth

(*b*) The angular momentum of *S* about the centre of the earth changes in direction, but its magnitude remains constant

(*c*) The total mechanical energy of *S* varies periodically with time

(*d*) The linear momentum of *S* remains constant in magnitude

183. If *L* is the angular momentum of a satellite revolving around earth is a circular orbit of radius *r* with speed *v*, then

(*a*) $L \propto v$ (*b*) $L \propto v$

(*c*) $L \propto \sqrt{r}$ (*d*) $L \propto \sqrt{v}$

184. The addition kinetic energy to be provided to a satellite of mass *m* revolving around a planet of mass *M*, at transfer it from a circular orbit of radius R_1 to another of radius R_2 ($R_2 > R_1$) is

(*a*) $GmM\left(\frac{1}{R_1^2}-\frac{1}{R_2^2}\right)$ (*b*) $GmM\left(\frac{1}{R_1}-\frac{1}{R_2}\right)$

(*c*) $2GmM\left(\frac{1}{R_1}-\frac{1}{R_2}\right)$ (*d*) $\frac{1}{2}GmM\left(\frac{1}{R_1}-\frac{1}{R_2}\right)$

185. Two satellites of earth S_1 and S_2 are moving in the same orbit. The mass of S_1 is four times the mass of S_2. Which one of the following statements is true?

(*a*) The potential energies of earth and satellite in the two cases are equal

(*b*) S_1 and S_2 are moving with the same speed

(*c*) The kinetic energies of the two satellites are equal

(*d*) The time period of S_1 is four times that of S_2

186. Choose the incorrect statement from the following:

(*a*) The speed of satellite in a given circular orbit remains constant.

(*b*) For a planet revolving around the sun in an elliptical orbit, the total energy of the planet remains constant.

(*c*) When a body fall towards earth, the displacement of earth towards the body is negligible.

(*d*) The linear speed of planet revolving around the sun remains constant.

187. Given below are two statements:

Statement-I: If E be the total energy of a satellite moving around the earth, then its potential energy will be E/2.

Statement-II: The kinetic energy of a satellite revolving in an orbit is equal to the half the magnitude of total energy E.

In the light of the above statements, choose the most appropriate answer from the options given below:

(*a*) Both Statement-I and Statement-II are correct

(*b*) Both Statement-I and Statement-II are incorrect

(*c*) Statement-I is incorrect but Statement-II is correct

(*d*) Statement-I is correct but Statement-II is incorrect

188. Two satellites *A* and *B* move round the earth in the same orbit The mass of A is twice the mass of *B*.

The quantity which is same for the two satellites will be:

(*a*) Potential energy (*b*) Total energy

(*c*) Kinetic energy (*d*) Speed

189. Two satellites, *A* and *B*, have masses *m* and 2*m* respectively. *A* is in a circular orbit of radius *R*, and *B* is in a circular orbit of radius 2*R* around the earth. The ratio of their kinetic energies, T_A/T_B is:

(*a*) 1/2 (*b*) 1

(*c*) 2 (*d*) $\sqrt{\frac{1}{2}}$

190. In an orbit if the time of revolution of a satellite is *T*, then PE is proportional to

(*a*) $T^{1/3}$ (*b*) T^3

(*c*) $T^{-2/3}$ (*d*) $T^{-4/3}$

191. Consider two satellites S_1 and S_2 with periods of revolution 1 hr . and 8 hr. respectively revolving around a planet in circular orbits. The ratio of angular velocity of satellite S_1 to the angular velocity of satellites S_2 is:

(*a*) 1 : 8 (*b*) 1 : 4

(*c*) 2 : 1 (*d*) 8 : 1

192. If potential energy of a satellite is -2*MJ*, then the binding energy of satellite is

(*a*) 1 MJ (*b*) 2 MJ

(*c*) 8 MJ (*d*) 4 MJ

193. A satellite launching station should be :

(*a*) Near the equatorial region (*b*) Near the polar region

(*c*) On the polar axis (*d*) All locations are equally good

194. A body is orbiting around earth at a mean radius which is two times as greater as the parking orbit of a satellite, the period of body is:

(*a*) 4 days (*b*) 16 days

(*c*) $2\sqrt{2}$ days (*d*) 64 days

195. Satellites orbiting the earth have finite life and sometimes debris of satellites fall to the earth. This is because :

(*a*) The solar cells and batteries in satellites run out

(*b*) The laws of gravitation predict a trajectory spiraling inwards

(*c*) Of viscous forces causing the speed of satellite and hence height of satellites gradually decrease

(*d*) Of collisions with other satellites

196. A satellite is moving in a circular orbit of radius R round the earth. Which of the following statements is incorrect?

(*a*) Its angular momentum varies as $1/\sqrt{R}$

(*b*) Its linear momentum varies as $1/\sqrt{R}$

(*c*) Its kinetic energy varies as 1/R

(*d*) Its frequency varies as $1/R^{(3/2)}$

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197. A satellite is moving round the earth in a circular orbit. The following statements are given:

(i) It is moving with a constant velocity.

(ii) It has no acceleration.

(iii) It's angular momentum w.r.t. centre of the earth remains conserved.

(iv) Its distance from center must be equal to √2 times of earth's radius.

The correct option is:

(*a*) i and ii SSare true (*b*) i, iii and iv are true

(*c*) only iii is true (*d*) i and iv are true

198. Consider the following statement for a satellite S moving in an elliptical orbit around the earth (mass of satellite is negligibly small compared to earth)

I. The acc. of S is always towards earth

II. The total mechanical energy of S varies periodically with time.

III. The linear momentum of 'S' remain constant in magnitude

The correct sequence of true (T) and false (F) for the above statement is:

(*a*) TTF (*b*) TFT

(*c*) TFF (*d*) FFF

199. A satellite is in a circular equatorial orbit of radius 7000 km around the earth. If it is transferred to a circular orbit of double of radius:

Column-I		Column-II	
A	Angular momentum	P	Increases
B	Area of earth covered by satellite signal	Q	Decreases
C	Potential energy	R	Becomes double
D	Kinetic energy	S	Becomes half

(*a*) (A) → Q; (B) → P; (C) → P, R; (D) → Q, S

(*b*) (A) → P; (B) → P; (C) → P; (D) → Q, S

(*c*) (A) → Q; (B) → Q; (C) → P, S; (D) → Q, S

(*d*) (A) → P; (B) → Q; (C) → P; (D) → P, R

200. A test particle is moving in a circular orbit in the gravitational field produced by a mass density $\rho(r) = \frac{K}{r^2}$. Identify the correct relation between the radius *R* of the particle's orbit and its period *T*

(*a*) T/R^2 is a constant (*b*) T/R is a constant

(*c*) T^2/R^2 is a constant (*d*) TR is a constant

Types of Satellite

201. The time period of polar satellite is about

(*a*) 24 *hr* (*b*) 100 *min*

(*c*) 84.6 *min* (*d*) 6 *hr*

202. Which of the following statements are true?

(i) A polar satellite goes around the earth's pole in north-south direction.

(ii) A geostationary satellite goes around the earth in east-west direction.

(iii) A geostationary satellite goes around the earth in west-east direction.

(iv) A polar satellite goes around the earth in east-west direction.

(*a*) Only (iii) is true. (*b*) (i) & (ii) are true.

(*c*) (i) & (iii) are true. (*d*) (i) & (iv) are true.

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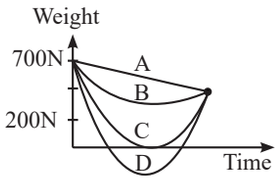
1. A 70 kg passenger goes from the earth to Mars in a spaceship moving with a constant velocity. Neglecting All other objects in the sky, ____ part of given figure Represents the weight of the passenger as a function of Time [Take g on earth = 10 m/s^2 and at Sunface of Mars g= 4 m/s^2]



2. **Statement I:** Consider a planet in some solar system which has a mass & times the mass of earth and density equal to the average density of earth. An object weighing *W* on the earth will weight double the value of *W* at the planet.

Statement II: The work Done in slowly lifting a Body of mass *m* from the earth's surface to a height *R* equal to Radius of earth will be *mgR*

3. A person Brings a mass of 1 kg from infinity to a point A. Initially the mass was at rest But it moves at a speed of ____ as it Reaches A. The work done by the person on mass is –3 Joule and Potential at A is –5Jkg^{-1}

4. **Statement I:** Let *V* and *E* denotes the gravitational potential and gravitational field at a distance from the centre of uniform spherical shell. Then, the plot of *E* against *r* will be discontinuous But the plot of *V* against *r* will not be discontinuous.

Statement II: Let *V* and & *E* denotes the gravitational potential

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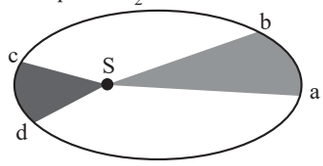
and gravitational field at a distance r from the centre of uniform Solid sphere. Then, the plot of E against r will be discontinuous and the plot of V against r will also be discontinuous.

5. **Statement I:** The Time period of an earth-satellite in circular orbit is independent of mass of the satellite and Radius of orbit.

Statement II: Figure shows the elliptical path of planet about the sun. The Two shaded part have equal area. If T_1 and T_2 denote Time Taken by the planet to go from a to b and from c to d Rapectively, Then T_1 will be equal to T_2.



6. **Statement I:** A person sitting in a chair in a satellite feels weightless because the normal force by the chair on the person balances the earth's attraction.

Statement II : Let V and E denote the gravitational potential and gravitational field at a point. It is impossible to have V = 0 but E ≠ 0

7. **Statement I:** Inside a uniform spherical shell, the gravitational field and potential is same everywhere.

Statement II: A uniform spherical shell gradually shrinks maintaining its shape. The gravitational potential at the Centre will decrease.

Ans. Both are true

8. _____Remain constant in a planetary motion [considering elliptical orbit as seen from the

(*a*) Speed (*b*) Angular speed

(*c*) kinetic energy (*d*) Angular Momentum

Answer Key

1. (*b*) **2.** (*a*) **3.** (*c*) **4.** (*c*) **5.** $\frac{\sqrt{3}\,Gm^2}{a^2}$ **6.** $\frac{Gm^2}{l^2}\left[\sqrt{2}+\frac{1}{2}\right]$ **7.** (*b*) **8.** (*d*) **9.** (*c*)

10. $F=\frac{GMm}{d(d+L)}$ **11.** $T=2\pi\sqrt{\frac{4r^3}{GM}}$ **12.** (*d*) **13.** $F=\frac{GMmr}{R^3}$ **14.** (*b*) **15.** 93.7% **16.** (*c*)

17. (*c*) **18.** (*a*) **19.** (*c*) **20.** (*b*) **21.** 50/9 **22.** $10\left(\frac{GMm_0}{a^2}\right)$ **23.** (*a*) **24.** (i) 0 (ii) 0, (iii) 0, (iv) 0

25. (*b*) **26.** $=\left(\frac{7}{8}\right)$F **27.** $\frac{7}{9}F$ **28.** (*a*) **29.** (*a*) **30.** (*c*) **31.** (*d*) **32.** (*d*) **33.** (*a*)

34. (*c*) **35.** (*d*) **36.** (*c*) **37.** (*e*) **38.** (*c*) **39.** (*d*) **40.** (*a*) **41.** (*a*) **42.** $I=\frac{4GM}{3}$

43. $I_0=\left(\frac{GM}{R^2}\right)\frac{\sin(\theta/2)}{\theta/2}, I_0=\frac{2Gm}{\pi R^2}$ **44.** (*a*) **45.** (*a*) **46.** (*d*) **47.** (*b*) **48.** (*d*) **49.** (*d*) **50.** (*c*)

51. (*d*) **52.** (*d*) **53.** (*a*) **54.** (*b*) **55.** (*c*) **56.** (*c*) **57.** (*d*) **58.** (*c*) **59.** (*c*) **60.** (*a*)

61. (*a*) **62.** (*c*) **63.** (*b*) **64.** (*c*) **65.** (*c*) **66.** (*d*) **67.** (*a*) **68.** (*c*) **69.** (*d*) **70.** (*c*)

71. (*c*) **72.** (*d*) **73.** 6400 km **74.** 6400 km **75.** (*b*) **76.** (*b*) **77.** (*c*) **78.** (*a*) **79.** (*b*) **80.** (*d*)

81. (*c*) **82.** (*c*) **83.** (*d*) **84.** (*d*) **85.** (*c*) **86.** (*d*) **87.** (*c*) **88.** (*d*) **89.** (*c*) **90.** (*c*)

91. (*b*) **92.** (*d*) **93.** (*b*) **94.** (*a*) **95.** (*b*) **96.** (*b*) **97.** (*b*) **98.** (*b*) **99.** (*a*) **100.** (*c*)

101. (*a*) **102.** (*a*) **103.** (*b*) **104.** $\frac{-4\sqrt{2}Gm}{l}$ **105.** $V=\frac{-3\sqrt{3}Gm}{a}$ **106.** $\frac{-9GM}{r}$ **107.** (*c*) **108.** (*b*) **109.** (*a*)

110. (*b*) **111.** (*b*) **112.** (*d*) **113.** (*c*) **114.** $U=-\frac{3Gm^2}{a}$ **115.** $\frac{-4Gm^2}{l}-\frac{2Gm^2}{\sqrt{2}\,l}$ **116.** $=\frac{-13Gm^2}{3a}$

117. $U=-\frac{12Gm^2}{a}-\frac{12Gm^2}{\sqrt{2}a}-\frac{4Gm^2}{\sqrt{3}a}$ **118.** $=\left(-\frac{Gm^2}{\sqrt{2}a}-\frac{2GMm}{a}\right)$ **119.** (*d*)

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120. (i) (*a*) $U_{\text{surface}} = -\frac{GMm}{R}$ (*b*) $U_H = -\frac{GMm}{R+H}$, (ii) $\Delta U = -\frac{GMm}{R+H} + \frac{GMm}{R}$ **121.** (*c*) **122.** (*c*) **123.** $W = \frac{-3Gm^2}{a}$

124. (*d*) **125.** $W = \frac{4\sqrt{2}GMm}{a}$ **126.** (i) $u = -\frac{11Gm^2}{a}$ (ii) $W = +\frac{11Gm^2}{2a}$ **127.** (*c*) **128.** (*c*) **129.** $\sqrt{\frac{3GM}{2R}}$

130. $\sqrt{\frac{GM}{R}}$ **131.** (*b*) **132.** (*b*) **133.** (*b*) **134.** (*b*) **135.** (*a*) **136.** (*b*) **137.** (*a*) **138.** (*c*) **139.** (*d*)

140. (*c*) **141.** (*c*) **142.** (*b*) **143.** (*a*) **144.** (*b*) **145.** (*d*) **146.** (*b*) **147.** (*a*) **148.** (*c*) **149.** (*a*)

150. (*c*) **151.** (*b*) **152.** (*a*) **153.** (*a*) **154.** (*a*) **155.** (*b*) **156.** (*d*) **157.** (*b*) **158.** (*a*) **159.** (*c*)

160. (*c*) **161.** (*d*) **162.** (*b*) **163.** (*b*) **164.** (*a*) **165.** (*d*) **166.** (*b*) **167.** (*a*) **168.** (*d*) **169.** (*d*)

170. (*a*) **171.** (*a*) **172.** (*d*) **173.** (*b*) **174.** (*b*) **175.** (*b*) **176.** (i) $\frac{1}{r^{(n-1)/2}}$ (ii) $\frac{1}{r^{(n+1)/2}}$ **177.** (*c*)

178. $\frac{7}{8}\frac{Gm}{R_e}$ **179.** (*c*) **180.** (*d*) **181.** (*b*) **182.** (*a*) **183.** (*c*) **184.** (*d*) **185.** (*b*) **186.** (*d*) **187.** (*b*)

188. (*d*) **189.** (*b*) **190.** (*c*) **191.** (*d*) **192.** (*a*) **193.** (*a*) **194.** (*c*) **195.** (*c*) **196.** (*a*) **197.** (*c*)

198. (*c*) **199.** (*b*) **200.** (*b*) **201.** (*b*) **202.** (*c*)

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1. (*c*) **2.** I. - True, II. - False **3.** 2 m/s. **4.** I. - True, II. - False **5.** I. - False, II. - True **6.** Both false
7. Both are true **8.** (*d*)

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Current Electricity

(Practice Questions)

Electric Current

1. **Assertion (A):** Current is a vector quantity.

Reason (R): Current has magnitude as well as direction.

(*a*) A is false but R is true

(*b*) Both A and R are true but R is NOT the correct explanation of A

(*c*) A is true but R is false

(*d*) Both A and R are true and R is the correct explanation of A

2. A current of 0.6 A is drawn by an electric bulb for 10 minutes. Which one of the following is the amount of electric charge that flows through the circuit?

(*a*) 6 C (*b*) 0.6 C (*c*) 360 C (*d*) 36 C

3. If the amount of charge passing through the cell in 4 minutes is 480 C then calculate the current passing through the cell?

4. The current in a wire varies with time according to the equation $I = 4 + 2t$, where I is in ampere and t is in sec. The quantity of charge which has passed through a cross-section of the wire during the time $t = 2$ sec to, $t = 6$ sec will be:

(*a*) 60 coulomb (*b*) 24 coulomb

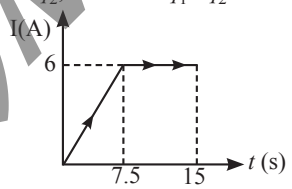
(*c*) 48 coulomb (*d*) 30 coulomb

5. If charge $Q = t^2 + 2t - 4$ is flowing through wire then find current at $t = 2$ sec and in 2 sec.

6. The electric current through a wire varies with time as $I = I_0 + \beta t$ where $I_0 = 20$ A and $\beta = 3$ A/s. The amount of electric charge crossed through a section of the wire in 20 seconds is :

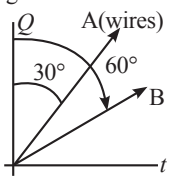
(*a*) 80 C (*b*) 800 C (*c*) 1000 C (*d*) 1600 C

7. The graph of current versus time in a wire is given below, If charge flows through the wire in 7.5s is q_1 and that flows through the wire in 15s is q_2, then ratio $q_1 : q_2$ is



(*a*) 2 : 1 (*b*) 1 : 2 (*c*) 4 : 1 (*d*) 1 : 3

8. Charge Flowing through wire A & B as given in graph then find ratio of current through A & B

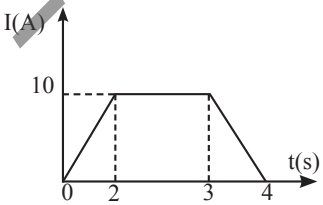


9. Through a given cross section n_1 electrons per second are passing from left to right and n_2 protons per second are passing from right to left simultaneously. The electric current through that cross section is (e = electronic charge)

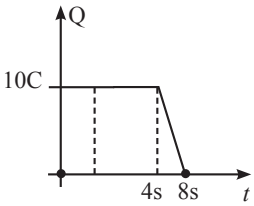
(*a*) $(n_1 + n_2)\,e$ towards left (*b*) $(n_2 - n_1)\,e$ towards right

(*c*) $(n_1^2 + n_2^2)\,e$ towards left (*d*) $(n_2^2 + n_1^2)$ towards right

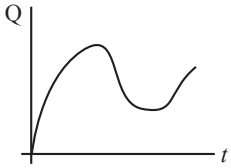
10. Find average current in 4 sec?



11. Find average current in 8 sec?



12. Find how many time current is zero in given graph?



13. Match column-I with Column-II:

Column-I		Column-I	
i	If $Q = t^2 + 2t - 4$, I in 2 seconds	A	6 A
ii	If $Q = t^2 + 2t - 4$, I at 2 seconds	B	28 A
iii	If $I = 3t^2 + 4$, average current in 2 seconds	C	4 A
iv	If $Q = 5t^2 - 2t$, $I_{average}$ = ?B/W $t_1 = 2$s to $t_2 = 4$s	D	8 A

(*a*) (i)-D, (ii)-A, (iii)-B, (iv)-C

(*b*) (i)-C, (ii)-A, (iii)-D, (iv)-B

(*c*) (i)-A, (ii)-B, (iii)-C, (iv)-A

(*d*) (i)-B, (ii)-C, (iii)-A, (iv)-C

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14. x is the current if electron is moving on circular path with frequency f and y is the current if e is moving with speed v in circle of radius R. Find x / y :

(*a*) $\frac{2\pi RF}{v}$ (*b*) $\frac{2\pi RF}{f}$ (*c*) $\frac{ef}{2\pi RF}$ (*d*) $\frac{\pi^2 ef}{2Rv}$

15. A current of 5A exists in a 10 Ω resistance for 4 minutes. The number of electrons and charge (in coulombs) passing through any section of the resistor in this time are

(*a*) 75×10^{20}, 600 C (*b*) 75×10^{21}, 600 C
(*c*) 75×10^{20} , 1200 C (4) 75×10^{19}, 1200 C

16. **Statement I:** A conductor carrying electric current becomes electrically charged.

Statement II: A conductor carrying electric current contains same number of positive and negative charges and is electrically neutral.

Drift Velocity and Conductivity

17. **Assertion (A) :** Electric field outside the conductor connected to battery of V volt is zero.

Reason (R) : Conductor remains neutral as number of incoming electron is equal to number of outgoing electrons.

(*a*) A is false but R is true
(*b*) Both A and R are true but R is NOT the correct explanation of A
(*c*) A is true but R is false
(*d*) Both A and R are true and R is the correct explanation of A

18. Two wires A and B of the same material, having radii in the ratio 1:2 carry currents in the ratio 4: 1. The ratio of drift speed of electrons in A and B is

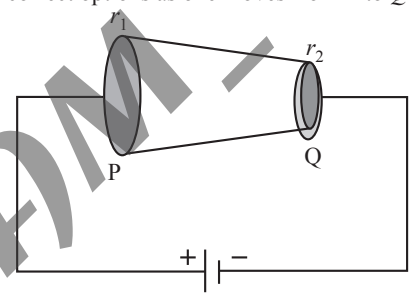
(*a*) 16 : 1 (*b*) 1 : 16 (*c*) 1 : 4 (*d*) 4 : 1

19. The drift velocity of electrons for a conductor connected in an electrical circuit is V_d The conductor is now replaced by another conductor with same material and same length but double the area of cross-section. The applied voltage remains same. The new drift velocity of electrons will be

(*a*) $V_d/4$ (*b*) V_d (*c*) $2V_d$ (*d*) $V_d/2$

20. In given figure, a batter of emf is connected across a conductor PQ of length l and different area of cross-sections having radii r_1 and $r_2 (r_2 < r_1)$.

Choose correct options as one moves from P to Q .



(*a*) Drift velocity of e^- increases
(*b*) Electric field decreases
(*c*) Electron current decreases
(*d*) All of these

21. Across a metallic conductor of non uniform cross section, a constant potential difference is applied. The quantity which remains constant along the conductor is

(*a*) current (*b*) drift velocity
(*c*) electric field (*d*) current density

22. Three wires of same material are connected in parallel to a source of emf. The length ratio of the wires is 1:2:3 and the ratio of their area of cross section is 2:4:1

Then match the RATIO OF QUANTITIES in COLOUMN -I with respective answer in Coloumn -II

	Column I		Column II
A.	Resistance	(i)	1 : 1 : 1
B.	Current	(ii)	6 : 6 : 1
C.	Power	(iii)	1 : 6 : 6
D.	Conductivity	(iv)	1 : 1 : 6

(*a*) A-(i), B-(iv), C-(iii), D-(ii)
(*b*) A-(iv), B-(ii), C-(ii), D-(i)
(*c*) A-(iii), B-(i), C-(ii), D-(iv)
(*d*) A-(iv), B-(iii), C-(i), D-(ii)

Mobility

23. **Statement-I :** In an isolated conductor, velocity of e^- is zero hence. They are in rest condition as no electric field is applied.

Statement-II : Drift velocity becomes double and hence due to this, mobility of electron will also gets doubled.

(*a*) Both statements false
(*b*) Both statements true
(*c*) Statement-I is false and Statement-II is true
(*d*) Statement-I is true and Statement-II is false

24. Is mobility depends on electric field?

25. Compare mobility of electron and proton?

26. Ratio for mobility of deuteron, proton and a-particle is 2: x: 2. Find value of x.

27. A charged particle having drift velocity of 7.5×10^{-4} m s^{-1} in an electric field of 3×10^{-10} V m^{-1}, has a mobility in m^2 V^{-1}s^{-1} of

(*a*) 2.25×10^{15} (*b*) 2.5×10^{6}
(*c*) 2.5×10^{-6} (*d*) 2.25×10^{-15}

28. The dimensional formula of mobility is

(*a*) $[M^{-1}L^0T^2A^1]$ (*b*) $[M^{-1}L^0T^1A^1]$
(*c*) $[M^{-1}L^{-1}T^2A^1]$ (*d*) $[[M^{-1}L^{-1}T^1A^1]$

29. Current density $\vec{J}$ at an area is $\vec{A} = (2\hat{i} + 3\hat{i})$ mm^2 is $\vec{j} = (3\hat{i} + 4\hat{i})$ A/ m^2. Current through the area is

(*a*) 9 μA (*b*) Zero
(*c*) 18 μA (*d*) 12 μA

Resistance and Resistivity

30. Three copper wires of length and cress-sectional areas are [l, A], $\left[2l, \frac{A}{2}\right]$, and $\left[\frac{l}{2}, 2A\right]$. Resistivity is maximum is

(*a*) Wire of cross-sectional area 2A
(*b*) Wire of cross-sectional area A/2
(*c*) Wire of cross-sectional area A.
(*d*) Same in all three cases.

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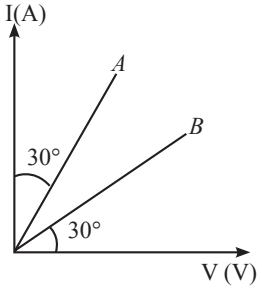
31. Figure shows graph between l and V for two conductor A and B. Their respective resistance are in the ratio.



(*a*) 1 : 1 (*b*) 1 : 3 (*c*) 3 : 1 (*d*) 1 : 2

32. A certain piece of copper is to be shaped into a conductor of minimum resistance. Its length and diameter should respectively be

(*a*) L, D (*b*) $2l, \frac{D}{2}$ (*c*) $\frac{L}{2}, 2D$ (*d*) $L, \frac{D}{2}$

33. A wire of resistance x ohm is drawn out so that its length is increased to twice its original length, and its mew resistance becomes 20 Ω, then x will be

(*a*) 5 Ω (*b*) 10 Ω (*c*) 15 Ω (*d*) 20 Ω

34. A 1m long wire is broken into two unequal parts x and y. The x part of wire is stretched into another wire W. Length of W is twice the length of x and resistance of W is twice that of y. Find ratio of length of x and y.

(*a*) 1: 4 (*b*) 1 : 2 (*c*) 4 : 1 (*d*) 2 : 1

35. An electric cable of copper has just one wire of radius 9 mm. Its resistance is 14 Ω. If this single copper wire of cable is replaced by seven identical well insulated copper wire each of radius 3 mm connected in parallel, then the new resistance of combination will be:

(*a*) 9 Ω (*b*) 18 Ω (*c*) 28 Ω (*d*) 126 Ω

36. The resistance of a wire is 'R' ohm. If it is melted and stretched to 'n' times its original length its new resistance will be

(*a*) $\frac{R}{n}$ (*b*) $\frac{R}{n^2}$ (*c*) n^2R (*d*) nR

37. A wire of a certain material is stretched slowly by ten percent. Its new resistance and specific resistance become respectively

(*a*) both remain the same (*b*) 1.1 times, 1.1 times

(*c*) 1.2 times, 1.1 times (*d*) 1.21 times, same

38. The masses of the wire of copper is in the ratio of 1 : 3 : 5 and their lengths are in the ratio 5 : 3 : 1. The ratio of their electrical resistance is

(*a*) 1 : 3 : 5 (*b*) 5 : 3 : 1

(*c*) 1 : 25 : 125 (*d*) 125 : 15 : 1

39. The electric resistance of a certain wire of iron is R. If its length and radius are both doubled, then

(*a*) The resistance will be doubled and the specific resistance will be halved

(*b*) The resistance will be halved and the specific resistance will remain unchanged

(*c*) The resistance will be halved and the specific resistance will the doubled

(*d*) The resistance and the specific resistance. will both remain unchanged

40. If a copper wire stretched to make its radius decrease by 0.1%, then the percentage increase in resistance is nearly

(*a*) 0.1% (*b*) 0.8% (*c*) 0.4% (*d*) 0.2%

41. Given below are two statements: one is labelled as Assertion A and the other is labelled as Reason R.

Assertion (A): Alloys such as constantan and manganin are used in making standard resistance coils.

Reason (R): Constantan and manganin have very small value of temperature coefficient of resistance.

In the light of the above statements, choose the correct answer from the options given below.

(*a*) Both (A) and (R) are true and (R) is the correct explanation of A

(*b*) Both (A) and (R) are true but (R) is NOT the correct explanation of A

(*c*) (A) is true but (R) is false

(*d*) (A) is false but (R) is true

42. The solids which have the negative temperature coefficient of resistance are

(*a*) semiconductors only

(*b*) insulators and semiconductors

(*c*) metals

(*d*) insulators only

43. **Statement I:** Constant potential difference is applied across a conductor. If temperature of conductor is increased, the drift speed of electrons will decrease.

Statement II: Resistivity of a conductor increases with increase in temperature.

44. Resistance wire used in resistance boxes have

(*a*) maximum resistance

(*b*) minimum resistance

(*c*) minimum value of thermal coefficient of resistance

(*d*) maximum value of thermal coefficient of resistance

Ohm's law

45. Ohm's law in terms of correct density J, electric field E and electrical conductivity σ is

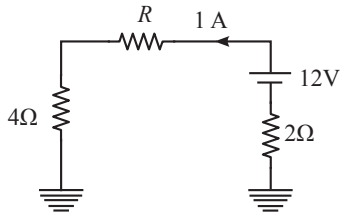
(*a*) $\sigma = \left(\frac{J}{E}\right)^{1/2}$ (*b*) $J = \sigma E$

(*c*) $E = (\sigma J)^{1/2}$ (*d*) $J = \frac{\sigma}{E}$

46. The potential difference $(V_A - V_B)$ between the points A and B in the given figure is

(*a*) –3 V (*b*) +3 V (*c*) +6 V (*d*) +9 V

47. Value of the resistance R in the figure is



(*a*) 6 Ω (*b*) 8 Ω (*c*) 10 Ω (*d*) 12 Ω

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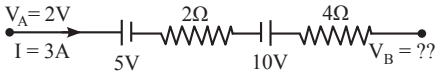
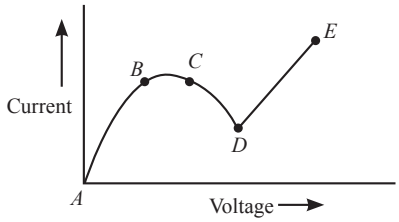
48. Find potential at point B



49. From the graph between current (I) and voltage (V) is shown. Identity the portion corresponding to negative resistance



(*a*) CD (*b*) DE

(*c*) AB (*d*) BC

50. A 6 volt battery is connected to the terminals of a three meter long wire of uniform thickness and resistance of 100 ohm. The difference of potential between two points on the wire separated by a distance of 50 cm will be

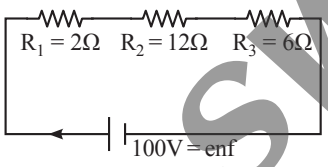
(*a*) 2 volt (*b*) 3 volt

(*c*) 1 volt (*d*) 1.5 volt

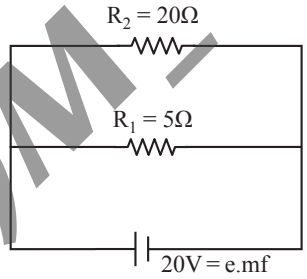
51. The relation between *V* and I is not unique, i.e., there is more than one value of *V* for the same current I. A material exhibiting such behaviour is_____.

Series and Parallel Combination of Resistor

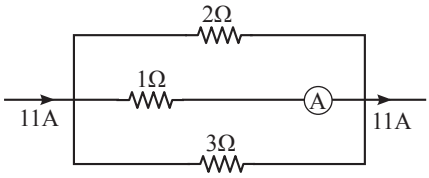
52. Find potential drop across each resistance:-



53. Find the current in each resistor.



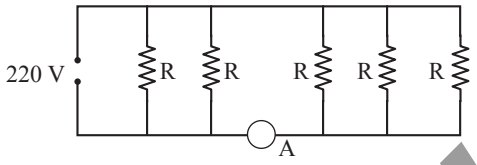
54. The ammeter reading in the circuit below is



(*a*) 2 A (*b*) 3 A

(*c*) 6 A (*d*) 5 A

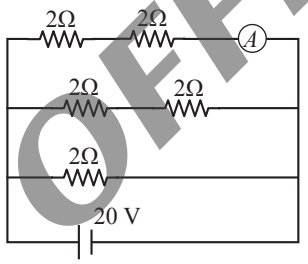
55. Five identical lamps each of resistance R = 1100 Ω are connected to 220 V as shown in the figure. The reading of ideal ammeter A is



(*a*) $\frac{1}{5}A$ (*b*) $\frac{2}{5}A$

(*c*) $\frac{3}{5}A$ (*d*) 1 A

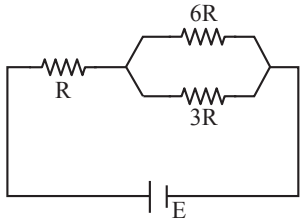
56. The reading of the ammeter in the circuit below is



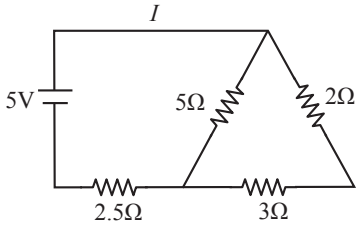
(*a*) 5 A (*b*) 15 A

(*c*) 20 A (*d*) 25 A

57. Find potential drop across '3R'



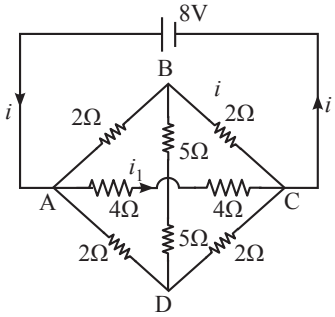
58. The current I through the cell in the network shown is



(*a*) 3 A (*b*) 2 A

(*c*) 1 A (*d*) 4 A

59. The value of current i_1 flowing from A to C in circuit diagram is:



(*a*) 1 A (*b*) 2 A

(*c*) 4 A (*d*) 5 A

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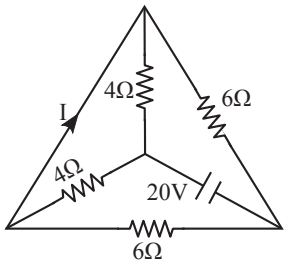
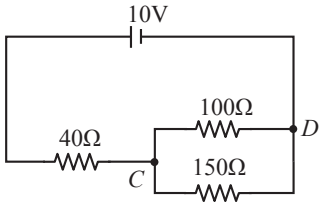
60. The value of I is :



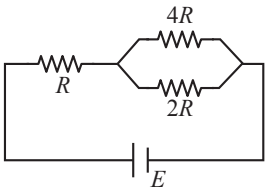
(*a*) 4 A (*b*) 0 A (*c*) 2 A (*d*) 3 A

61. In the network shown below, potential difference across *CD* is



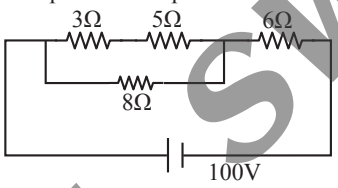
(*a*) 4 V (*b*) 6 V
(*c*) 10 V (*d*) 5 V

62. In a network as shown in the figure, the potential difference across the resistance 2*R* is (the cell has emf *E* volt and no internal resistance)



(*a*) 2*E* (*b*) 4*E*/7
(*c*) *E*/7 (*d*) *E*

63. Find current and potential drop in 3Ω



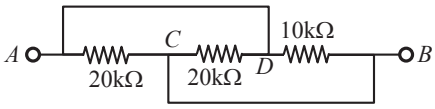
64. Two metallic wires of identical dimensions are connected in series. If σ_1 and σ_2 are the Conductivities of the these wires respectively, the effective conductivity of the combination is:

(*a*) $\frac{\sigma_1\sigma_2}{\sigma_1+\sigma_2}$ (*b*) $\frac{2\sigma_1\sigma_2}{\sigma_1+\sigma_2}$

(*c*) $\frac{\sigma_1+\sigma_2}{2\sigma_1\sigma_2}$ (*d*) $\frac{\sigma_1+\sigma_2}{\sigma_1\sigma_2}$

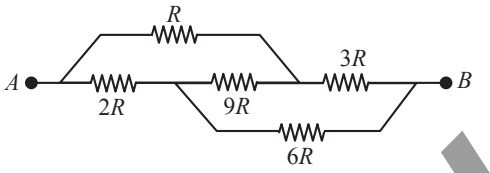
Equivalent Resistance

65. The equivalent resistance between A and B as shown in figure is:



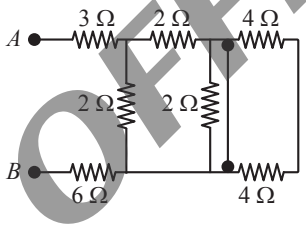
(*a*) 5 kΩ (*b*) 30 kΩ (*c*) 10 kΩ (*d*) 20 kΩ

66. The equivalent resistance between *A* and *B* of the network shown in figure:



(*a*) $11\frac{2R}{3}$ (*b*) 14 R (*c*) 21 R (*d*) $\frac{8}{3}$R

67. In the given circuit, the equivalent resistance between the terminal *A* and *B* is _____ Ω.

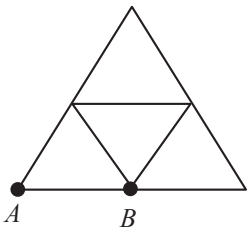


68. If you are provided a set of resistances 2Ω, 4Ω, 6Ω and 8Ω. Connect these resistances so as to obtain an equivalent 46 resistance of $\frac{46}{3}\Omega$

(*a*) 4 Ω and 6 Ω are in parallel with 2 Ω and 8 Ω in series.
(*b*) 6 Ω and 8 Ω are in parallel with 2 Ω and 4 Ω in series.
(*c*) 2 Ω and 4 Ω are in parallel with 6 Ω and 8 Ω in series.
(*d*) 2 Ω and 6 Ω are in parallel with 4 Ω and 8 Ω in series.

69. A square shaped wire with resistance of each side 3 Ω is bent to form a complete circle. The resistance between two diametrically opposite points of the circle in unit of Ω will be

70. In the given diagram, resistance between any two junctions is *R*. Equivalent resistance across terminals *A* and *B* is



(*a*) $\frac{11R}{7}$ (*b*) $\frac{18R}{7}$

(*c*) $\frac{7R}{7}$ (*d*) $\frac{11R}{18}$

Kirchhoff Law and Circuit Analysis

71. **Assertion:** If potential difference between two points is zero, and the resistance between those points is zero, current may flow between the points.

Reason: Kirchhoff's first law is based on conservation of charge.

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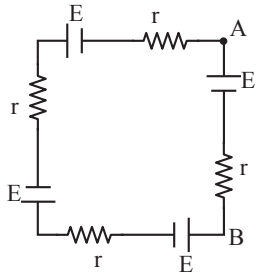
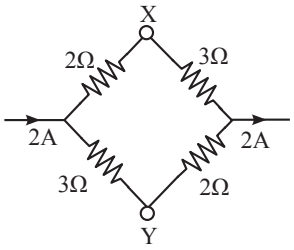
72. Potential difference across AB in the network shown in



(*a*) Zero (*b*) E

(*c*) $E - \frac{Ir}{2}$ (*d*) E – 2 I*r*

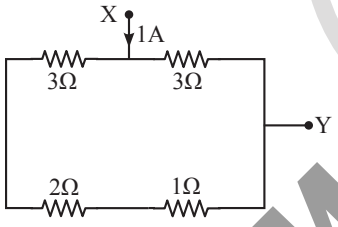
73. Find $V_x - V_y = ?$



(*a*) 1 (*b*) –1

(*c*) 2 (*d*) –2

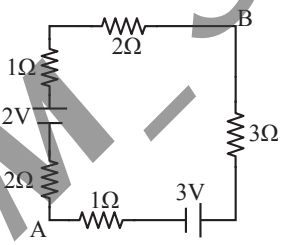
74. Find $V_x - V_y = ?$



(*a*) 2 (*b*) 3

(*c*) 6 (*d*) 9

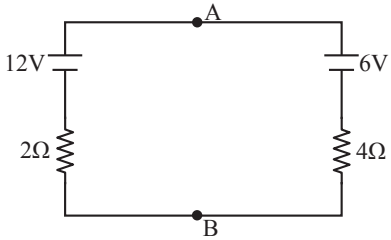
75. Potential difference $V_B - V_A$ in the network shown in



(*a*) 7 V (*b*) 6 V

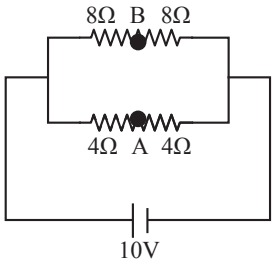
(*c*) 5 V (*d*) 8 V

76. Potential difference across AB *i.e.*, $V_A - V_B$ is



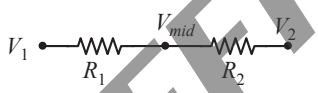
(*a*) 10 V (*b*) 8 V (*c*) 6 V (*d*) Zero

77. The potential difference between points A and B is

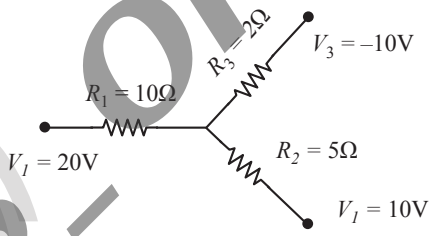


(*a*) $\frac{20}{7}$ V (*b*) $\frac{40}{7}$ V (*c*) $\frac{10}{7}$ V (*d*) Zero

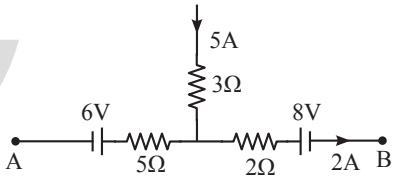
78. Find V_{mid} = ??.



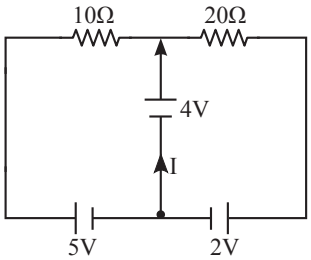
79. Find potential at junction.



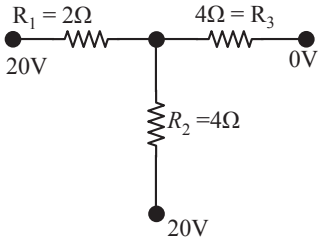
80. Find $V_B - V_A$ given circuit.



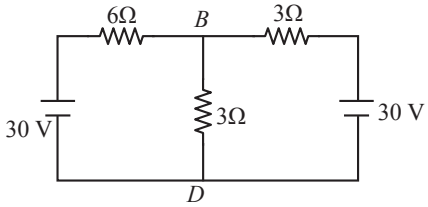
81. Current in 10Ω & 20Ω



82. Find current in 2 Ω?



83. Find current in BD Branch.



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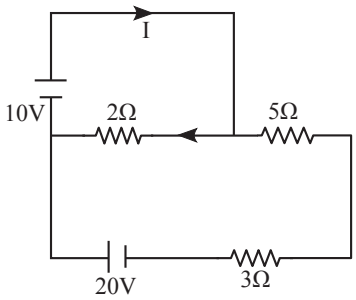
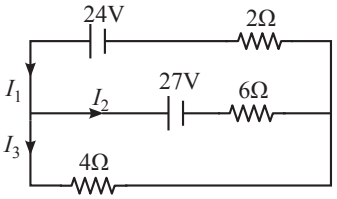
84. Find current I



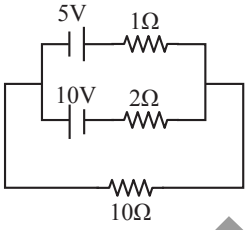
85. In given circuit, the value of currents I_1, I_2 and I_3 are



(*a*) $3A, \frac{-3}{2}A, \frac{9}{2}A$ (*b*) $\frac{9}{2}A, 3A, \frac{-3}{2}A$

(*c*) $5A, 4A, -3A$ (*d*) $7A, \frac{5}{4}A, \frac{9}{2}A$

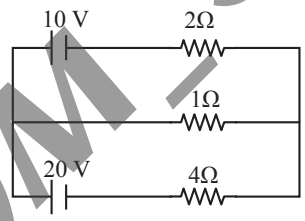
86. Current through 10 Ω resistor shown in figure is



(*a*) Zero (*b*) 1 A

(*c*) 1.5 A (*d*) 2 A

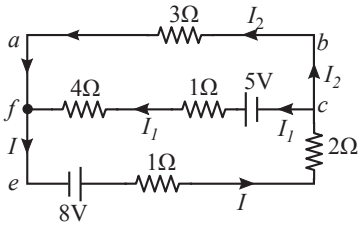
87. The value of current through 2 Ω resistor is



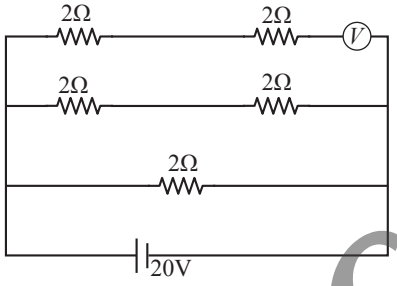
(*a*) 1.0 A (*b*) 1.5 A

(*c*) 5.0 A (*d*) 2.1 A

88. In the network in given figure find I_1 , I_2 and I.

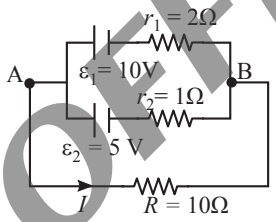


89. The reading of ideal voltmeter in given hypothetical circuit is



(*a*) 5 V (*b*) 20 V (*c*) 10 V (*d*) 16 V

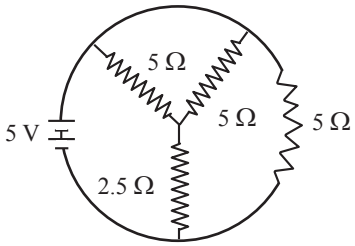
90. Find current *I* through the 10 resistance in the network shown in figure.



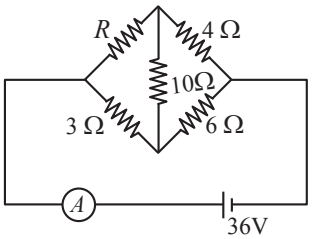
91. In a building there are 15 bulbs of 45 W, 15 bulbs of 100 W, 15 small fans of 10 W and 2 heaters of kW. The voltage of electric main is 220 V. The minimum fuse capacity (rated value) of the building will be

(*a*) 10 A (*c*) 25 A (*b*) 20 A (*d*) 15 A

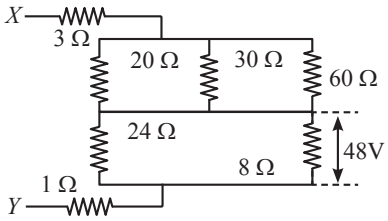
92. The total current supplied to the circuit as shown in figure by the 5 V battery is_____*A*.



93. Current measured by the ammeter (*A*) in the reported circuit when no current flows through 10 resistance, will be _____A.



94. The potential difference across 8 ohm resistance is 48 volt, as shown in the figure. The value of potential difference across X and Y points will be



(*a*) 160 V (*b*) 128 V

(*c*) 80 V (*d*) 62 V

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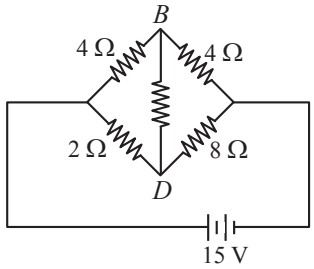
95. In the circuit shown, if a conducting wire is connected between points B and D, then current in this wire will



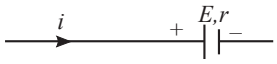
(*a*) Flow from B to D (*b*) Flow from D to B
(*c*) Be zero (*d*) Data is insufficient to answer

Charging & Discharging of a Cell

96. A student measures the terminal potential differences (V) of cell (of emf and internal resistance r) as a function of the current (I) flowing through it. The slope, and intercept,of the graph between V and I, will respectively be equal to.

(*a*) $-r$ and ε (*b*) r and $-$ ε
(*c*) $-$ ε and r (*d*) ε and $-r$

97. According to this diagram, the potential differences across the terminals is (internal resistance of cell = r)



(*a*) $V = E - Ir$ (*b*) $V = E + ir$
(*c*) $V = E$ (*d*) Zero

98. The internal resistance of a 2.1 V cell which gives a current of 0.2 A through a resistance of 10Ω is

(*a*) 0.8 Ω (*b*) 1.0 Ω
(*c*) 0.2 Ω (*d*) 0.5 Ω

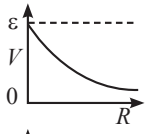
99. A current of 2 A flows through a 2Ω resistor when connected across a battery. The same battery supplies a current of 0.5 A when connected across a 9 Ω resistor. The internal resistance of the battery is.

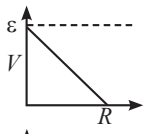
(*a*) 0.5 Ω (*b*) 1/3 Ω
(*c*) 1/4 Ω (*d*) 1 Ω

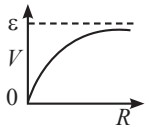
100. For a cell terminal potential difference is 2.2 V when circuit is open and reduces to 1.8 V when cell is connected to a resistance of R = 5 Ω. Determine internal resistance of cell (r).

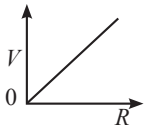
(*a*) 10/9 Ω (*b*) 9/10 Ω
(*c*) 11/9 Ω (*d*) 5/9 Ω

101. A cell having an emf ε and internal resistance r is connected across a variable external resistance R. As the resistance R is increased, the plot of potential difference V across R is given by

(*a*)


(*b*)


(*c*)


(*d*)


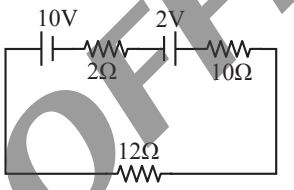
102. A car battery of emf $12V$ and internal resistance 5×10^{-2} Ω, receives a current of 60amp from external source, then terminal potential difference of battery is

(*a*) 12 V (*b*) 9 V
(*c*) 15 V (*d*) 20 V

103. The internal resistance of a cell of e.m.f. 2V is 0.1Ω. It is connected to a resistance of 3.9 Ω. The voltage across the cell will be

(*a*) 1.95 V (*b*) 1.9 V
(*c*) 0.5 V (*d*) 2 V

104. Terminal potential across 10 V battery is x and across 2 volt battery is y. If $x + y = \frac{11A}{3}$, find the value of A.



105. Two cells, having the same e.m.f. Are connected in series through an external resistance R. Cells have internal resistances r_1 and r_2 respectively. When the circuit is closed, the potential difference across the first cell is zero. The value of R is

(*a*) $r_1 + r_2$ (*b*) $r_1 - r_2$
(*c*) $\frac{r_1 + r_2}{2}$ (*d*) $\frac{r_1 - r_2}{2}$

106. When a current of 2 A flows in a battery from negative to positive terminal, the potential difference across it is 12 V. If a current of 3 A flows in the opposite direction potential difference across the terminals of the battery is 15 V, the emf of the battery is

(*a*) 12.6 V (*b*) 13.2 V (*c*) 13.5 V (*d*) 14.0V

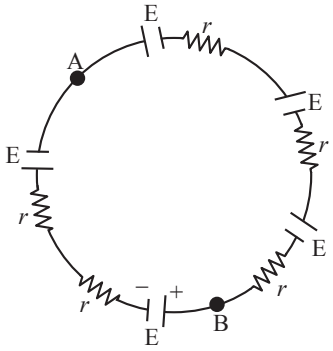
Series and Parallel Combination of Cell

107. If out of n identical cells m are wrongly connected then find equivalent emf & equivalent internal resistance?

108. Five cells each of e.m.f. E and internal resistance r are connected in series. If due to over sight, one cell is connected wrongly, then the equivalent e.m.f. of the combination is

(*a*) 5 E (*b*) 2 E
(*c*) 3 E (*d*) 4 E

109. Find potential different between A & B



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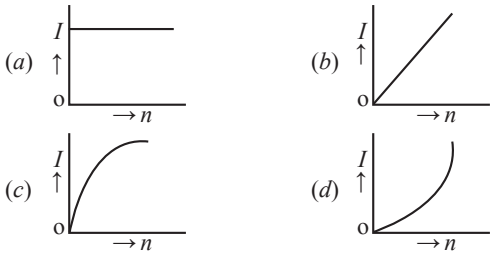
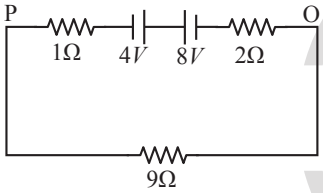
110. A battery consists of a variable number n of identical cells (having internal resistance r each) which are connected in series. The terminals of the battery are short-circuited and the current I is measured. Which of the graphs shows the correct relationship between I and n?



111. Thousand cells of same emf E and same internal resistance r are connected in series in same order without as external resistance. The potential drop across 399 cells is found to be

(*a*) Zero (*b*) 399 E (*c*) 601 E (*d*) 1000 E

112. Two batteries of emf 4 V and 8 V having the internal resistance of 1 Ω and 2 Ω respectively are connected in circuit with a resistance of 9 Ω as shown in figure. The current and potential difference between the points P and Q are



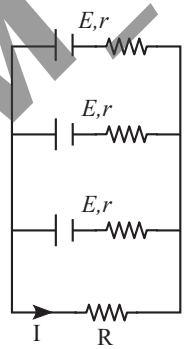
(*a*) $\frac{1}{2}$ A and 12 V (*b*) $\frac{1}{9}$ A and 9 V

(*c*) $\frac{1}{6}$ A and 4 V (*d*) $\frac{1}{3}$ A and 3 V

113. Two batteries of different e.m.f.'s and internal resistance connected in series with each other and with an external load resistor. The current is 3.0 A. When the polarity of one battery is reversed, the current becomes 1.0. A. The ratio of the e.m.f's of the two batteries is

(*a*) 2.5 (*b*) 2 (*c*) 1.5 (*d*) 1

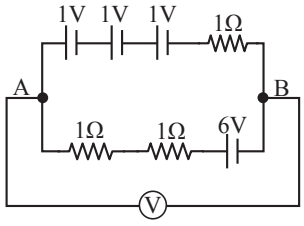
114. n-Identical battery connected in parallel with external resistance (R)then current in extenal resistance.



115. A set of 'n' equal resistors, of value 'R' each, are connected in series to a battery of emf 'E' and internal resistance 'R'. The current drawn is I. Now, the 'n' resistors are connected in parallel to the same battery. Then the current drawn from battery becomes 10 I. The value of 'n' is

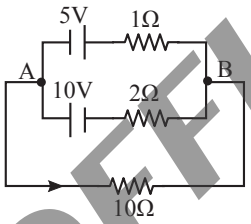
(*a*) 10 (*b*) 11 (*c*) 9 (*d*) 20

116. Reading of an ideal voltmeter in the circuit below is



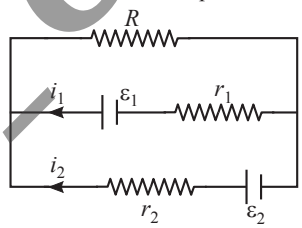
(*a*) zero (*b*) 2 V (*c*) 4 V (*d*) 6 V

117. Current through 10 Ω resistor shown in figure is



(*a*) zero (*b*) 1 A (*c*) 1.5 A (*d*) 2 A

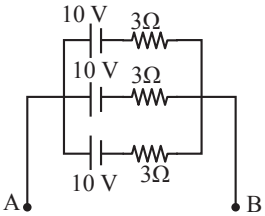
118. See the electrical circuit shown in this figure. Which of the following equations is a correct equation for it?



(*a*) $\varepsilon_2 - i_2r_2 - \varepsilon_1 - i_1r_1 = 0$ (*b*) $-\varepsilon_2 - (i_1 + i_2)R + i_2r_2 = 0$

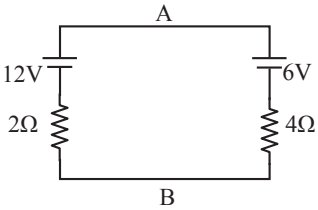
(*c*) $\varepsilon_1 - (i_1 + i_2)R + i_1r_1 = 0$ (*d*) $\varepsilon_1 - (i_1 + i_2)R - i_1r_1 = 0$

119. Three identical cells are connected in parallel across AB. Net emf across AB is.



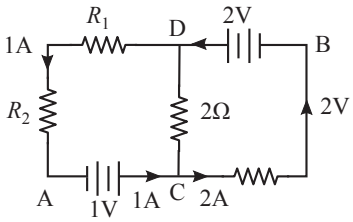
(*a*) 10 V (*b*) 30 V (*c*) 15 V (*d*) 12 V

120. Potential difference across AB i.e., ($V_A - V_B$ is)



(*a*) 10 V (*b*) 8 V (*c*) 6 V (*d*) zero

121. In the circuit shown in the figure, if the potential at point A is taken to be zero, the potential at point B is



(*a*) +1 V (*b*) –1 V (*c*) +2 V (*d*) –2 V

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122. The combination of two identical cells, whether connected in series or parallel combination provides same current through external resistor of 2Ω resistance. Value of internal resistance of each cell is :

(*a*) 2 Ω (*b*) 4 Ω (*c*) 6 Ω (*d*) 8 Ω

123. *n* identical cell [ε, *r*] connected in series and this arrangement is in *m*-times parallel. Current I through load resistance *R* will be maximum when

(*a*) $R = \frac{nr}{m}$ (*b*) $R = \frac{m}{nr}$ (*c*) $R = r$ (*d*) $R = nr$

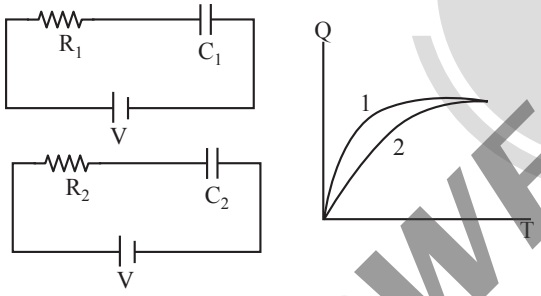
124. There are a large number of cells available, each marked (6 V, 0.5 Ω) to be used to supply current to a device of resistance 0.75 Ω, requiring 24 A current. How should the cells be arranged, so that power is transmitted to the load using minimum number of cells?

(*a*) Six rows, each containing four cells
(*b*) four rows, each containing six cells
(*c*) Four rows, each containing four cells
(*d*) Six rows, each containing six cells

Charging of Capacitor

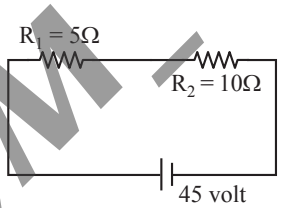
125. Find time when charge on capacitor is half of the maximum charge.

126. Compare C_1, C_2, and R_1, R_2 from charge – time graph for both the circuit

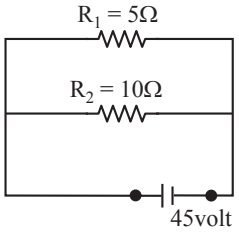


Power Loss

127. Find ratio of Power loss in 5 Ω and 10 Ω and also find total power loss in circuit.



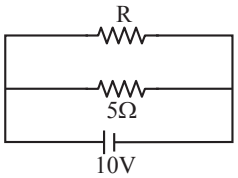
128. Find ratio of power loss in 5 Ω and 10 Ω and also find total power loss in circuit?



129. Kilowatthour is the unit of

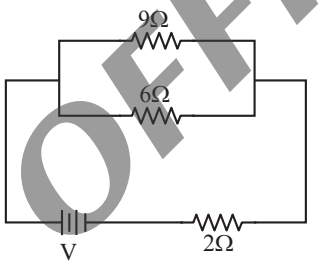
(*a*) Energy (*b*) Power (*c*) Charge (*d*) Time

130. The power dissipated in the circuit shown in the figure is 30 watts. The value of R is



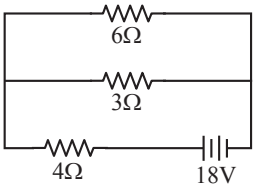
(*a*) 20 Ω (*b*) 15 Ω
(*c*) 10 Ω (*d*) 30 Ω

131. If power dissipated in the 9 Ω resistor in the circuit shown is 36 watt, the potential difference across the 2 Ω resistor is



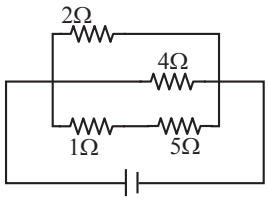
(*a*) 4 volt (*b*) 8 volt
(*c*) 10 volt (*d*) 2 volt

132. The total power dissipated in watt in the circuit shown here is



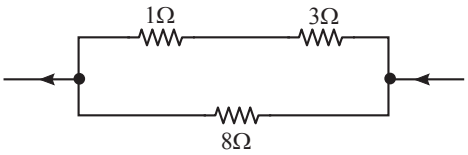
(*a*) 40 (*b*) 54
(*c*) 4 (*d*) 16

133. A current of 3 amp . flows through the 2 Ω resistor shown in the circuit. The power dissipated in the 5 Ω resistor is



(*a*) 1 watt (*b*) 5 watt
(*c*) 4 watt (*d*) 2 watt

134. Power dissipated across the 8 Ω resistor in the circuit shown here is 2 watt. The power dissipated in watt units across the 3 Ω resistor is



(*a*) 3.0 (*b*) 2.0
(*c*) 1.0 (*d*) 0.5

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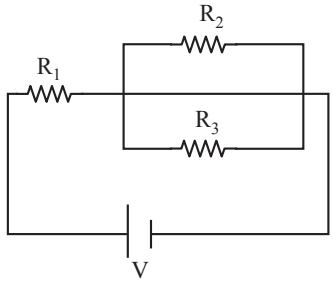
135. Three identical resistors $R_1 = R_2 = R_3$ are connected as shown to a battery of constant e.m.f. The power dissipated is



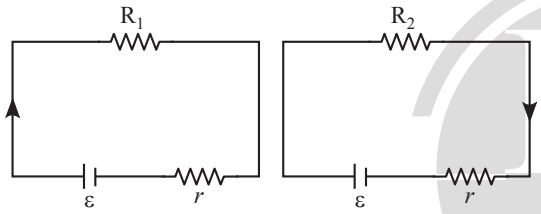
(*a*) The least in R_1

(*b*) Greatest in R_1

(*c*) In the ratio 1: 2 in resistance R_1 and R_2 respectively

(*d*) The same in R_1 and in the parallel combination of R_2 and R_3

136. Two unequal resistances R_1 and R_2 are connected across two identical batteries of emf ε and internal resistance *r*. Can the thermal energy developed in R_1 and R_2 be equal. If yes, find the condition.



137. Three equal resistors connected in series across a source of EMF together dissipate 10 W of power. What would be the power dissipate, if the same resistors are connected in parallel across the same source of EMF?

(*a*) 25 W (*b*) 80 W

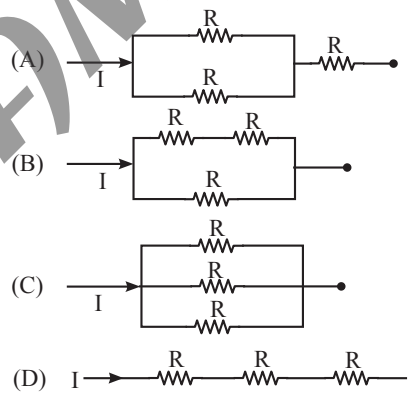
(*c*) 45 W (*d*) 90 W

138. Four equal resistance dissipated 5 W of power together when connected in series to a battery of negligible internal resistance. The total power dissipated in these resistance when connected in parallel across the same battery would be

(*a*) 125 W (*b*) 80 W

(*c*) 20 W (*d*) 5 W

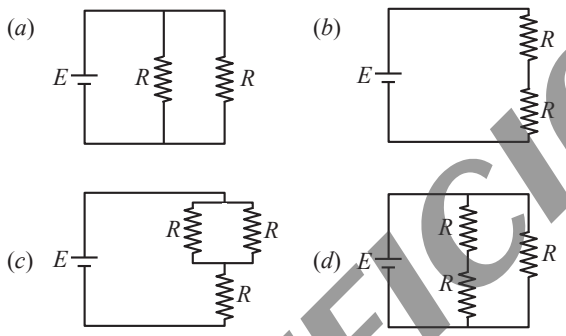
139. Different combination of 3 resistors of equal resistance R are shown in the figures. The increasing order for power dissipation is :



(*a*) $P_B < P_C < P_D < P_A$ (*b*) $P_C < P_B < P_A < P_D$

(*c*) $P_C < P_D < P_A < P_B$ (*d*) $P_A < P_B < P_C < P_D$

140. Consider the four circuits, shown in the figure. In which circuit the power dissipated is the greatest? (Neglect the internal resistance of the power supply)



141. Consider two identical cells each Of emf E and internal resistance r connected to a load resistance R.

	Column I		Column II
A.	Maximum power transfer to load if cells are connected in series	(i)	$\frac{E^2}{4r}$
B.	Maximum power transfer to Load if cells are connected in parallel	(ii)	$\frac{E^2}{2r}$
C.	For series combination of cells	(iii)	$E_{eq} = E, r_q = \frac{r}{2}$
D.	For parallel connected of cells	(iv)	$E_{eq} = 2E, r_{eq} = 2r$

(*a*) A-(ii), B-(i), C-(iii), D-(iv)

(*b*) A-(i), B-(iii), C-(ii), D-(iv)

(*c*) A-(ii), B-(ii), C-(iv), D-(iii)

(*d*) A-(i), B-(iv), C-(ii), D-(iii)

Joule's Law of Heating

142. Current 2 A is flowing through a conductor of resistance 4Ω. Find the electrical energy consumed in 10 s.

143. The charge flowing through a resistance *R* varies with time *t* as $Q = at - bt^2$, where *a* and *b* are positive constants. The total heat produced in *R* is

(*a*) $\frac{a^3R}{b}$ (*b*) $\frac{a^3R}{6b}$

(*c*) $\frac{a^3R}{3b}$ (*d*) $\frac{a^3R}{2b}$

144. An electric kettle takes 4 A current at 220 V. How much time will it take to boil 1 kg of water, from temperature 20°*C*? (The temperature of boiling water is 100°*C*.)

(*a*) 4.2 min (*b*) 6.3 min

(*c*) 8.4 min (*d*) 12.6 min

145. To drive a device of power *P*, the power wasted in the connecting wires is inversely proportional to

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Bulb

146. Two bulbs are marked (a) 100 W, 220 V (b) 40 W, 220 V. Which has higher resistance ?

147. An electric bulb marked 40 W and 200 V , is used in a circuit of supply voltage 100 V. Its power consumed

(*a*) 10 W (*b*) 20 W
(*c*) 40 W (*d*) 100 W

148. If voltage across a bulb rated 220 V – 100 W drops by 2.5 % of its rated value, the percentage of the rated value by which the power would decrease is

(*a*) 5% (*b*) 10%
(*c*) 20% (*d*) 2.5%

149. A current through a lamp marked 50 W, 250 V is

(*a*) 0.1 A (*b*) 0.2 A
(*c*) 0.4 A (*d*) 0.3 A

150. An electric bulb of 500 watt at 100 volt is used in circuit having a 200 V supply. Calculate resistance R to be connected in series with bulb so that power delivered by bulb is 500 W .

(*a*) 20 Ω (*b*) 5 Ω
(*c*) 30 Ω (*d*) 10 Ω

151. **Assertion:** When current through a bulb is increased by 2%, power increases by 4%.

Reason: Current passing through the bulb is inversely proportional to its resistance.

Series & Parallel Combination of Bulb

152. Three bulbs of 40 W, 60 W and 100 W are arranged in series with 220 V . Which bulb has minimum resistance?

(*a*) 100 W (*b*) 40 W
(*c*) 60 W (*d*) Equal in all bulbs

153. Rated individual power of two elements are 100 W and 150 W . Effective power of their series combination will be

(*a*) 120 W (*b*) 75 W
(*c*) 50 W (*d*) 60 W

154. Two electric bulbs whose resistances are in the ratio 1: 2 are connected in series to a constant voltage source. The power dissipated in them are in the ratio

(*a*) 1 : 2 (*b*) 1 : 1
(*c*) 1 : 4 (*d*) 2 : 1

155. When three identical bulbs of 60 watt, 200 volt rating are connected in series to a 200 volt supply, the power drawn by them will be

(*a*) 160 watt (*b*) 180 watt
(*c*) 10 watt (*d*) 20 watt

156. Two electric bulbs A and B rated 200 V ~ 100 W and 200 V ~ 60 W are connected in series to a 200 V line. Then the potential drop across

(*a*) Each bulb is 200 V
(*b*) 100 W bulb is greater than that across 60 W bulb
(*c*) 100 W bulb is smaller than that across 60 W bulb
(*d*) Each bulb is 100 V

157. Two (220 volt, 100 watt bulbs) are connected first in series and then in parallel. Each time the combination is connected to a 220 volt a.c. supply line. The power drawn by the combination in each case respectively will be

(*a*) 50 watt, 100 watt (*b*) 100 watt, 50 watt
(*c*) 200 watt, 150 watt (*d*) 50 watt, 200 watt

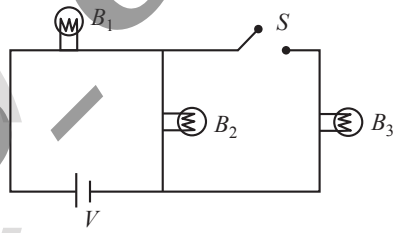
158. Of the two bulbs in a house hold circuit one glows brighter than the other. Which of the two bulbs has a large resistance?

(*a*) The bright bulb
(*b*) The dim bulb
(*c*) Both have the same resistance
(*d*) The brightness does not depend upon the resistance

159. If two bulbs of power 60 W and 100 W respectively each rated 110 V are connected in series with the supply of 220 V, then

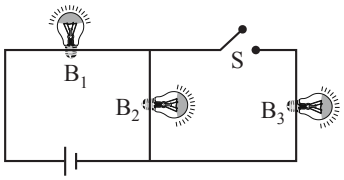
(*a*) 60 W bulb will fuse (*b*) 100 W bulb will fuse
(*c*) Both bulbs will fuse (*d*) Bulbs will not fuse

160. Three identical bulbs B_1, B_2 and B_3 are connected to the mains as shown in figure. If B_3 is disconnected from the circuit by opening switch *S*, then incandescence of bulb B_1 will



(*a*) increase (*b*) decrease
(*c*) constant (*d*) can't say

161. Three identical bulbs B_1, B_2, B_3 are connected to mains as shown in figure. If B_3 is disconnected from circuit by opening switch *S*, then incandescence of bulb B_2 will



(*a*) Increase (*b*) Decrease
(*c*) Become zero (*d*) No change

162. How many 60 W bulbs may be safely run on 220 V using a 5 A fuse?

(*a*) 18 (*b*) 16 (*c*) 14 (*d*) 12

Series & Parallel Combination of Heating Coils

163. A heater coil connected across a given potential difference has power P. Now, the coil is cut into two equal halves and joined in parallel. Across the same potential difference, this combination has power

(*a*) P (*b*) 4P (*c*) P/4 (*d*) 2P

164. Two identical heater filaments are connected first in parallel and then in series. At same applied voltage, ratio of heat produced in same time for parallel to series will be:

(*a*) 4 : 1 (*b*) 1 : 4 (*c*) 2 : 1 (*d*) 1 : 2

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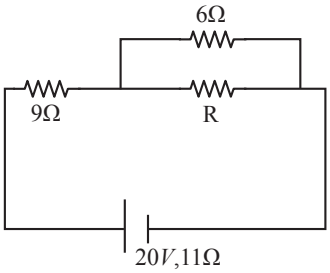
165. A heater boils certain amount of water in 15 minute. Another heater boils same amount of water in 10 minute. Time taken to boil same amount of water when both are used in parallel is

(*a*) 25 minute (*b*) 6 minute (*c*) 12 minute (*d*) 12.5 minute

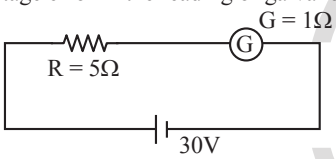
Maximum Power Theorem

166. Find R so that battery will supply maximum power to external circuit?

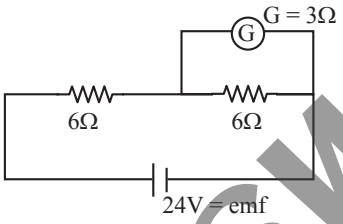


Galvanometer

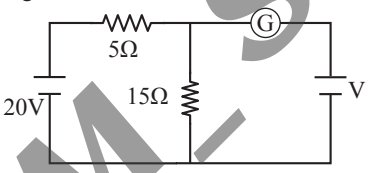
167. Find percentage error in the reading of galvanometer.



168. Find percentage error in the reading of galvanometer connected across 6 Ω as shown in figure to measure voltage.



169. If current in galvanometer is Zero; then find Value of V:



Ammeter and Voltmeter

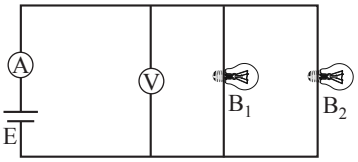
170. Two identical bulbs are connected in parallel across an ideal source of emf E. The ammeter A and voltmeter V are ideal. If bulb B_2 gets fused, then

(*a*) Reading of A will increase but that of V will remain same

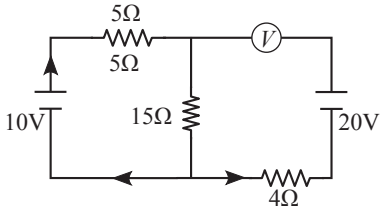
(*b*) Reading of A will decrease but that of V will increase

(*c*) Reading of A will decrease but that of V will remain same

(*d*) Reading of A will increase and reading of V will also increase



171. Find reading of voltmeter



172. **Assertion (A):** For measuring the potential difference across a resistance of 600 Ω. the voltmeter with resistance 1000 Ω will be preferred over voltmeter with resistance 4000 Ω

Reason (R): Voltmeter with higher resistance will draw smaller current than voltmeter with lower resistance.

(*a*) A is false but R is trug

(*b*) Both A and R are true but R is NOT the correct explanation of A

(*c*) A is true but R is false

(*d*) Both A and R are true and R is the correct explanation of A

173. A circuit to verify Ohm's law uses ammeter and voltmeter in series or parallel connected correctly to the resistor. In the circuit:

(*a*) ammeter is always used in parallel and voltmeter is series.

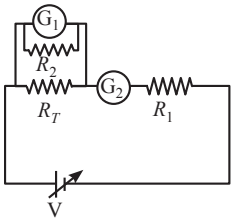
(*b*) both ammeter and voltmeter must be connected in parallel.

(*c*) ammeter is always connected in series and voltmeter in parallel.

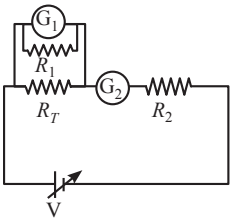
(*d*) both, ammeter and voltmeter must be connected in series.

174. A student is provided with a variable voltage source V, a test resistor $R_r = 10\Omega$, two identical galvanometers G_1 and G_2 and two additional resistors, $R_1 = 10M\Omega$ and $R_2 = 0.001\Omega$. For conducting an experiment to verify ohms law, the most suitable circuit is:

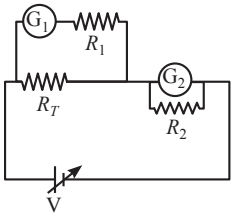
(*a*)



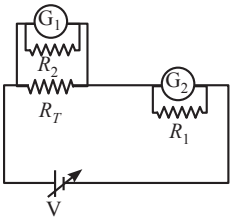
(*b*)



(*c*)



(*d*)



Galvanometer into Ammeter

175. To convert a galvanometer into a ammeter, one needs to connect a

(*a*) low resistance in parallel (*b*) high resistance in parallel

(*c*) low resistance in series (*d*) high resistance in series.

176. A galvanometer having a coil of resistance 60 Ω shows full scale deflection when a current of 1.0 amp passes through it. It can be converted into an ammeter to read currents upto 5.0 amp by

(*a*) putting in series a resistance of 15 Ω

(*b*) putting in series a resistance of 240 Ω

(*c*) putting in parallel a resistance of 15 Ω

(*d*) putting in parallel a resistance of 240 Ω

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177. The resistance of an ammeter is 13 Ω and its scale is graduated for a current upto 100 amps. After an additional shunt has been connected to this ammeter it becomes possible to measure currents unto 750 amperes by this meter. The value of shunt resistance is

(*a*) 2 Ω (*b*) 0.2 Ω (*c*) 0.02 Ω (*d*) 20 Ω

178. Ammeter of resistance 100 Ω is used to measure 10 A. Find resistance of shunt if we want to measure 50 A .

179. A galvanometer having a resistance of 9 ohm is shunted by a wire of resistance 2 ohm . If the total current is 1 amp , the part of it passing through the shunt will be

(*a*) 0.2 amp (*b*) 0.8 amp (*c*) 0.25 amp (*d*) 0.5 amp

180. In an ammeter 0.2 % of main current passes through the galvanometer. If resistance of galvanometer is G, the resistance of ammeter will be

(*a*) $\frac{1}{499}$ G (*b*) $\frac{499}{500}$ G (*c*) $\frac{1}{500}$ G (*d*) $\frac{500}{499}$ G

181. A millivoltmeter of 25 millivolt range is to be converted into an ammeter of 25 ampere range. The value (in ohm) of necessary shunt will be

(*a*) 1 (*b*) 0.05 (*c*) 0.001 (*d*) 0.01

Galvanometer into voltmeter

182. The convert a galvanometer into a voltmeter one should connect a

(*a*) high resistance in series with galvanometer

(*b*) low resistance in series with galvanometer

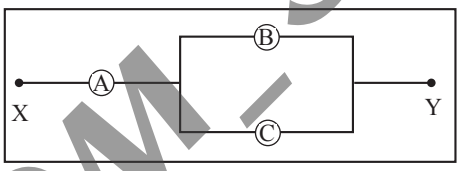
(*c*) high resistance in parallel with galvanometer

(*d*) high resistance in parallel with galvanometer

183. A, B and C are voltmeters of resistance R, 1.5 R and 3 R respectively as shown in the figure. When some potential difference is applied between X and Y, the voltmeter readings are V_A, V_B and V_C respectively, then

(*a*) $V_A \neq V_B \neq V_C$ (*b*) $V_A = V_B = V_C$

(*c*) $V_A \neq V_B = V_C$ (*d*) $V_A = V_B > V_C$



184. A galvanometer of resistance, G is shunted by a resistance S.ohm. To keep the main current in the circuit unchanged, the resistance to be put in series with the galvanometer is

(*a*) $\frac{G^2}{(S+G)}$ (*b*) $\frac{G}{(S+G)}$ (*c*) $\frac{G^2}{(S+2G)}$ (*d*) $\frac{SG}{(S+G)}$

185. A galvanometer has a coil of resistance 100 Ω and gives a full scale deflection for 30 mA current. (if it is to work as a voltmeter of 30 V range, the resistance required to be added will be

(*a*) 1000 Ω (*b*) 900 Ω *c*) 1800 Ω (*d*) 500 Ω

186. A galvanometer of resistance 50 Ω is connected to a battery of 3 V along with a resistance of 2950 Ω in series. A full scale deflection of 30 divisions is obtained in the galvanometer, In order to reduce, this deflection to 20 divisions, the resistance in series should be

(*a*) 4450 Ω (*b*) 5050 Ω (*c*) 5550 Ω (*d*) 6050 Ω

187. A galvanometer of 50 ohm resistance has 25 divisions. A current of 4×10^{-4} ampere gives a deflection of one division. To convert this galvanometer into a voltmeter having a range of 25 volts, it should be connected with a resistance of

(*a*) 2500 Ω as a shunt (*b*) 2450 Ω as a shunt

(*c*) 2550 Ω in series (*d*) 2450 Ω in series

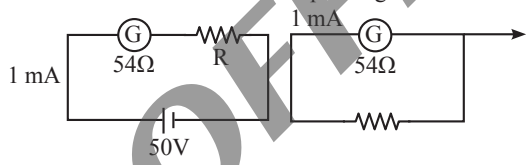
188. For designing a voltmeter of rang 50 V and an ammeter of range 10 mA using a galvanometer which has a coil of resistance 54 Ω showing a full deflection for 1 mA as in figure.

(1) for voltmeter R ≈ 50 kΩ (2) for ammeter $r \approx 0.2$ Ω

(3) for ammeter $r \approx 6$ Ω (4) for voltmeter R ≈ 5 k Ω

(5) for voltmeter R ≈ 500 Ω

Choose correct answer from the options given below :

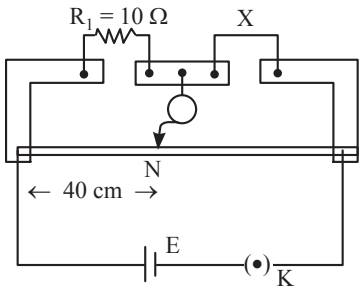


(*a*) (1) and (3) (*b*) (1) and (2)

(*c*) (3) and (5) (*d*) (3) and (4)

Meter Bridge

189. In the meter bridge experiment, the null point is obtained at N . The value of unknown resistance X will



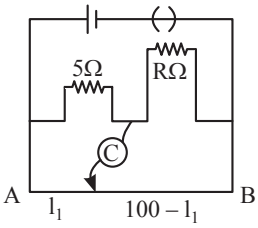
(*a*) 60 Ω (*b*) 40 Ω (*c*) 6 Ω (*d*) 15 Ω

190. A resistance wire connected in the left gap of a meter bridge balances a 10 Ω resistance in the right gap at a point which divides the bridge wire in the ratio 3 : 2. If the length of the resistance wire is 1.5 m , then the length of 1 Ω of the resistance wire is

(*a*) 1.0×10^{-2} m (*b*) 1.0×10^{-1}m

(*c*) 1.5×10^{-1} m (*d*) 1.5×10^{-2} m

191. The resistances in the two arms of the meter bridge are 5 Ω and R Ω respectively. When the resistance R is shunted with an equal resistance, the new balance point is at 1.6 l_1. The resistance R is



(*a*) 10 Ω (*b*) 15 Ω (*c*) 20 Ω (*d*) 25 Ω

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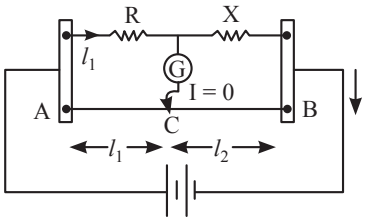
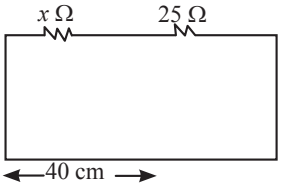
192. In the meter bridge shown, the resistance X has a negative temperature coefficient of resistance. Neglecting the variation in other resistor, when current is passed for some time, in the circuit balance point should shift towards



(*a*) A (*b*) B

(*c*) First A then B (*d*) It will remain at C

193. The resistance per centimeter of meter bridge wire is r with x Ω resistor in left gap. Balancing length from left end is a 40 cm with 25 Ω resistance in right gap. Now wire is replaced by another wire of $2r$ resistance per cm. New balancing length for same settings will be at



(*a*) 10 cm (*b*) 80 cm (*c*) 20 cm (*d*) 40 cm

Potentiometer Wire

194. Two cells of emf E_1 and E_2 are to be compared in a potentiometer ($E_1 > E_2$). When the cells are used in series correctly, the balancing length obtained is 400 cm , When they are used in series but E_2 is connected with reverse polarities, the balancing length obtained is 200 cm . Ratio of emf of cells is

(*a*) 3 : 2 (*b*) 3 : 1 (*c*) 4 : 1 (*d*) 4 : 3

195. Two cells of e.m.f. E_1 and E_2 are joined in series and the balancing length of the potentiometer wire is 625 cm . If the terminals of E_1 are reversed, the balancing length obtained is 125 cm . Given $E_2 > E_1$ the ratio $E_1 : E_2$ will be

(*a*) 2 : 3 (*b*) 5 : 1 (*c*) 3 : 2 (*d*) 1 : 5

196. A potentiometer wire is 100 cm long and a constant potential difference is maintained across it Two cells are connected in series first to support one another and then in opposite direction. The balance points are obtained at 50 cm and 10 cm from the positive end of the wire in the two cases. The ratio of emf's is

(*a*) 3 : 2 (*b*) 5 : 1 (*c*) 5 : 4 (*d*) 3 : 4

197. A potentiometer wire has length 4 m and resistance 8 Ω. The resistance that must be connected in series with the wire and an accumulator of e.m.f. 2 V so as to get a potential gradient 1 mV per cm on the wire is

(*a*) 48 Ω (*b*) 32 Ω (*c*) 40 Ω (*d*) 44 Ω

198. A 10 m long potentiometer wire is connected to a battery having a steady voltage. A Leclanche cell is balanced at 4 m length of the wire. If the length is kept the same, but its cross-section is doubled, the null point will be obtained at

(*a*) 8 m (*b*) 4 m

(*c*) 2 m (*d*) None of these

199. A potentiometer wire of length L and a resistance r are connected in series with a battery of e.m.f. E_0 and a resistance r_1. An unknown e.m.f. E is balanced at a length l of the potentiometer wire. The e.m.f. E will be given by

(*a*) $\frac{LE_0 r}{(r+r_1)l}$ (*b*) $\frac{LE_0 r}{lr_1}$ (*c*) $\frac{E_0 r}{(r+r_1)}\frac{l}{L}$ (*d*) $\frac{E_0}{L}$

200. A potentiometer is an accurate and versatile device to make electrical measurements of E.M.F, because the method involves :

(*a*) Cells

(*b*) Potential gradients

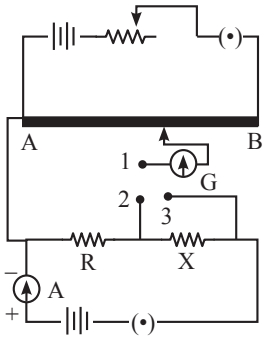
(*c*) A condition of no current flow through the galvanometer

(*d*) A combination of cells, galvanometer and resistances .

201. A potentiometer circuit has been set up for finding the internal resistance of given cell. The main battery, used across the potentiometer wire, has an emf of 2.0 V and a negligible internal resistance. The potentiometer wire itself is 4m long. When the resistance, R, connected across the given cell, has values of (*i*) Infinity, (*ii*) 9.5 Ω, the 'balancing lengths', on the potentiometer wire are found to be 3 m and 2.85 m, respectively. The value of internal resistance of the cell is

(*a*) 0.25 Ω (*b*) 0.95 Ω (*c*) 0.5 Ω (*d*) 0.75 Ω

202. Potential drop per unit length in potentiometers-wire is K and current flowing in lower circuit is 1 A . If key 1 and 2 is connected then balance point is at l_1, when key (1) and (3) is connected then balance point is at l_2 then value of R and x will be?



(*a*) $k(l_2 - l_1)$ and kl_2 (*b*) kl_1 and $k(l_2 - l_1)$

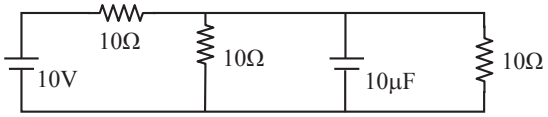
(*c*) $k(l_2 - l_1)$ and kl_1 (*d*) kl_1 and kl_2

203. The potentiometer is a device to compare potential differences. Since the method involves a condition of _____ current flow, the device can be used to measure potential difference; internal resistance of a cell and compare emf's of two sources.

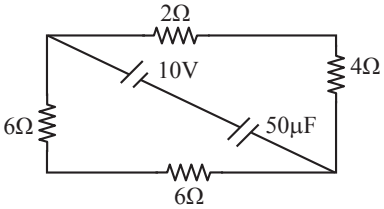
DC - RC Circuit

204. (*i*) Find I at $t = 0$ when Key is closed

(*ii*) Find I at $t = \infty$ from battery (steady State)



205. Find current – at $t = 0$ and at $t = \infty$.



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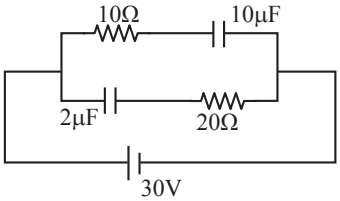
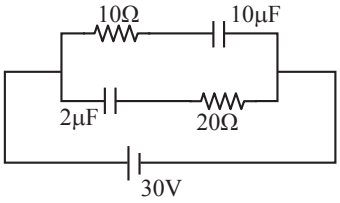
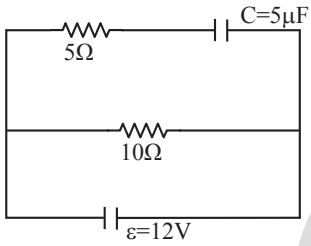
206. Find current from Battery at $t = 0$, and at steady state.



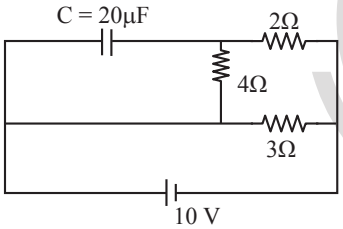
207. Find charge on 2 μF capacitor of steady state



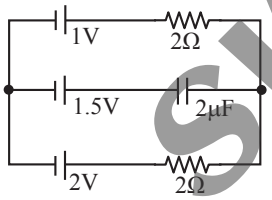
208. Find current through Battery & charge on capacitor in steady State



209. Find charge on capacitor at steady state.?

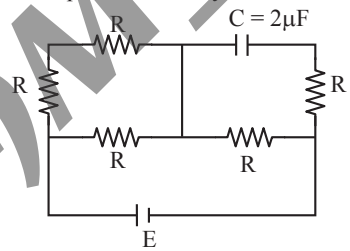


210. The charge in the 2 μF capacitor at steady state is

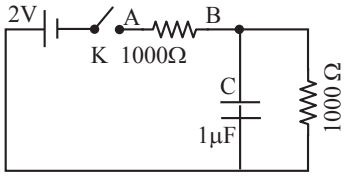


(*a*) Zero (*b*) 2 μC (*c*) 4 μC (*d*) 6 μC

211. Find charge on capacitor at steady state



212. When the key K is pressed at time $t = 0$, then which of the following statement about the current I in the resistance AB of resistance 1000 Ω of the given circuit is true?



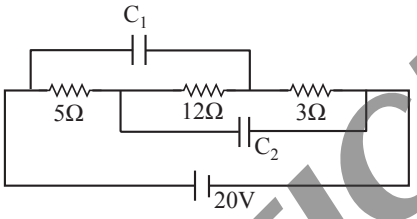
(*a*) I oscillates between 1 mA and 2 mA

(*b*) At $t = 0$, $I = 2$ mA and with time it goes to 1 mA

(*c*) $I = 1$ mA at all t

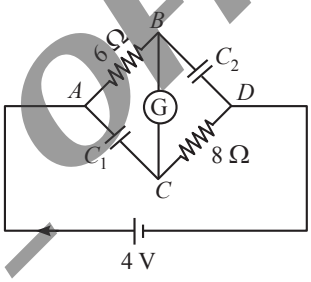
(*d*) $I = 2$ mA at all t

213. At steady state find Potential difference across C_1 & C_2



(*a*) 17 V, 3 V (*b*) 15 V, 3V (*c*) 17 V, 15 V (*d*) 5V, 3V

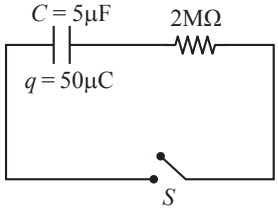
214. In this figure the resistance of the coil of galvanometer G is 2 Ω. The emf of the cell is 4 V. The ratio of potential difference across C_1 and C_2 is:



(*a*) 1 (*b*) $\frac{4}{5}$ (*c*) $\frac{3}{4}$ (*d*) $\frac{5}{4}$

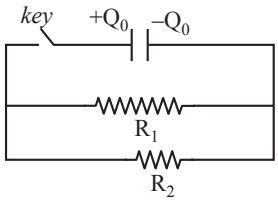
Discharging of Capacitor

215. The following circuit consists of a 5 μF capacitor, having charge 50 μ C as shown. The switch is closed at $t = 0$. The value of current in 2 MΩ resistor at $t = 0$ is

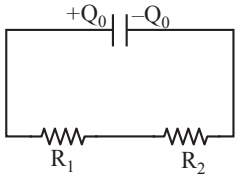


(*a*) 1 μA (*b*) 2 μA (*c*) 5 μA (*d*) 5 A

216. Find Ratio of heat loss in R_1 and R_2. When capacitor is discharging through R_1 & R_2



217. Find ratio of heat loss across R_1 and R_2 when capacitor is discharging.



218. Find time when energy on capacitor is half of the maximum energy.

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1. **Statement I:** A metallic resistor is connected across a battery. If the number of collisions of free electron with the lattice is somehow decreased in the resistor, the current will increase.

   Statement II: The product of resistivity and conductivity of a cylindrical conductor depends on the material of conductor.

2. **Statement I:** As the temperature of metallic resistor is increased the product of its resistivity & conductivity increases.

   Statement II: In an electric circuit containing a battery the charge (assumed positive) inside the battery always goes from negative terminal to the positive terminal.

3. **Statement I:** A resistor of resistance R is connected to an ideal battery. If the value of R is decreased. The power dissipated in resistor will increase.

   Statement II: Two resistors R and 2R are connected in series in an electric circuit. The Thermal energy developed in R and 2R are in Ratio 2:1

4. **Statement I:** A uniform wire of resistance 50Ω is cut longitudinally into 5 parts each having same area cross section but length being same as their parent wire. These parts are now connected in parallel. The equivalent resistance of combination will Remain 50Ω.

   Statement II: Kirchhoff's loop law follows from conservative nature of electric field.

5. **Statement I:** Two non-ideal batteries are connected in series. The equivalent emf is longer than either of the Two emfs.

   Statement II: Two non-ideal batteries are connected in parallel. The equivalent emf is smaller than either of the two emfs.

6. **Statement I:** Two non-ideal batteries are connected in series. The equivalent internal resistance is longer than either of the Two internal resistances.

   Statement II: Two non-ideal batteries are connected in parallel. The equivalent internal resistance is smaller than either of the two internal resistance.

7. **Statement I:** The net resistance of the ammeter should be small to ensure that it does not appreciably change the current to be measured.

   Statement II: The net resistance of voltmeter should be large to ensure that it does not get overheated.

8. **Statement I:** When no current is passed through a conductor, the free electrons do not move.

   Statement II: When no current is passed through a conductor, the average speed of free electron over a large period of time is zero.

9. **Statement I:** Number of free electrons and resistivity of resistor do not changes when resistor connected to a battery is heated due to the current.

   Statement II: As the Temperature of conductor increases its ratio of resistivity to conductivity increases.

10. **Statement I:** A current passes through a wire of non-uniform Cross-section. The charge crossing in a given interval of time. Remain independent of the cross-section.

    Statement II: A current passes through a wire of non-uniform cross-section. The current density remains independent of the cross-section.

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Answer Key

1. (*a*) **2.** (*c*) **3.** (2A) **4.** (*c*) **5.** 6A, 4A **6.** (*c*) **7.** (*d*) **8.** (3 : 1) **9.** (*a*) **10.** $\frac{25}{4}A$

11. $\frac{10}{8}A$ **12.** 2 times **13.** (*b*) **14.** (*a*) **15.** (*c*) **16.** (*d*) **17.** (*d*) **18.** (*a*) **19.** (*b*) **20.** (a)

21. (*a*) **22.** (*b*) **23.** (*a*) **24.** (No) **25.** $\mu_e >> \mu_p$ **26.** (4) **27.** (*b*) **28.** (*a*) **29.** (c)

30. (*d*) **31.** (*b*) **32.** (*c*) **33.** (*a*) **34.** (*b*) **35.** (*b*) **36.** (*c*) **37.** (*d*) **38.** (*d*) **39.** (b)

40. (*c*) **41.** (*a*) **42.** (*b*) **43.** (*a*) **44.** (*c*) **45.** (*b*) **46.** (*d*) **47.** (*a*) **48.** $V_B = -11$ volt

49. (*a*) **50.** (*c*) **51.** GaAs **52.** 10V, 60V, 30V **53.** $I_{20\Omega} = 1A, I_{5\Omega} = 4A$ **54.** (*c*) **55.** (*c*) **56.** (a)

57. $\frac{2E}{3}V$ **58.** (*c*) **59.** (*b*) **60.** (*b*) **61.** (*b*) **62.** (*b*) **63.** 5A, 15V **64.** (*b*) **65.** (*a*) **66.** (d)

67. 10 Ω **68.** (*c*) **69.** 3Ω **70.** (*d*) **71.** (*b*) **72.** (*a*) **73.** (*a*) **74.** (*a*) **75.** (*a*) **76.** (a)

77. (*d*) **78.** $\frac{\left(\frac{V_1}{R_1}+\frac{V_2}{R_2}\right)}{\left(\frac{1}{R_1}+\frac{1}{R_1}\right)}$ **79.** $\frac{-10}{8}V$ **80.** 9V **81.** $I_{10\Omega} = 0.1A, I_{20\Omega} = 0.1A$ **82.** $\frac{5}{2}A$ **83.** 6A

84. $\frac{35}{4}A$ **85.** (*a*) **86.** (*a*) **87.** (*d*) **88.** $I_1 = \frac{18}{13}A, I_2 = \frac{25}{39}A, I_3 = \frac{79}{39}A$ **89.** (*b*) **90.** $\frac{5}{8}$A **91.** (*b*)

92. (2) **93.** 10A **94.** (*a*) **95.** (*b*) **96.** (*a*) **97.** (*b*) **98.** (*d*) **99.** (*b*) **100.** (*a*) **101.** (*c*)

102. (*c*) **103.** (*a*) **104.** (4) **105.** (*b*) **106.** (*b*) **107.** (*nE* –2*mE*), *nr* **108.** (*c*) **109.** (0) **110.** (*a*)

111. (*a*) **112.** (*d*) **113.** (*b*) **114.** $I = \frac{3E}{3R+r}$ **115.** (*a*) **116.** (*c*) **117.** (*a*) **118.** (*d*) **119.** (*a*)

120. (*a*) **121.** (*a*) **122.** (*a*) **123.** (*a*) **124.** (*b*) **125.** $t = RC \ln 2 = \tau \ln 2$ **126.** $C_1 = C_2, R_1 < R_2$

127. 1 : 2, 135 W **128.** 2 : 1, 607.5 W **129.** (*a*) **130.** (*c*) **131.** (*c*) **132.** (*b*) **133.** (*b*) **134.** (*a*)

135. (*b*) **136.** $\left(\text{Yes}, r = \sqrt{R_1R_2}\right)$ **137.** (*d*) **138.** (*b*) **139.** (*b*) **140.** (*a*) **141.** (*c*) **142.** 160 J **143.** (b)

144. (*b*) **145.** Square of voltage across the device **146.** $R_{100W} < R_{40W}$ **147.** (*a*) **148.** (*a*) **149.** (*b*) **150.** (*a*)

151. (*b*) **152.** (*a*) **153.** (*d*) **154.** (*a*) **155.** (*d*) **156.** (*c*) **157.** (*d*) **158.** (*b*) **159.** (*a*) **160.** (*b*)

161. (*a*) **162.** (*a*) **163.** (*b*) **164.** (*a*) **165.** (*b*) **166.** (R = 3Ω) **167.** (16.7%) **168.** 50%

169. 15 volt **170.** (*c*) **171.** 12.5 volt **172.** (*a*) **173.** (*c*) **174.** (*c*) **175.** (*a*) **176.** (*c*) **177.** (*a*)

178. 25Ω **179.** (*b*) **180.** (*c*) **181.** (*c*) **182.** (*a*) **183.** (*b*) **184.** (*a*) **185.** (*b*) **186.** (*a*) **187.** (*d*)

188. (*a*) **189.** (*d*) **190.** (*b*) **191.** (*b*) **192.** (*b*) **193.** (*d*) **194.** (*b*) **195.** (*a*) **196.** (*a*) **197.** (*b*)

198. (*b*) **199.** (*c*) **200.** (*c*) **201.** (*c*) **202.** (*b*) **203.** No **204.** $I_{(t=0)} = 1A, I_{(t=\infty)} = \frac{2}{3}A$

205. at $t = 0$, I = 2.5 A, at t = ∞, I = 0 **206.** at $t = 0$, I = 4.5 A, at t = ∞, I = 0 **207.** 60μC **208.** I = 1.5A, Q = 60μC **209.** $\frac{400}{3}C$

210. (*a*) **211.** $\frac{6E}{5}$ **212.** (*b*) **213.** (*c*) **214.** (*b*) **215.** (*c*) **216.** $\frac{E_1}{E_2} = \frac{R_2}{R_1}$ **217.** $\frac{H_1}{H_2} = \frac{R_1}{R_2}$

218. $t = -RC \ln\left(\frac{\sqrt{2}-1}{\sqrt{2}}\right)$

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1. I. True, II. - False **2.** Both are False **3.** I. - True, II. - False **4.** Both are True.

5. I. - True, II. - False **6.** Both True **7.** I. - True, II. - False **8.** Both are False

9. I. - False, II. - True **10.** I. - True, II. - False

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SHM Motion
(Practice Questions)

Periodic, Oscillatory & SHM Motion

1. Circular Motion is an example of?
(*a*) Periodic Motion
(*b*) Non-Periodic
(*c*) Oscillatory
(*d*) May be Periodic or non Periodic

2. The circular motion of a particle with constant speed is
(*a*) Periodic but not simple harmonic
(*b*) Simple harmonic but not periodic
(*c*) Period and simple harmonic
(*d*) Neither periodic nor simple harmonic

3. Identify the correct definition-
(*a*) If after every certain interval of time, particle repeats its motion then motion is called periodic motion
(*b*) To and for motion of a particle over the same path is called oscillatory motion
(*c*) Oscillatory motion described in terms of single sine and cosine functions is called simple harmonic motion
(*d*) All of these

4. Given below are two statements: One is labelled as **Assertion (A)** and the other is labelled as **Reason (R)**.

Assertion (A): General vibration of a polyatomic molecule about its equilibrium position is periodic but not SHM.

Reason (R): A periodic motion can always be expressed as a sum of infinite number of harmonic motion with appropriate amplitude.

In the light of the above statements, choose the most appropriate answer from the options given below:
(*a*) Both (A) and (R) are true and (R) is the correct explanation of (A).
(*b*) Both (A) and (R) are true and (R) is Not the correct explanation of (A).
(*c*) (A) is true but (R) is false.
(*d*) (A) is false but (R) is true.

Period & Frequency

5. If frequency of object is π rad/sec. then find time period-

6. A nurse in a hospital, noted for a patient the heart was beating 75 times a minute. Find its frequency and time period.

Equation of SHM

7. A particle moves under force $F = -5(x-2)^3$. Motion of the particle is-
(*a*) Translatory (*b*) Oscillatory
(*c*) SHM (*d*) All of these

8. For a particle showing motion under the forces $F = -5(x-2)^2$, the motion is-
(*a*) Translatory (*b*) Oscillatory
(*c*) SHM (*d*) All of these

9. For a particle showing motion under the forces $F = -5(x-2)$, the motion is-
(*a*) Translatory (*b*) Oscillatory
(*c*) SHM (*d*) Both 2 and 3

10. If a particle is executing simple harmonic motion, then acceleration of particle,
(*a*) Is uniform
(*b*) Varies linearly with time
(*c*) Is non uniform
(*d*) Both 2 and 3

11. Which of the following is/are not SHM?
(*a*) $y = A\cos\omega t$ (*b*) $y = A\sin\omega t$
(*c*) $y = A\sin 3\omega t$ (*d*) $y = Ae^{kT}$

12. A particle moves such that acceleration is given by $a = -4x$. The period of oscillation is-
(*a*) π (*b*) $\frac{2}{\pi}$
(*c*) $\frac{1}{\pi}$ (*d*) 2π

13. If motion started from the positive extreme, then find ϕ

14. If motion started from $x = \frac{+A}{2}$, then find ϕ

15. If motion started from $x = \frac{A}{\sqrt{2}}$, then find ϕ

16. Particle executing SHM along y-axis has its motion described by the equation $y = 2 + 10\sin 5\pi t$. Amplitude of SHM is-
(*a*) 2 (*b*) 12
(*c*) 10 (*d*) $\sqrt{104}$

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17. Phase difference between the instantaneous velocity and acceleration of a particle executing SHM is-

(*a*) Zero (*b*) $\frac{\pi}{2}$

(*c*) π (*d*) 2π

18. A particle executing SHM along *y*-axis, which is described by $y = 10 \sin \frac{\pi t}{4}$, phase of particle at $t = 2$s is-

(*a*) $\frac{\pi}{4}$ (*b*) $\frac{\pi}{2}$

(*c*) $\frac{\pi}{8}$ (*d*) π

19. The displacement of a particle executing SHM is given by $x = 10 \sin\left(\omega t + \frac{\pi}{3}\right) m$. The time period of motion is 3.14s.

The velocity of the particle at $t = 0$ is _____ m/s.

20. A particle execute simple harmonic motion according to equation $4\frac{d^2x}{dt^2} + 320\,x = 0$. Its time period of oscillation is-

(*a*) $\frac{2\pi}{5\sqrt{3}}$ s (*b*) $\frac{\pi}{3\sqrt{2}}$ s

(*c*) $\frac{\pi}{2\sqrt{5}}$ s (*d*) $\frac{2\pi}{\sqrt{3}}$ s

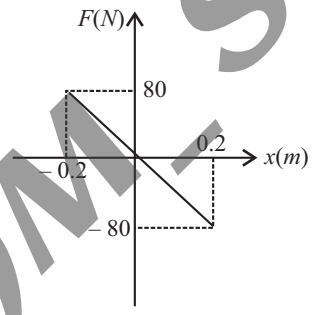
21. The displacements of two particles executing SHM on the same line are given as $y_1 = a \sin\left(\frac{\pi}{2}t + \theta\right)$ and $y_2 = b \sin\left(\frac{2\pi}{3}t + \theta\right)$.

The phase difference between them at $t = 1$s is-

(*a*) π (*b*) $\frac{\pi}{2}$

(*c*) $\frac{\pi}{4}$ (*d*) $\frac{\pi}{6}$

22. A body of mass 0.01 kg executes simple harmonic motion about $x = 0$ under the influence of a force as shown in figure. The time period of SHM is-



(*a*) 1.05 s (*b*) 0.52 s

(*c*) 0.25 s (*d*) 0.03 s

23. A particle is executing a simple harmonic motion. Its maximum acceleration is α and maximum velocity is β. Then, its time period of vibration will be-

(*a*) $\frac{2\pi\beta}{\alpha}$ (*b*) $\frac{\beta^2}{\alpha^2}$

(*c*) $\frac{\alpha}{\beta}$ (*d*) $\frac{\beta^2}{\alpha}$

24. A particle is executing S.H.M. with amplitude A and has maximum velocity v_0. Its speed at displacement $\frac{3A}{4}$ will be-

(*a*) $\frac{\sqrt{7}}{4} v_0$ (*b*) $\frac{v_0}{\sqrt{2}}$

(*c*) v_0 (*d*) $\frac{\sqrt{3}}{2} v_0$

25. For a particle executing simple harmonic motion, the amplitude is *A* and time period is *T*. The maximum speed will be-

(*a*) $4AT$ (*b*) $\frac{2A}{T}$

(*c*) 2π (*d*) $\frac{2\pi A}{T}$

26. In a linear simple harmonic motion (SHM)

A. Restoring force is directly proportional to the displacement.

B. The acceleration and displacement are opposite in direction.

C. The velocity is maximum at mean position.

D. The acceleration is minimum at extreme points.

Choose the correct answer from the options given below:

(*a*) A, B and C only (*b*) C and D only

(*c*) A, B and D only (*d*) A, C and D only

27. Two simple Harmonic Motions of angular frequency 100 and 1000 rad s^{-1} have the same displacement amplitude. The ratio of their maximum accelerations is:

(*a*) $1:10^3$ (*b*) $1:10^4$

(*c*) $1:10$ (*d*) $1:10^2$

28. If a simple harmonic oscillator has got a displacement of 0.02 *m* and acceleration equal to 2.0 ms^{-2} at any time, the angular frequency of oscillator is equal to

(*a*) 10 $rad\ s^{-1}$ (*b*) 0.1 $rad\ s^{-1}$

(*c*) 100 $rad\ s^{-1}$ (*d*) 1 $rad\ s^{-1}$

29. The distance covered by a particle undergoing SHM in one time period is (amplitude = A).

(*a*) 4A (*b*) Zero

(*c*) A (*d*) 2A

30. Which one of the following statements is true for the velocity *v* and the acceleration *a* of a particle executing simple harmonic motion?

(*a*) When *v* is maximum, *a* is zero.

(*b*) When *v* is zero, *a* is zero.

(*c*) When *v* is maximum, *a* is maximum.

(*d*) Value of *a* is zero, whatever may be the value of *v*.

31. A body is executing SHM when its displacement from the mean position is 4 cm and 5 cm, the corresponding velocity of the body is 10 cm/sec and 8 cm/sec. Then the time period of the body is-

(*a*) 2π sec (*b*) $\pi/2$ sec

(*c*) π sec (*d*) $3\pi/2$ sec

32. A particle is executing SHM along a straight line. Its velocities at distance x_1 and x_2 from the mean position are V_1 and V_2 respectively. Its time period is-

(*a*) $2\pi\sqrt{\frac{V_1^2 - V_2^2}{x_1^2 - x_2^2}}$ (*b*) $2\pi\sqrt{\frac{x_1^2 + x_2^2}{V_1^2 + V_2^2}}$

(*c*) $2\pi\sqrt{\frac{x_1^2 - x_2^2}{V_1^2 - V_2^2}}$ (*d*) $2\pi\sqrt{\frac{V_1^2 + V_2^2}{x_1^2 + x_2^2}}$

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33. A particle is executing SHM about $y = 0$ along y-axis. Its position at an instant is given by $y(m) = 5(\sin 3\pi t + \sqrt{3}\cos 3\pi t)$. The amplitude of oscillation is-

(*a*) 10 m (*b*) 5 m

(*c*) $5(1 + \sqrt{3})$m (*d*) $5\sqrt{3}$ m

34. A simple pendulum performs simple harmonic motion about $x = 0$ with an amplitude a and time period t. The speed of the pendulum at $x = \frac{a}{2}$ will be

(*a*) $\frac{\pi a}{T}$ (*b*) $\frac{3\pi^2 a}{T}$

(*c*) $\frac{\pi a\sqrt{3}}{T}$ (*d*) $\frac{\pi a\sqrt{3}}{2T}$

35. A particle executes linear simple harmonic motion with an amplitude of 3 cm. When the particle is at 2 cm from the mean position, the magnitude of its velocity is equal to that of its acceleration. Then its time period in second is-

(*a*) $\frac{\sqrt{5}}{\pi}$ (*b*) $\frac{\sqrt{5}}{2\pi}$

(*c*) $\frac{4\pi}{\sqrt{5}}$ (*d*) $\frac{2\pi}{\sqrt{3}}$

36. **Statement-I:** In SHM let x be the maximum speed, y the frequency of oscillation and z the maximum acceleration, then $\left(\frac{xy}{z}\right)$ is a constant quantity.

Statement-II: This is because $\left(\frac{xy}{z}\right)$ becomes a dimensionless quantity.

(*a*) Statement-I is true, statement-II is true and statement-II is correct explanation for statement-I.

(*b*) Statement-I is true, statement-II is true and statement-II is Not the correct explanation for statement-I.

(*c*) Statement-I is true, statement-II is false.

(*d*) Statement-I is false, statement-II is true.

37. A particle of mass m in a unidirectional potential field have potential energy $U(x) = \alpha + 2\beta x^2$, wehre α and β are positive constants. Find its time period of oscillation.

(*a*) $2\pi\sqrt{\frac{2\beta}{m}}$ (*b*) $2\pi\sqrt{\frac{m}{2\beta}}$

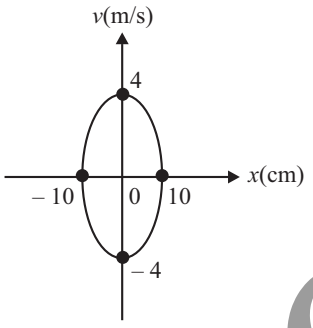
(*c*) $\pi\sqrt{\frac{m}{\beta}}$ (*d*) $\pi\sqrt{\frac{\beta}{m}}$

38. A particle is executing SHM and its velocity v is related to its position (x) as $v^2 + ax^2 = b$, where a and b are positive constants. The frequency of oscillation of particle is-

(*a*) $\frac{1}{2\pi}\sqrt{\frac{b}{a}}$ (*b*) $\frac{\sqrt{a}}{2\pi}$

(*c*) $\frac{\sqrt{b}}{2\pi}$ (*d*) $\frac{1}{2\pi}\sqrt{\frac{a}{b}}$

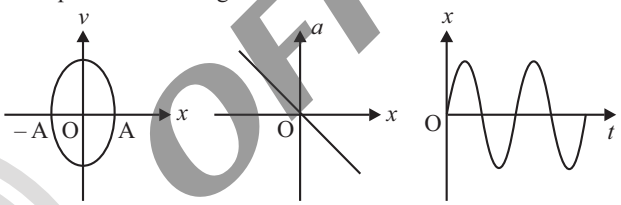
39. The plot of velocity (v) versus displacement (x) of a particle executing simple harmonic motion is shown in figure. The time period of oscillation of particle is-



(*a*) $\frac{\pi}{2}$ s (*b*) $\frac{\pi}{20}$

(*c*) 2π s (*d*) 3π s

40. For a particle executing S.H.M.



Select the correct graph.

(*a*) only (*a*) (*b*) only (*b*)

(*c*) both (*a*) and (*b*) (*d*) all (*a*), (*b*) and (*c*)

41. The position, velocity and acceleration of a particle executing simple harmonic motion are found to have magnitudes of 4m, $2ms^{-1}$ and 16 ms^{-2} at a certain instant. The amplitude of the motion is $\sqrt{x}$ m where x is_____.

42. The shape of graph plotted between velocity and position of a particle executing simple harmonic motion is-

(*a*) A straight line (*b*) An ellipse

(*c*) A parabola (*d*) A hyperbola

43. Match the column

Column-I		Column-II	
(*i*)	$t = 0$ M.P.(Mean Position)	A.	$x = A\cos\omega t$
(*ii*)	$t = 0$ M.P. +A	B.	$x = A\sin\omega t$
(*iii*)	$t = 0$ M.P.	C.	$x = -A\sin\omega t$
(*iv*)	$t = 0$ –A M.P.	D.	$x = -A\cos\omega t$

Choose the correct option:

(*a*) i→B, ii→D, iii→A, iv→C

(*b*) i→C, ii→D, iii→B, iv→A

(*c*) i→B, ii→A, iii→C, iv→D

(*d*) i→A, ii→C, iii→D, iv→B

44. Objects moves from mean half of the extreme $\left(x = \frac{A}{2}\right)$, phase at that time t is,

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45. A particle is executing SHM with time period T. Starting from mean position, time taken by it to complete $\frac{5}{8}$ oscillations, is-

(*a*) $\frac{T}{12}$ (*b*) $\frac{T}{6}$

(*c*) $\frac{5T}{12}$ (*d*) $\frac{7T}{12}$

46. A particle executes simple harmonic motion between $x = -A$ and $x = +A$. If time taken by the particle to go from $x = 0$ to $\frac{A}{2}$ is $2s$; then time taken by the particle in going from $x = \frac{A}{2}$ to A will be:

(*a*) $3s$ (*b*) $2s$

(*c*) $13.5s$ (*d*) $4s$

47. A particle performing SHM with time period T according to the equation $x = A\sin\omega t$, then match the following:

Column-I		Column-II	
(*i*)	Time taken to displace from $x = 0$ to $x = A/2$	A.	$\frac{T}{24}$
(*ii*)	Time taken to displace from $x = A/2$ to $x = A$	B.	$\frac{T}{8}$
(*iii*)	Time taken to go form $x = A/\sqrt{2}$ to $x = \sqrt{3}\ A/2$	C.	$\frac{T}{12}$
(*iv*)	Time taken to displace from $x = A/\sqrt{2}$ to $x = A$	D.	$\frac{T}{6}$

(*a*) i - C, ii - A, iii - D, iv - B

(*b*) i - C, ii - A, iii - B, iv - D

(*c*) i - C, ii - D, iii - A, iv - B

(*d*) i - C, ii - B, iii - D, iv - A

48. Two particles executing SHM of same frequency, meet at $x = +A/2$, while moving in opposite directions. Phase difference between the particles is-

(*a*) $\frac{\pi}{6}$ (*b*) $\frac{\pi}{3}$

(*c*) $\frac{5\pi}{6}$ (*d*) $\frac{2\pi}{3}$

49. A simple pendulum of mass m executes SHM with total energy E. If at an instant it is at one of extreme positions, then its linear momentum after a phase shift of $\frac{\pi}{3}$ rad will be:

(*a*) $\sqrt{2mE}$ (*b*) $\sqrt{\frac{3mE}{2}}$

(*c*) $2\sqrt{mE}$ (*d*) $\sqrt{\frac{2mE}{3}}$

50. A particle executes SHM and its position varies with time as $x = A \sin \omega t$. Its average speed during its motion from mean position to mid-point of mean and extreme position is-

(*a*) Zero (*b*) $\frac{3A\omega}{\pi}$

(*c*) $\frac{A\omega}{2\pi}$ (*d*) $\frac{2A\omega}{\pi}$

51. The equation of an SHM with amplitude A and angular frequency ω in which all the distances are measured from one extreme position and time is taken to be zero at the other extreme position is-

(*a*) $x = A \sin \omega t$ (*b*) $x = A(\cos \omega t + \sin \omega t)$

(*c*) $x = A - A \cos \omega t$ (*d*) $x = A + A \cos \omega t$

Energy of SHM

52. The kinetic energy and potential energy of a particle executing SHM are equal, when displacement in terms of amplitude 'A' is-

(*a*) $\frac{A}{2}$ (*b*) $\frac{A}{\sqrt{2}}$

(*c*) $\frac{A\sqrt{2}}{3}$ (*d*) $A\sqrt{2}$

53. At what displacement the kinetic energy is half of the potential energy?

54. A body is executing SHM with amplitude a and time period T. The ratio of kinetic and potential energy when displacement from the equilibrium position is half the amplitude

(*a*) 1 : 1 (*b*) 2 : 1

(*c*) 1 : 3 (*d*) 3 : 1

55. In a simple harmonic oscillation, what fraction of total mechanical energy is in the form of kinetic energy, when the particle is midway between mean and extreme position?

(*a*) $\frac{1}{2}$ (*b*) $\frac{3}{4}$

(*c*) $\frac{1}{3}$ (*d*) $\frac{1}{4}$

56. Find ratio of kinetic & potential energy at $x = \frac{A}{4}$.

57. When the displacement of a simple harmonic oscillator is one third of its amplitude, the ratio of total energy to the kinetic energy is $\frac{x}{8}$, where $x =$ _____.

58. Find position of particle from mean position where *P.E.* is half of the kinetic energy.

59. At the time $t = 0$, the particle is at its mean position, then at what times, the particle will have potential energy 50% of its total energy within $t = 0$ to $t = T$.

60. A linear harmonic oscillator of force constant 6×10^5 N/m and amplitude 4 cm, has a total energy 600 J. Select the correct statement.

(*a*) Maximum potential energy is 600 J

(*b*) Maximum kinetic energy is 480 J

(*c*) Minimum potential energy is 120 J

(*d*) All of these

61. A particle is executing SHM with time period T. If time period of its total mechanical energy is T' then T'/T is-

(*a*) 2 (*b*) 1/2

(*c*) Zero (*d*) Infinite

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62. A loaded vertical spring executes SHM with a time period of 4 *s*. The difference between the kinetic energy and potential energy of this system varies with a period of-

(*a*) 2 *s* (*b*) 1 *s*

(*c*) 8 *s* (*d*) 4 *s*

63. **Statement-I:** Total energy in SHM will be always more than or equal to potential energy.

Statement-II: Total energy in SHM will be always more than or equal to kinetic energy.

(*a*) Statement-I is True, statement-II is true; statement-II is a correct explanation for statement-I.

(*b*) Statement-I is True, statement-II is true; statement-II is not a correct explanation for statement-I.

(*c*) Statement-I is true, statement-II is false.

(*d*) Statement-I is false, statement-II is true.

64. The amplitude of a particle executing SHM is 3 cm. The displacement at which its kinetic energy will be 25% more than the potential energy is: _____ cm.

65. For a body executing S.H.M.:

A. Potential energy is always equal to its K.E.

B. Average potential and kinetic energy over any given time interval are always equal.

C. Sum of the kinetic and potential energy at any point of time is constant.

D. Average K.E. in one time period is equal to average potential energy in one time period.

Choose the most appropriate option from the options given below:

(*a*) Only B (*b*) B and C

(*c*) Only C (*d*) C and D

66. The potential energy of a particle of mass 100 g moving along *x*-axis is given by $U = 5x(x-4)$, where *x* is in metre. The period of oscillation is-

(*a*) $0.2\,\pi\ s$ (*b*) $0.1\,\pi\ s$

(*c*) $\pi\ s$ (*d*) $\frac{1}{\pi}\ s$

67. Two masses M_A and M_B are hung from two strings of length l_A and l_B respectively. They are executing SHM with frequency relation $f_A = 2f_B$, then relation

(*a*) $l_A = \frac{l_B}{4}$, does not depend on mass

(*b*) $l_A = 4\,l_B$, does not depend on mass

(*c*) $l_A = 2\,l_B$ and $M_A = 2M_B$

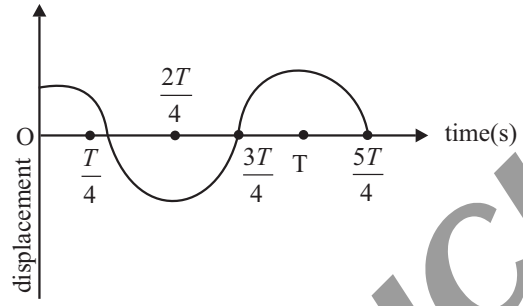
(*d*) $l_A = \frac{l_B}{2}$ and $M_A = \frac{M_B}{2}$

68. The displacement of simple harmonic oscillator after 3 seconds starting from its mean position is equal to half of its amplitude. The time period of harmonic motion is:

(*a*) 6 *s* (*b*) 8 *s*

(*c*) 12 *s* (*d*) 36 *s*

69. The displacement time graph of a particle executing SHM is given in figure (sketch is schematic and not to scale)



Which of the following statements is/are true for this motion?

A. The force is zero at $t = \frac{3T}{4}$

B. The acceleration is maximum at $t = T$

C. The speed is maximum at $t = \frac{T}{4}$

D. The *P.E.* is equal to *K.E.* of the oscillation at $t = \frac{T}{2}$

(*a*) B, C and D (*b*) A and D

(*c*) A, B and C (*d*) A, B and D

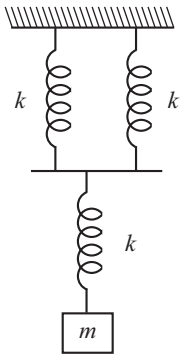
70. Two simple harmonic motions are represented by the equations $x_1 = 5\sin\left(2\pi t + \frac{\pi}{4}\right)$ and $x_2 = 5\sqrt{2}\,(\sin 2\pi t + \cos 2\pi t)$. The amplitude of second motion is _____ times the amplitude in first motion.

71. A particle executes S.H.M. with amplitude '*a*' and time period 'T'. The displacement of the particle when its speed is half of maximum speed is $\frac{\sqrt{xa}}{2}$. The value of *x* is_____.

72. Two simple harmonic motion, are represented by the equations $y_1 = 10\sin\left(3\pi t + \frac{\pi}{3}\right)$, $y_2 = 5(\sin 3\pi t + \sqrt{3}\cos 3\pi t)$. Ratio of amplitude of y_1 to $y_2 = x : 1$. The value of *x* is _____.

Spring-Mass Oscillation

73. A block of mass *m* hangs from three springs having same spring constant *k*. If the mass is slightly displaced downwards, the time period of oscillation will be:



(*a*) $2\pi\sqrt{\frac{m}{3k}}$ (*b*) $2\pi\sqrt{\frac{3m}{2k}}$

(*c*) $2\pi\sqrt{\frac{2m}{3k}}$ (*d*) $2\pi\sqrt{\frac{3k}{m}}$

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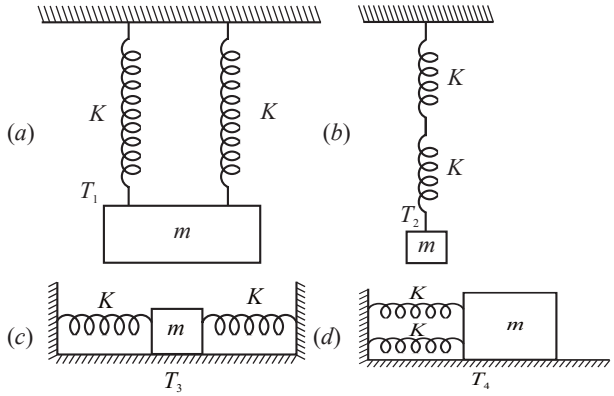
74. A mass m is attached to two springs of same force constant K, as shown in following four arrangements. It T_1, T_2, T_3 and T_4 respectively be the time periods of oscillation in the following arrangements, in which case time period is maximum?



75. A body of mass m is attached to the lower end of a spring whose upper end is fixed. The spring has negligible mass. When the mass m is slightly pulled down and released, it oscillates with a time period of 3 s. When the mass m is increased by 1 kg, the time period of oscillations becomes 5 s. The value of m in kg is-

(*a*) 3/4 (*b*) 4/3

(*c*) 16/9 (*d*) 9/16

76. A spring block system in horizontal oscillation has a time-period T. Now the spring is cut into four equal parts and the block is re-connected with one of the parts. The new time period of vertical oscillation will be:

(*a*) $\frac{T}{\sqrt{2}}$ (*b*) $2T$

(*c*) $\frac{T}{2}$ (*d*) $\frac{T}{2\sqrt{2}}$

77. A block of mass m is suspended separately by two different springs have time period t_1 and t_2. If same mass is connected to parallel combination of both springs, then its time period is given by

(*a*) $\frac{t_1 t_2}{t_1 + t_2}$ (*b*) $\frac{t_1 t_2}{\sqrt{t_1^2 + t_2^2}}$

(*c*) $\sqrt{\frac{t_1 t_2}{t_1 + t_2}}$ (*d*) $t_1 + t_2$

78. Two identical springs have the same force constant 73.5 Nm^{-1}. The elongation produced in each spring in three cases shown in figure-1, figure-2 and figure-3 are ($g = 9.8\ ms^{-2}$)

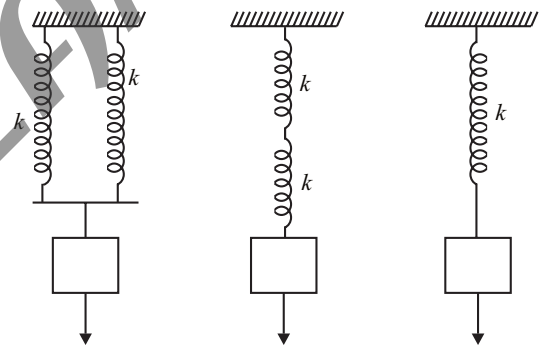
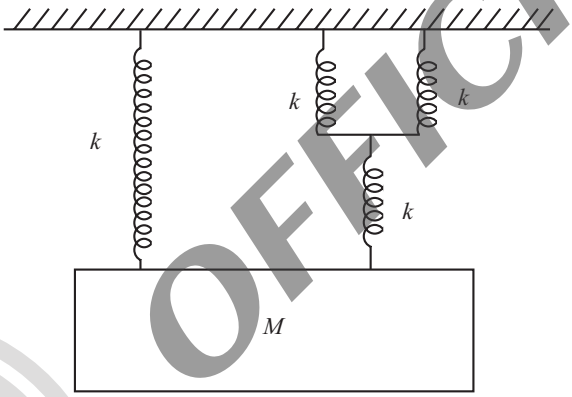


Figure 1 Figure 2 Figure 3

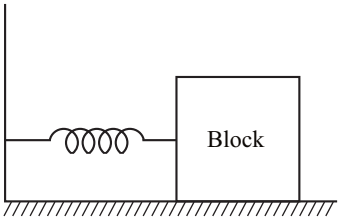
(*a*) $\frac{1}{6}m, \frac{2}{3}m, \frac{1}{3}m$ (*b*) $\frac{1}{3}m, \frac{1}{3}m, \frac{1}{3}m$

(*c*) $\frac{2}{3}m, \frac{1}{3}m, \frac{1}{6}m$ (*d*) $\frac{1}{3}m, \frac{4}{3}m, \frac{2}{3}m$

79. The time period of simple harmonic motion of mass M in the given figure $\sqrt{\frac{\alpha M}{5K}}$ is, where the value of α is _____.



80. For a simple harmonic motion in a mass spring system shown, the surface is frictionless. When the mass of the block is 1 kg, the angular frequency is ω_1. When the mass of the block is 2 kg the angular frequency is ω_2. The ratio ω_2/ω_1 is:



(*a*) $\sqrt{2}$ (*b*) $\frac{1}{\sqrt{2}}$ (*c*) 2 (*d*) $\frac{1}{2}$

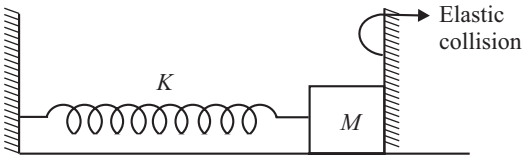
81. A mass m is suspended from a spring of negligible mass and the system oscillates with a frequency f_1. The frequency of oscillations if a mass 9 m is suspended from the same spring is f_2. The value of $\frac{f_1}{f_2}$ is_____.

82. The frequency of oscillation of a mass m suspended by a spring is v_1. If length of spring is cut to one third then the same mass oscillates with frequency v_2, then

(*a*) $v_2 = 3v_1$ (*b*) $3v_2 = v_1$

(*c*) $v_2 = \sqrt{3}\, v_1$ (*d*) $\sqrt{3}\, v_2 = v_1$

83. Initially spring is at its natural length, Now it is compressed by x and then released. Find time period of SHM.



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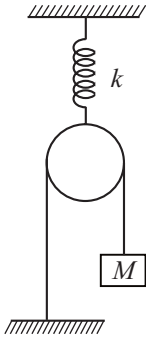
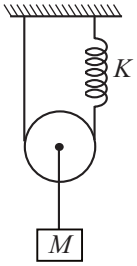
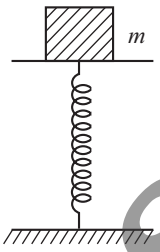
84. Object is in equilibrium, it is displaced distance downwards and then released. Find time period of oscillation.



85. Object is in equilibrium, now displaced x distance downwards and released then find time period of oscillation.



86. A mass of 2.0 kg is put on a flat pan attached to a vertical spring fixed on the ground as shown in the figure. The mass of the spring and the pan is negligible. When pressed slightly and released by mass executes a simple harmonic motion. The spring constant is 200 N/m. What should be the minimum amplitude of the motion so that the mass gets detached from the pan? [Take $g = 10$ m/s^2]



(*a*) 10.0 cm (*b*) Any value less than 12.0 cm
(*c*) 4.0 cm (*d*) 8.0 cm

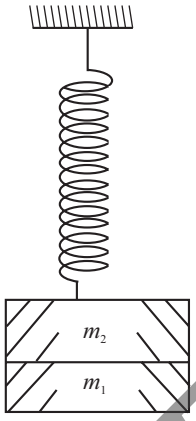
87. A block is resting on a piston which executes simple harmonic motion with a period 2.0 s. The maximum velocity of the piston at an amplitude just sufficient for the block to separate from the piston is:

(*a*) 1.57 ms^{-1} (*b*) 3.12 ms^{-1}
(*c*) 2.0 ms^{-1} (*d*) 6.42 ms^{-1}

88. A mass m is vertically suspended from a spring of negligible mass; the system oscillates with a frequency n. What will be the frequency of the system, if a mass 4m is suspended from the same spring?

(*a*) $\frac{n}{2}$ (*b*) $4n$
(*c*) $\frac{n}{4}$ (*d*) $2n$

89. Two masses m_1 and m_2 are suspended together by a massless spring of force constant k, as shown in figure. When the masses are in equilibrium, mass, m_1 is removed without disturbing the system. The angular frequency of oscillation of mass m_2 is:



(*a*) $\sqrt{\frac{k}{m_2}}$ (*b*) $\sqrt{\frac{k}{m_1}}$
(*c*) $\sqrt{\frac{km_1}{m_2^2}}$ (*d*) $\sqrt{\frac{km_2}{m_1^2}}$

90. A vertical spring block system is made to oscillate.

Statement-I: Its time period on earth is more than that on the moon.

Statement-II: Its extension on earth (in equilibrium) is more than that on the moon.

(*a*) Statement-I is true, statement-II is true and statement-II is correct explanation for statement-I.
(*b*) Statement-I is true, statement-II is true and statement-II is not the correct explanation for statement-I.
(*c*) Statement-I is true, statement-II is false.
(*d*) Statement-I is false, statement-II is true.

91. A particle is executing linear SHM. For this match the following:

Column-I		Column-II	
(*i*)	If mass of the block is doubled (keeping other factor constant)	A.	Energy of oscillation becomes 4 times
(*ii*)	If amplitude of oscillation is doubled (keeping other factor constant)	B.	Max. speed of the particle becomes half times
(*iii*)	If force constant is doubled (Keeping other factor constant)	C.	Time period become $\sqrt{2}$ times.
(*iv*)	If angular frequency is halved (keeping mass constant)	D.	Max. potential energy becomes 2 times.

(*a*) i - C, ii - A, iii - D, iv - B
(*b*) i - C, ii - A, iii - B, iv - D
(*c*) i - a, ii - C, iii - B, iv - D
(*d*) i - C, ii - B, iii - D, iv - A

92. Two particles A and B of equal masses are suspended from two massless springs of spring constants K_1 and K_2 respectively. If the maximum velocities during oscillations are equal, the ratio of the amplitude of A and B is

(*a*) $\frac{K_1}{K_2}$ (*b*) $\sqrt{\frac{K_1}{K_2}}$
(*c*) $\frac{K_2}{K_1}$ (*d*) $\sqrt{\frac{K_2}{K_1}}$

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93. Two massless springs with spring constants $2k$ and $9k$, carry 50g and 100g masses at their free ends. These two masses oscillate vertically such that their maximum velocities are equal. Then, the ratio of their respective amplitudes will -

(*a*) 1:2 (*b*) 3:2
(*c*) 3:1 (*d*) 2:3

Simple Pendulum

94. Time period of a simple pendulum in a freely falling lift will be:

(*a*) Finite (*b*) Infinite
(*c*) Zero (*d*) All of these

95. A simple pendulum is suspended from the roof of a trolley which moves in a horizontal direction with an acceleration a, then the time period is given by $T = 2\pi\sqrt{(l/a')}$, where a' is equal to:

(*a*) g (*b*) $g - a$
(*c*) $g + a$ (*d*) $\sqrt{(a^2 + g^2)}$

96. A simple pendulum with a metallic bob has a time period T. The bob is now immersed in a non-viscous liquid and oscillated. If the density of the liquid is 1/4 that of metal, the time period of the same pendulum will be:

(*a*) $\frac{T}{\sqrt{3}}$ (*b*) $\frac{2T}{\sqrt{3}}$
(*c*) $\frac{4}{3}T$ (*d*) $\frac{2}{3}T$

97. If effective length of a simple pendulum is equal to radius of earth (R), time period will be:

(*a*) $T = \pi\sqrt{\frac{R}{g}}$ (*b*) $T = \pi\sqrt{\frac{2R}{g}}$
(*c*) $T = 2\pi\sqrt{\frac{R}{g}}$ (*d*) $T = \pi\sqrt{\frac{R}{2g}}$

98. A boy is swinging in a swing. If he stands, the time period will:

(*a*) First decrease, then increase
(*b*) Decrease
(*c*) Increase
(*d*) Remain same

99. A seconds pendulum is mounted in a rocket. Its period of oscillation will decrease when rocket is:

(*a*) moving down with uniform acceleration
(*b*) Moving around the earth in geostationary orbit
(*c*) Moving up with uniform velocity
(*d*) Moving up with uniform acceleration.

100. Time period of a simple pendulum in a stationary lift is 'T'. If the lift accelerates with $\frac{g}{6}$ vertically upwards then the time period will be:

(Where g = acceleration due to gravity)

(*a*) $\sqrt{\frac{6}{5}}\,T$ (*b*) $\sqrt{\frac{5}{6}}\,T$
(*c*) $\sqrt{\frac{6}{7}}\,T$ (*d*) $\sqrt{\frac{7}{6}}\,T$

101. The time period of oscillation of a simple pendulum of length L suspended from the roof of a vehicle, which moves without friction down an inclined plane of inclination α, is given by.

(*a*) $2\pi\sqrt{L/(g\cos\alpha)}$ (*b*) $2\pi\sqrt{L/(g\sin\alpha)}$
(*c*) $2\pi\sqrt{L/g}$ (*d*) $2\pi\sqrt{L/(g\tan\alpha)}$

102. A pendulum suspended from the roof of an elevator at rest has time period T_1; when the elevator moves up with an acceleration a its time period becomes T_2; when the elevator moves down with an acceleration a, its time period becomes T_3, then:

(*a*) $T_1 = \sqrt{(T_3T_2)}$ (*b*) $T_1 = \sqrt{(T_2^2 + T_3^2)}$
(*c*) $T_1 = \frac{T_2T_3\sqrt{2}}{\sqrt{(T_2^2 + T_3^2)}}$ (*d*) $T_1 = \frac{T_2^2}{T_3}$

103. If a Second's pendulum is moved to a planet where acceleration due to gravity is 4 times, the length of the second's pendulum on the planet should be made

(*a*) 2 times (*b*) 4 times
(*c*) 8 times (*d*) 15 times

104. A simple pendulum suspended from the ceiling of a stationary lift has period T_0. When the lift descends at steady speed, the period is T_1 and when it descends with constant downward acceleration, the period is T_2. Which one of the following is true?

(*a*) $T_0 = T_1 = T_2$ (*b*) $T_0 = T_1 < T_2$
(*c*) $T_0 = T_1 > T_2$ (*d*) $T_0 < T_1 < T_2$

105. The time period of oscillations of a simple pendulum is 1 minute. If its length is increased by 44%, then its new time period of oscillation will be:

(*a*) 96 *s* (*b*) 58 *s*
(*c*) 82 *s* (*d*) 72 *s*

106. If the length of a simple pendulum is increased by 2%, then the time period

(*a*) Increases by 1% (*b*) Decreases by 1%
(*c*) Increases by 2% (*d*) Decreases by 2%

107. T_0 is the time period of a simple pendulum at a place. If the length of the pendulum is reduced to $\frac{1}{16}$ times of its initial value, the modified time period is:

(*a*) T_0 (*b*) $8\pi\,T_0$
(*c*) $4\,T_0$ (*d*) $\frac{1}{4}T_0$

108. If the length of a clock pendulum increases by 0.2% due to atmospheric temperature rise, then the loss in time of clock per day is:

(*a*) 86.4 *s* (*b*) 43.2 *s*
(*c*) 72.5 *s* (*d*) 32.5 *s*

109. A simple pendulum is oscillating in a trolley moving on a horizontal straight road with constant acceleration a. If direction of motion of trolley is taken as positive x direction and vertical upward direction as positive y direction then the mean position of pendulum makes an angle.

(*a*) $\text{Tan}^{-1}\left(\frac{g}{a}\right)$ with y axis in $+x$ direction
(*b*) $\text{Tan}^{-1}\left(\frac{a}{g}\right)$ with y axis in $-x$ direction
(*c*) $\text{Tan}^{-1}\left(\frac{a}{g}\right)$ with y axis in $+x$ direction
(*d*) $\text{Tan}^{-1}\left(\frac{g}{a}\right)$ with y axis in $-x$ direction

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110. The time period of oscillations of a second's pendulum on the surface of a planet having mass and radius double those of earth is:

(*a*) $4\ s$ (*b*) $1\ s$

(*c*) $\sqrt{2}\ s$ (*d*) $2\sqrt{2}\ s$

111. The bob of simple pendulum having length l, is displaced from mean position to an angular position θ with respect to vertical. If it is released, then velocity of bob at equilibrium position:

(*a*) $\sqrt{2gl(1-\cos\theta)}$ (*b*) $\sqrt{2gl(1+\cos\theta)}$

(*c*) $\sqrt{2gl\cos\theta}$ (*d*) $\sqrt{2gl}$

112. A hollow metal sphere is filled with water through a small hole in it. It is hung by a long thread and is made to oscillate. Water slowly flows out of the hole at the bottom. Select the correct variation of its time period.

(*a*) The period will go on increasing till the sphere is empty.

(*b*) The period will go on decreasing till the sphere is empty.

(*c*) The period will not be affected at all.

(*d*) The period will increase first, then decreased to initial value till the sphere is empty.

113. Two pendulum of length 1 m and 1.21 m starts oscillation at same time, after how many oscillation of longer pendulum they again comes to in phase.

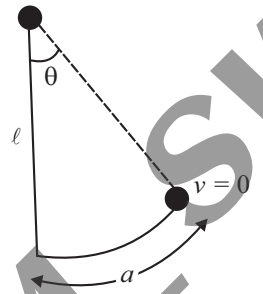
114. Two simple pendulums of length 5m and 20m respectively are given small linear displacement in one direction at the same time. They will again be in the phase when the pendulum of shorter length has completed oscillations.

(*a*) 2 (*b*) 1

(*c*) 5 (*d*) 3

115. Given below are two statements:

Statement-I: The motion of a simple pendulum is simple harmonic only if $a << \ell$.



Statement-II: The motion of a simple pendulum is simple harmonic for large angular displacement.

In light of above statement choose the most **appropriate** answer from the options given below:

(*a*) Both statement-I and statement-II are correct.

(*b*) Statement-I is correct and statement-II is incorrect.

(*c*) Statement-I is incorrect and statement-II is correct.

(*d*) Both statements-I and statements-II are incorrect.

116. The mass and the diameter of a planet are three times the respective values for the Earth. The period of oscillation of a simple pendulum on the Earth is 2*s*. The period of oscillation of the same pendulum on the planet would be:

(*a*) $\frac{\sqrt{3}}{2}\ s$ (*b*) $\frac{2}{\sqrt{3}}\ s$

(*c*) $\frac{3}{2}\ s$ (*d*) $2\sqrt{3}\ s$

117. Given below are two statements:

Statement-I: A second's pendulum has a time period of 1 second.

Statement-II: It takes precisely one second to move between the two extreme positions.

In light of above statement choose the correct answer from the options given below:

(*a*) Both statement-I and statement-II are false..

(*b*) Statement-I is false but statement-II is true.

(*c*) Statement-I is true but statement-II is false.

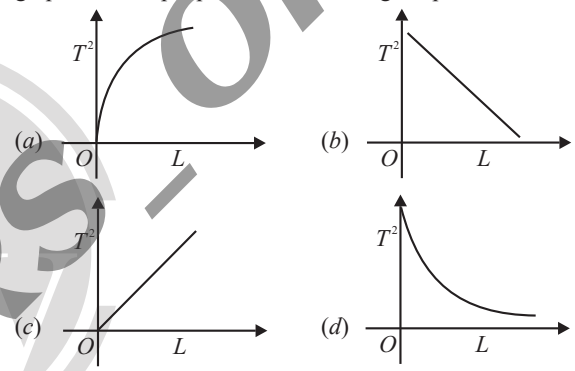
(*d*) Both statements-I and statements-II are true.

118. A simple pendulum doing small oscillations at a place R height above earth surface has time period of $T_1 = 4\ s$. T_2 would be it's time period if it is brought to a point which is at a height $2R$ from earth surface. Choose the correct relation [R = radius of Earth]:

(*a*) $T_1 = T_2$ (*b*) $2T_1 = 3T_2$

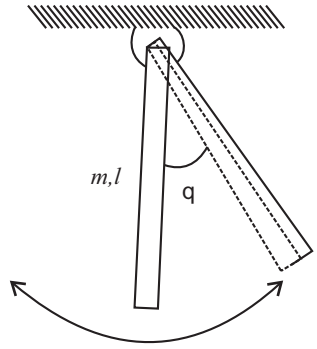
(*c*) $3T_1 = 2T_2$ (*d*) $2T_1 = T_2$

119. Choose the correct length (L) versus square of time period (T^2) graph for a simple pendulum executing simple harmonic motion.



Compound Pendulum

120. A uniform rod of mass m and length l is suspended about its end. Time period of small angular oscillations is:



(*a*) $2\pi\sqrt{\frac{l}{g}}$ (*b*) $2\pi\sqrt{\frac{2l}{g}}$

(*c*) $2\pi\sqrt{\frac{2l}{3g}}$ (*d*) $2\pi\sqrt{\frac{l}{3g}}$

121. A small iron ball of mass m is suspended with the help of a massless rod of length L and is free to oscillate in vertical plane. Its time period of oscillation is:

(*a*) $2\pi\sqrt{\frac{mL}{2g}}$ (*b*) $2\pi\sqrt{\frac{mL}{g}}$

(*c*) $2\pi\sqrt{\frac{L}{g}}$ (*d*) $2\pi\sqrt{\frac{m}{gL}}$

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122. A uniform disc of mass M and radius R is suspended in vertical plane from a point on its periphery. Its time period of oscillation is:

(*a*) $2\pi\sqrt{\frac{3R}{g}}$ (*b*) $2\pi\sqrt{\frac{R}{3g}}$

(*c*) $2\pi\sqrt{\frac{2R}{3g}}$ (*d*) $2\pi\sqrt{\frac{3R}{2g}}$

Oscillation of Solid Object inside liquid

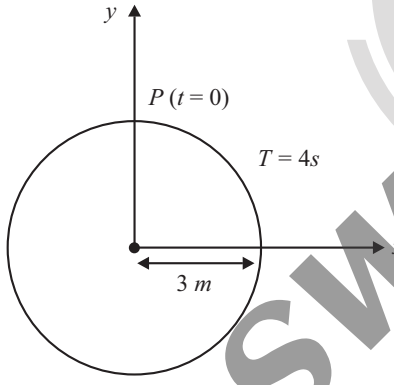
123. A rectangular block of mass m and area of cross-section A floats in a liquid of density ρ. If it is given a small vertical displacement from equilibrium it undergoes oscillation with a time period T. Then

(*a*) $T \propto \sqrt{\rho}$ (*b*) $T \propto \frac{1}{\sqrt{A}}$

(*c*) $T \propto \frac{1}{\rho}$ (*d*) $T \propto \frac{1}{\sqrt{m}}$

SHM as a Projection of Circular Motion

124. The radius of circle, the period of revolution, initial position and sense of revolution are indicated in the y-projection of the radius vector of rotating particle P is:



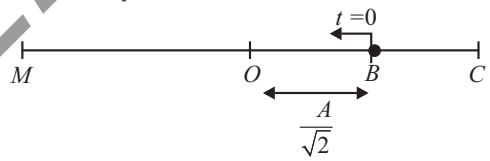
(*a*) $y(t) = -3\cos 2\pi t$, where y in m

(*b*) $y(t) = 4\sin\left(\frac{\pi t}{2}\right)$, where y in m

(*c*) $y(t) = 3\cos\left(\frac{3\pi t}{2}\right)$, where y in m

(*d*) $y(t) = -3\cos\left(\frac{\pi t}{2}\right)$, where y in m

125. For the given situation, which of the following options correctly represents the equation of the SHM?



(*a*) $x = (\omega t + \frac{\pi}{2})$ (*b*) $x = A\sin(\omega t + \frac{3\pi}{4})$

(*c*) $x = A\sin(\omega t + \frac{\pi}{4})$ (*d*) $x = A\sin(\omega t - \frac{3\pi}{4})$

126. Given below are two statements:

Statement-I: SHM is not an example of uniformly accelerated motion.

Statement-II: SHM is the projection of uniform circular motion along one of the diameter of the circle.

In light of above statement choose the most **appropriate** answer from the options given below:

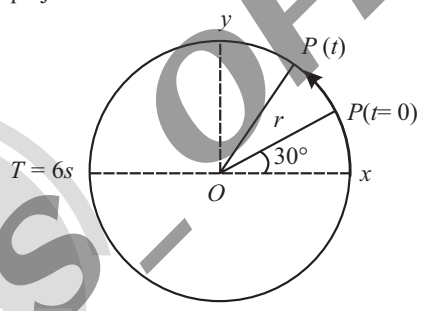
(*a*) Both statement-I and statement-II are correct.

(*b*) Statement-I is correct and statement-II is incorrect.

(*c*) Statement-I is incorrect and statement-II is correct.

(*d*) Both statements-I and statements-II are incorrect.

127. For particle P revolving round the centre O with radius of circular path r and angular velocity ω, as shown in below figure, the projection of OP on the x-axis at time t is:



(*a*) $x(t) = r\cos\left(\omega t + \frac{\pi}{6}\right)$ (*b*) $x(t) = r\cos(\omega t)$

(*c*) $x(t) = r\sin\left(\omega t + \frac{\pi}{6}\right)$ (*d*) $x(t) = r\cos\left(\omega t - \frac{\pi}{6}\omega\right)$

Superposition of SHM

128. Equation of two oscillating particle $x_1 = A_1\sin(\omega t)$, $x_2 = A_2\sin(\omega t + \phi)$, then equation of superimposed SHM is ?

129. Equation of two oscillating particle $x_1 = 3\sin(\omega t)$, $x_2 = 4\cos(\omega t)$ then equation of superimposed SHM is ?

130. Equation of two oscillating particle $x_1 = 5\sin(\omega t - \frac{\pi}{6})$, $x_2 = 15\cos(\omega t + \frac{\pi}{3})$, then equation of superimposed SHM is?

131. Equation of two oscillating particle $x_1 = 5\sin(\omega t)$, $x_2 = 5\cos(\omega t + \frac{\pi}{6})$, then equation of superimposed SHM is ?

132. Equation of two oscillation particle is $x_1 = 4\sin(\omega t)$ and $x_2 = 3\cos(\omega t)$ then find equation of superimposed oscillation of these two.

133. If $x_1 = 3\sin\left(\omega t + \frac{\pi}{3}\right)$, $x_2 = 3\sin\left(\omega t - \frac{\pi}{3}\right)$ then, find $x = x_1 + x_2$.

134. If $x_1 = 3\sin\left(\omega t - \frac{\pi}{2}\right)$, $x_2 = 4\cos(\omega t)$ then, find $x_1 + x_2$.

135. If two mutually perpendicular simple harmonic motion of same amplitude, frequency and having zero phase difference superimpose on a particle, then its resultant path will be:

(*a*) A straight line (*b*) A circle

(*c*) An ellipse (*d*) A hyperbola

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136. The SHM of particle is given by the equation $x = 2 \sin \omega t + 4 \cos \omega t$. Its amplitude of oscillation is-

(*a*) 4 units (*b*) 2 units

(*c*) 6 units (*d*) $2\sqrt{5}$ units

137. The displacement of particle executing simple harmonic motion is given by $y = A_0. + A \sin \omega t + B \cos \omega t$. Then the amplitude of its oscillation is given by

(*a*) $A + B$ (*b*) $A_0 + \sqrt{A^2 + B^2}$

(*c*) $\sqrt{A^2 + B^2}$ (*d*) $\sqrt{A_0^2 + (A + B)^2}$

138. Out of the following function representing motion of a particle, which represents SHM?

1. $y = \sin \omega t - \cos \omega t$

2. $y = \sin^3 \omega t$

3. $y = 5 \cos \left(\frac{3\pi}{4} - 3\omega t\right)$

4. $y = 1 + \omega t + \omega^2 t^2$

(*a*) only 1

(*b*) only 4 does not represent SHM

(*c*) only 1 and 3

(*d*) only 1 and 2

139. If two mutually perpendicular simple harmonic motion of same amplitude, frequency and having $\frac{\pi}{2}$ phase difference superimpose on a particle, then its resultant path will be:

(*a*) A straight line (*b*) A circle

(*c*) An ellipse (*d*) A hyperbola

140. Which of the following represents a SHM?

(*a*) $\sin \omega t - \cos \omega t$ (*b*) $\sin \omega t + \cos \omega t$

(*c*) $\sin \omega t + 2 \cos \omega t$ (*d*) All of these

141. When two displacements represented by $y_1 = a \sin (\omega t)$ and $y_2 = b \cos (\omega t)$ are superimposed the motion is-

(*a*) Simple harmonic with amplitude $\frac{(a+b)}{2}$

(*b*) Not a simple harmonic

(*c*) Simple harmonic with amplitude a/b

(*d*) Simple harmonic with amplitude $\sqrt{a^2 + b^2}$

142. The equation of motion for an oscillating particle is given by

$x = 3\sin 4\pi t + 4\cos 4\pi t$

Where x is in cm and t is in sec. Choose the correct statements:

1. The motion is simple harmonic

2. Amplitude of oscillating is 5 cm

3. Motion is periodic

(*a*) 1, 2, 3 (*b*) Only 1, 2

(*c*) Only 2, 3 (*d*) Only 2

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1. **Statement I:** The Time interval of a particle in SHM is equal to the time between consecutive appearances of particle at mean position in its motion.

   Statement II: The Time period of particle in SHM is equal to the smallest time Between the particle acquiring a zero velocity.

2. **Statement I:** The average velocity of a particle in SHM in one Time period is zero.

   Statement II: The distance moved by particle in SHM in one Time period is having value double as that of Amplitude of SHM.

3. **Statement I:** A particle moves on X-axis according to the equation $x = A + B\sin\omega t$. The Motion is simple Harmonic with Amplitude of A+B.

   Statement II: The Motion of particle is given by $x = A \sin \omega t + B\cos \omega t$ The Motion of particle is simple Harmonic with Amplitude $\sqrt{A^2 + B^2}$

4. **Statement I:** If The Total Mechanical energy of a spring-mass system in SHM is given by $E = ½ m\omega^2 A^2$, then New Mechanical energy will become 2E. if oscillating particle is replaced by another particle of double the mass while keeping the amplitude the same.

   Statement II: The average energy in one Time period in SHM is zero.

5. **Statement I:** The kinetic energy oscillates with double the frequency with which particle executes SHM.

   Statement II: A spring mass system oscillates with frequency ν. If it is Taken in an elevator slowly accelerating upward, the frequency will Remain same.

6. **Statement I:** A pendulum clock that keeps correct Time on the earth is Taken on the Moon. It will run $\sqrt{6}$ Times faster.

   Statement II: A wall clock uses a vertical spring-mass system to measure the Time. Each Time the mass reaches an extreme position, the clock advances by a second. The clock giving correct Time at the equator, It will run faster if clock is Taken to the poles.

7. **Statement I:** A pendulum clock Keeping correct time is Taken to high altitude. To keep correct Time, its length should be decreased.

   Statement II: A Tunnel is dug along a diameter of earth. A particle is dropped from a point, a distance h directly above the tunnel. The motion of the particle will be simple Harmonic as seen from the earth.

8. **Statement I:** $\vec{v}.\vec{r}$ will always remain negative in a SHM.

   Statement II: $\vec{a}.\vec{r}$ will always remain zero in SHM.

9. **Statement I:** A particle moves in X-Y plane according to equation $\vec{r} = (\hat{i} + 2\hat{j})\, A \cos(\omega t)$. The Motion of the particle is on a straight line and simple Harmonic.

   Statement II: In SHM, the potential energy is always equal to the kinetic energy.

   Statement III: In SHM, The average P.E. in one Time period is equal to the average. K.E. in this period.

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Answer Key

1. (*d*) **2.** (*a*) **3.** (*d*) **4.** (*b*) **5.** T = 2sec **6.** f = 1.25 Hz, T = 0.8 sec **7.** (*b*) **8.** (*a*) **9.** (*d*)

10. (*c*) **11.** (*d*) **12.** (*a*) **13.** $\phi = \frac{\pi}{2} = 90^o$ **14.** $\phi = \frac{\pi}{6} = 30^o$ **15.** $\phi = \frac{\pi}{4} = 45^o$ **16.** (*c*) **17.** (*b*)

18. (*b*) **19.** 10 m/s **20.** (*c*) **21.** (*d*) **22.** (*d*) **23.** (*a*) **24.** (*a*) **25.** (*d*) **26.** (*a*) **27.** (*d*)

28. (*a*) **29.** (*a*) **30.** (*a*) **31.** (*c*) **32.** (*c*) **33.** (*a*) **34.** (*c*) **35.** (*c*) **36.** (*b*) **37.** (*c*)

38. (*b*) **39.** (*b*) **40.** (*d*) **41.** 17 **42.** (*b*) **43.** (*c*) **44.** $\phi = \frac{\pi}{6}$ **45.** (*d*) **46.** (*d*) **47.** (*c*)

48. (*d*) **49.** (*b*) **50.** (*b*) **51.** (*d*) **52.** (*b*) **53.** $x = \sqrt{\frac{2}{3}}A$ **54.** (*d*) **55.** (*b*)

56. $\frac{K.E}{P.E} = \frac{15}{1} = 15:1$ **57.** (9) **58.** $\frac{A}{\sqrt{3}}$ **59.** $t = \frac{T}{8}$ sec **60.** (*d*) **61.** (*d*) **62.** (*a*) **63.** (*b*)

64. (2) **65.** (*d*) **66.** (*a*) **67.** (*a*) **68.** (*d*) **69.** (*c*) **70.** (2) **71.** (x = 3) **72.** (1) **73.** (*b*)

74. (*b*) **75.** (*d*) **76.** (*c*) **77.** (*b*) **78.** (*d*) **79.** (3) **80.** (*b*) **81.** (3) **82.** (*c*)

83. $\frac{4\pi}{3}\sqrt{\frac{m}{k}}$ **84.** $T = 2\pi\sqrt{\frac{4m}{k}}$ **85.** $T = 2\pi\sqrt{\frac{m}{4k}}$ **86.** (*a*) **87.** (*b*) **88.** (*a*) **89.** (*a*) **90.** (*d*)

91. (*a*) **92.** (*d*) **93.** (*b*) **94.** (*b*) **95.** (*d*) **96.** (*b*) **97.** (*d*) **98.** (*b*) **99.** (*d*) **100.** (*c*)

101. (*a*) **102.** (*c*) **103.** (*b*) **104.** (*b*) **105.** (*d*) **106.** (*a*) **107.** (*d*) **108.** (*a*) **109.** (*b*) **110.** (*d*)

111. (*a*) **112.** (*d*) **113.** 11 oscillations of small pendulum and 10 oscillations of large pendulum **114.** (*a*) **115.** (*b*)

116. (*d*) **117.** (*b*) **118.** (*c*) **119.** (*c*) **120.** (*c*) **121.** (*c*) **122.** (*d*) **123.** (*b*) **124.** (*d*) **125.** (*b*)

126. (*a*) **127.** (*a*) **128.** $x = \sqrt{A_2^1 + A_2^2 + 2A_1A_2\cos\phi}\sin(\omega t + \theta)$ **129.** x = 5 sin (ωt + 53°) **130.** 10 sin (ωt + 150°)

131. $5\sin\left(\omega t + \frac{\pi}{3}\right)$ **132.** 5 cos (ωt – 53°) **133.** 3sin ωt **134.** 1cos ωt **135.** (*a*) **136.** (*d*)

137. (*c*) **138.** (*c*) **139.** (*b*) **140.** (*d*) **141.** (*d*) **142.** (*a*)

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1. Both are false. **2.** I. True, II. False **3.** I. False, II. True **4.** Both false **5.** Both are Correct.
6. Both false **7.** I. True, II. False **8.** I. False, II. True **9.** I. True, II. False, II. True

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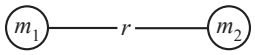
MR PHYSICS for questions practice

30 Motion of System of Particles & C.O.M

(Practice Questions)

Location of C.O.M

1. Find Location of Centre of Mass from mass 1 and 2



2. The centre of mass of a system of particles does not depend on

(*a*) Masses of the particles
(*b*) Internal forces of the particles
(*c*) Position of the particles
(*d*) Relative distance between the particles

3. Position of centre of mass of a body:

(*a*) Depends on the choice of co-ordinate system
(*b*) Is independent of the choice of co-ordinate system
(*c*) May or may not depend on the choice of co-ordinate system
(*d*) None of the above

4. A system of consists of mass M and m ($<<M$). The centre of mass of the system is

(*a*) At the middle (*b*) Nearer to M
(*c*) Nearer to m (*d*) the position of larger mass

5. The centre of mass of a system of two particles divides the distance between them

(*a*) In inverse ratio of square of masses of particles
(*b*) In direct ratio of square of masses of particles
(*c*) In inverse ratio of masses of particles
(*d*) In direct ratio of masses of particles

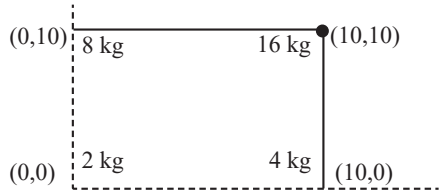
6. The centre of mass of a body

(*a*) Lies always outside the body
(*b*) May lie within, outside the surface of the body
(*c*) Lies always inside the body
(*d*) Lies always on the surface of the body

7. A point object of mass m is kept at (a, 0) along x-axis. What mass should be kept at (-3 a, 0), so that centre of mass lies at origin.

(*a*) m (*b*) 2 m (*c*) $m/3$ (*d*) 3 m

8. Find position of C.O.M.?



(*a*) $\frac{20}{3}, 8$ (*b*) $8, \frac{20}{3}$ (*c*) $\frac{20}{3}, \frac{20}{3}$ (*d*) 8,4

9. n particles of masses m, 2 m, 3 m... 4 m grams are placed on the same line at distances l, $2l$, $3l$, ... $4l$ c.m. from a fixed point. The distance of centre of mass of the particles from the fixed point in centimeter is

(*a*) $\frac{(2n+1)l}{3}$ (*b*) $\frac{l}{n}+l$

(*c*) $\frac{n(n^2+1)l}{2}$ (*d*) $\frac{l}{n}-l$

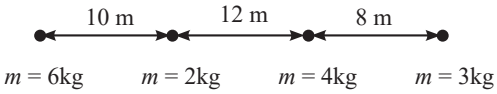
10. The position vector of three particle of mass m_1 = 3 kg, m_2 = 2 kg, m_3 = 5 kg are $(\hat{i},\hat{j},\hat{k})$, $(2\hat{i}+\hat{j}+\hat{k})$ and $(\hat{i}-\hat{j}+\hat{k})$

(*a*) $1.2\hat{i}+\hat{k}$ (*b*) $\hat{i}+1.2\hat{j}+3\hat{k}$

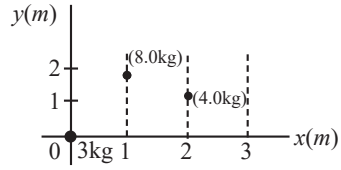
(*c*) $2\hat{i}+3\hat{k}+\hat{j}$ (*d*) $4\hat{j}+1.2\hat{k}$

11. Two bodies of masses 1 kg and 2kg are lying in xy plane at (-1, 2) and (2, 4) respectively. What are the coordinates of the centre of mass?

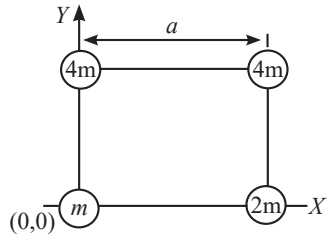
12. What is the distance of C.O.M from 4 kg mass in the following arrangement



13. What are the coordinates of the centre of mass of the three particles system shown in figure?



14. Four particles of masses m, 2m, 3m, 4m are placed at the corners of a square of side 'a' as shown in fig. Find out the co-ordinates of centre of mass.



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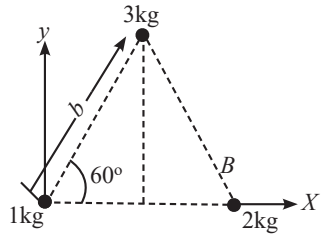
15. Locate the centre of mass of a system of particles of masses 1kg, 2 kg and 3kg situated at the corners of an equilateral triangle of side b as shown in figure.

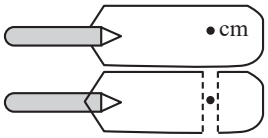


16. The coordinates of a triangle *ABC* are *A*(1, 2), *B*(4, 6) and C(-3, -2). Three particles of masses 1kg, 2 kg and m kg are placed the vertices of the triangle. If the coordinates of the centre of mass are $\left(\frac{3}{5}, 2\right)$, calculate the mass *m*.

17. Three identical spheres each of mass *M* are placed at corners of right triangle with mutually perpendicular sides equal to 3m each. Taking point of intersection of mutually perpendicular sides as origin, the magnitude of position vector of centre of mass of the system will be $\sqrt{x}\ m$. The value of *x* is

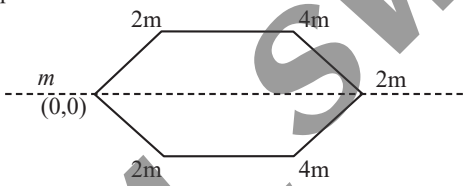
18. Find the position vector of centre of mass of a system of three particles of masses 1kg, 2kg and 3kg located at position vectors $\vec{r_1} = (4\hat{i} + 2\hat{j} - 3\hat{k})m, \vec{r_2} = (\hat{i} - 4\hat{j} + 2\hat{k})m$ and $\vec{r_3} = \left(2\hat{i} - 2\hat{j} + \hat{k}\right)$ respectively.

19. A cricket bat is cut at the location of its centre of mass as shown. Then



(*a*) The two pieces will have the same mass
(*b*) The bottom piece will have large mass
(*c*) The handle piece will have larger mass
(*d*) Mass of handle piece is double the mass of bottom piece

20. Find position of C.O.M.



21. Two bodies of mass 1 kg and 3 kg have position vectors $\hat{i} + 2\hat{j} + \hat{k}$ and $-3\hat{i} - 2\hat{j} + \hat{k}$ respectively. The magnitude of position vector of centre of mass of this system will be similar to the magnitude of vector:

(*a*) $\hat{i} - 2\hat{j} + \hat{k}$ (*b*) $-3\hat{i} - 2\hat{j} + \hat{k}$
(*c*) $-2\hat{i} + 2\hat{k}$ (*d*) $-2\hat{i} - \hat{j} + \hat{k}$

C.O.M of Continuous Mass System

22. A rod of length L placed along *x*-axis having linear mass density is proportional to *x* then distance of COM from one end.

(*a*) L/2 (*b*) 2L/3 (*c*) L/4 (*d*) 3L/2

23. Mass is non-uniformly distributed on the circumference of a ring of radius *r* and centre at origin. Let a be the distance of the centre of mass of the ring form origin. Then

(*a*) $r = a$ (*b*) $0 \le a \le r$ (*c*) $a < r$ (*d*) $a > r$

24. The center of mass of a solid hemisphere of radius 8 cm is *x* cm form the centre of the flat surface. The value of *x* is

25. If linear density of a rod of length 3m varies as $\lambda = 2 + x$, then the position of the center of gravity of the rod is

(*a*) $\frac{7}{3}m$ (*b*) $\frac{12}{7}m$
(*c*) $\frac{10}{7}m$ (*d*) $\frac{9}{7}m$

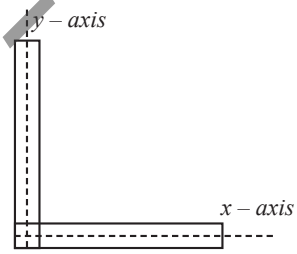
26. Length of a rod is 3m and its mass acting per unit length is directly proportional to distance *x* from one of its end then its centre of gravity from that end will be at :-

(*a*) 1.5*m* (*b*) 2 m (*c*) 2.5m (*d*) 3m

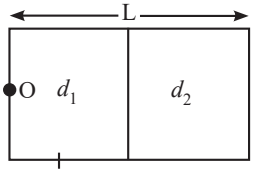
27. The linear mass density (λ) of a rod of length *L* kept along *x*-axis varies as $\lambda = \alpha + \beta x$; where α and β are positive constants. The centre of mass of the rod is at

(*a*) $\frac{(2\beta + 3\alpha L)L}{2(2\beta + \alpha L)}$ (*b*) $\frac{(3\alpha + 2\beta L)L}{3(2\alpha + \beta L)}$
(*c*) $\frac{(3\beta + 2\alpha L)L}{3(2\beta + \alpha L)}$ (*d*) $\frac{(3\beta + 2\alpha L)L}{3\beta + 2\alpha)}$

28. Two Identical Rod (M,L) placed along *x* and *y*-axis as shown in fig. Then find Location of C.O.M.

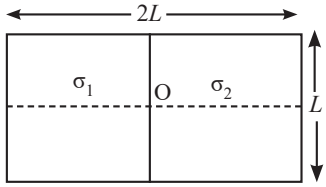


29. Shows a rectangular plane of length *L*, the half of which is made of material of density d_1 and another half of density d_2. The distance of centre of mass from the origin O is



(*a*) $\frac{d_1 + 2d_2}{2(d_1 + d_2)}L$ (*b*) $\frac{(d_1 + 3d_2)L}{4(d_1 + d_2)}$
(*c*) $\frac{(d_1 + 3d_2)L}{2(d_1 + d_2)}$ (*d*) $\frac{(3d_1 + d_2)L}{4(d_1 + d_2)}$

30. Find location of centre of mass of system



(*a*) $\left(\frac{\sigma_1 + 3\sigma_2}{\sigma_1 + \sigma_2}\right)\frac{L}{2}$ (*b*) $\left(\frac{3\sigma_1 + \sigma_2}{\sigma_1 + \sigma_2}\right)\frac{L}{2}$
(*c*) $\left(\frac{\sigma_1 - 3\sigma_2}{\sigma_1 + \sigma_2}\right)L$ (*d*) $\left(\frac{\sigma_1 + \sigma_2}{\sigma_1 + 3\sigma_2}\right)\frac{L}{2}$

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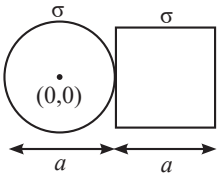
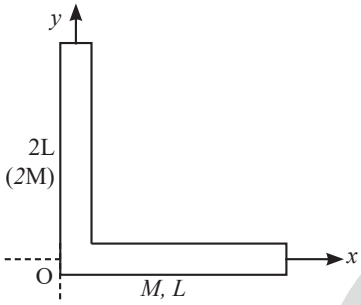
31. Find centre of mass from origin for a given combination of circular plate and square plate of same density (σ).



(*a*) $\frac{4a}{\pi+4}$ (*b*) $\frac{4a}{\pi}$ (*c*) $\frac{a}{\pi+4}$ (*d*) $\frac{a}{4}$

32. Figure shows a composite system of two uniform rods of lengths as indicated. Then the coordinates of the centre of mass of the system of rods are

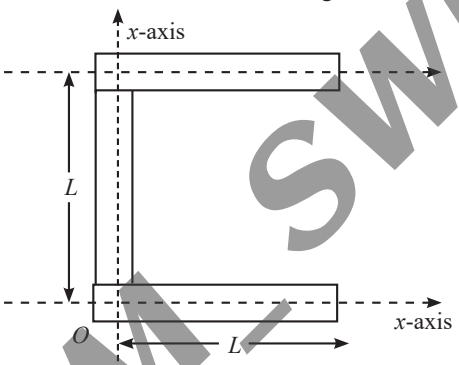


(*a*) $\left(\frac{L}{2},\frac{2L}{3}\right)$ (*b*) $\left(\frac{L}{4},\frac{2L}{3}\right)$ (*c*) $\left(\frac{L}{6},\frac{2L}{3}\right)$ (*d*) $\left(\frac{L}{6},\frac{L}{3}\right)$

33. A uniform metre rod is bent into *L* shape with the bent arms at 90° to each other. The distance of the center of mass from the bent point is

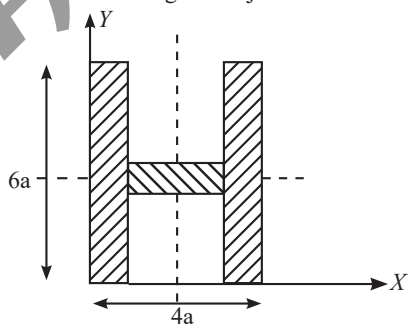
(*a*) $\frac{L}{4\sqrt{2}}m$ (*b*) $\frac{L}{2\sqrt{2}}m$ (*c*) $\frac{L}{\sqrt{2}}m$ (*d*) $\frac{L}{8\sqrt{2}}m$

34. Locate the centre of mass of arrangement shown in figure. The three rods are identical in mass and length



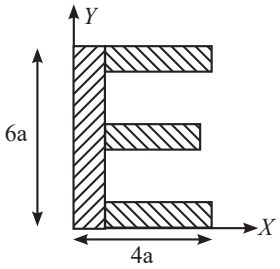
(*a*) $\left(\frac{L}{2},\frac{L}{2}\right)$ (*b*) $\left(\frac{L}{3},0\right)$ (*c*) $\left(\frac{L}{3},\frac{L}{2}\right)$ (*d*) $\left(0,\frac{L}{3}\right)$

35. Co-ordinate of COM for given object will be-



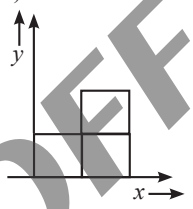
(*a*) (2*a*, *a*) (*b*) (2*a*, 3*a*) (*c*) (*a*, 3*a*) (*d*) (3*a*, 3*a*)

36. Co-ordinate of COM for given object will be-

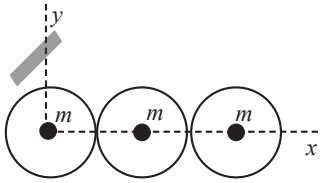


(*a*) (2*a*, 3*a*) (*b*) (*a*, 3*a*) (*c*) (*a*, 2*a*) (*d*) (*a*, 4*a*)

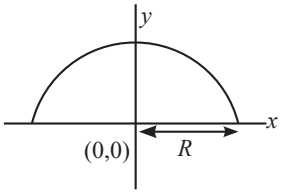
37. Find position of COM for given combination (each plate is square of side a and mass *m*).



38. Three identical spheres, each of mass *M* and radius *R*, are placed in a row as shown in the figure. Find the location of the center of mass (C.O.M.) of the system..

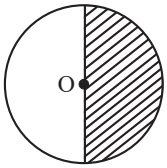


39. Find the position of the center of mass of a half ring, given its radius *R*. The center of the ring is located at the origin (0,0)



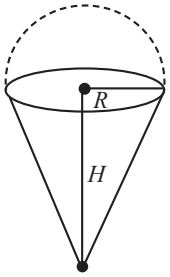
(*a*) $\left(\frac{2\pi}{R}\right)$ (*b*) $\left(\frac{2R}{\pi}\right)$ (*c*) $\left(\frac{R}{2}\right)$ (*d*) $\left(\frac{R}{2\pi}\right)$

40. The disc of mass *M* with uniform surface mass density σ is shown in the figure. The centre of mass of shaded area is at the position $\left(\frac{xa}{6\pi},0\right)$ where *x* is_____



Surface mass density σ
Radius = *a*

41. Centre of mass of solid cone and solid hemisphere (same density) is at center then find relation between *R* and *H*.



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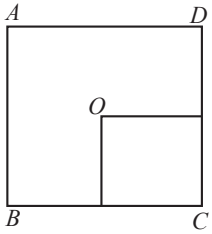
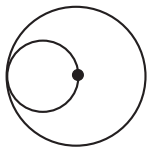
42. From a uniform square plate, one-fourth part is removed as shown. The centre of mass of remaining part will lie on

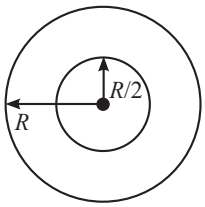


(*a*) OC (*b*) OA (*c*) OB (*d*) OD

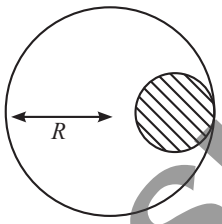
43. From a uniform circular disc of mass *M* and radius *R*, a small circular disc of radius *R*/2 is removed in such a way that both have a common tangent. Find the distance of centre of mass of remaining part from the centre of original disc.



44. A disc of mass *M* and radius *R* given, a small disc of *R*/2 is removed as shown in figure then find the C.O.M of remaining part.

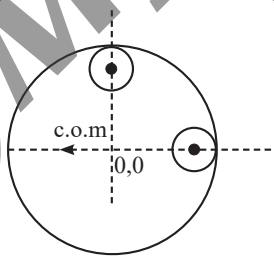


45. A uniform disc of padius (*R*/4) is removed as shown in figure then c.o.m of remaining part.

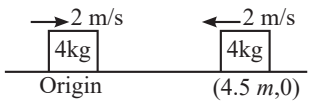


46. Find the centre of mass of a uniform disc of radius '*a*' from which a circular section of radius '*b*' has been removed. The centre of the hole is at a distance c from the centre of the disc.

47. A disc of mass (*M,R*), Two disc of radius *R*/4 is cut and removed as shown in figure then C.O.M of remaining part



48. Blocks *A* and *B* kept on a smooth horizontal surface are given equal speeds of 2 m/s in opposite sense as shown in the figure.

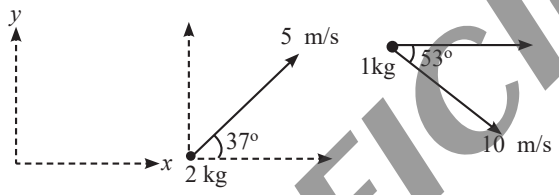


At $t = 0$ the position of blocks are shown, then the coordinates of centre of mass of system of two blocks, at $t = 3$s will be:

Velocity of Center of Mass

49. Two particles of masses 1 kg and 0.5 kg are moving in the same direction with speeds of 2 m/s and 6 m/s, respectively, on a smooth horizontal surface. Find the speed of the centre of mass of the system

50. Find velocity of COM.



51. Two blocks of masses 5kg and 2kg are connected by a spring of negligible mass and placed on a frictionless horizontal surface. An impulse provides a velocity of 7 m/s to the heavier block in the direction of the lighter block. The velocity of the centre of mass is/

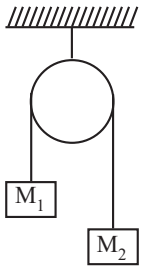
(*a*) 4 m/s (*b*) 5 m/s (*c*) 2 m/s (*d*) 3 m/s

Acceleration of Center of Mass

52. Three particles of masses 1kg, 2 kg and 3kg are subjected to forces $(3\hat{i} - 2\hat{j} + 2\hat{k})$N, $(-\hat{i} + 2\hat{j} - \hat{k})$N and $(\hat{i} + \hat{j} + \hat{k})$N respectively. Find the magnitude of the acceleration of the CM of the system

53. Two particles of mass 1kg and 3kg are having acceleration $(\hat{i} - 2\hat{j} + 5\hat{k})m/s^2$ and $(-2\hat{i} + \frac{4}{3}\hat{j} - \hat{k})m/s^2$. Find out $\vec{a}_{cm}$

54. Find acceleration of centre of mass.



55. A ball of mass *m* is thrown upward and another ball of same mass is thrown downward so as to move freely under gravity. The acceleration of centre of mass is

(*a*) g (*b*) 9g/3 (*c*) 2g/3 (*d*) g/2

For System of Object

56. Position of C.O.M will only change when external force will act

(*a*) True (*b*) False

57. Momentum of system (C.O.M) will only change when external force will act

(*a*) True (*b*) False

58. K.E. of system will only change when external force will act

(*a*) True (*b*) False

59. Internal force can change K-E of System→ Yes/No

60. Internal force can change Momentum of system→ Yes/No

61. Internal force Can Change Moment of object → Yes/No

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62. Internal forces can change

(*a*) The linear momentum but not the kinetic energy

(*b*) The kinetic energy but not the linear momentum

(*c*) Linear momentum as well as kinetic energy

(*d*) Neither the linear momentum nor the kinetic energy

63. Which of the following statement is correct:-

(*a*) Kinetic energy of a system can be changed without changing its momentum.

(*b*) Kinetic energy of a system cannot be changed without changing its momentum.

(*c*) Momentum of a system cannot be changed without changing its kinetic energy.

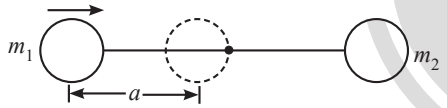
(*d*) Body cannot have energy without having momentum.

64. A child is standing at one end of a long trolley moving with a speed v on a smooth horizontal track. If the child starts running towards the other end of the trolley with a speed u, the centre of mass of the system (trolley + child) will move with a speed

(*a*) Zero (*b*) $(v + u)$ (*c*) v (*d*) $(v - u)$

Shift in Center of Mass

65. Consider a system having two masses m_1 and m_2 in which first mass is pushed towards the centre of mass by a distance a. The distance by which the second mass should be moved to keep the centre of mass at same position



(*a*) $\frac{m_1}{m_2}a$ (*b*) $\frac{m_1}{(m_1+m_2)}a$

(*c*) $\frac{m_2}{m_1}a$ (*d*) $\left(\frac{m_2}{(m_1+m_2)}\right)a$

66. Two blocks of masses 10 kg and 30 kg are placed on the same straight line with coordinates [0, 0] cm and [x, 0] cm respectively. The block of 10 kg is moved on same line through a distance of 6 cm towards the other block. The distance through which block of 30 kg must be moved to keep the position of C.O.M. of system unchanged is:

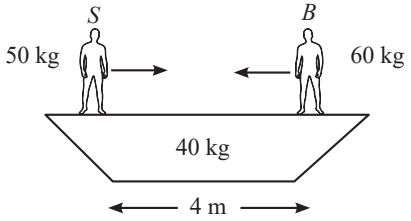
(*a*) 4 cm towards the 10 kg block

(*b*) 2 cm away from the 10 kg block

(*c*) 2 cm towards the 10kg block

(*d*) 4 cm away from the 10 kg block

67. Santi (50 kg) and Banti (60 kg) are sitting at the two extremes of a 4 m long boat (40 kg) standing still in water, To discuss a mechanics problem, they come to the middle of the boat. Neglecting friction with water, how far does the boat move on the water during the process?



Conservation of Momentum for System of Particles

68. A man of mass m is suspended in air by holding the rope of a balloon of mass M. As the man climbs up the rope, the balloon

(*a*) Moves upward (*b*) Moves downward

(*c*) Remains stationary (*d*) Can not Say

69. Two particles A and B, initially at rest moves towards each other under the mutual force of attraction. At the instant when speed of A is v and speed of B is 2v, the speed of centre of mass of the system is:

(*a*) 3v (*b*) v (*c*) 1.5v (*d*) Zero

70. A man (mass = 50 kg) and his son (mass = 20 kg) are standing on a frictionless surface facing each other. The man pushes his son so that he starts moving at speed of 0.7 ms^{-1} with respect to man. The speed of man with respect to surface is :

(*a*) 0.25 ms^{-1} (*b*) 0.20 ms^{-1} (*c*) 0.47 ms^{-1} (*d*) 0.14 ms^{-1}

71. A man of half the weight of trolley car is running on the road and suddenly jumps into a stationary trolley car. Then, the whole system of trolley car along with man weighing 180 kg starts moving with velocity 2 m/s. The velocity of the running man was m/s, when he jumps into the car

72. A man of 50 kg mass is standing in a gravity free space at a height of 10 m above the floor. He throws a stone of 0.5 kg mass downwards with a speed 2 m/s. When the stone reaches the floor, the distance of the man above the floor will be

(*a*) 9.9 m (*b*) 10.1m (*c*) 10 m (*d*) 20 m

73. Two spherical bodies of mass M and $5M$ and radii R and $2R$ respectively are released in free space with initial separation between their centres equal to $12R$. If they attract each other due to gravitational force only, then the distance covered by the smaller body just before collision is

(*a*) 1.5 R (*b*) 2.5 R (*c*) 4.5 R (*d*) 7.5 R

74. A ball strikes the floor and after collision rebounds back. In this state

(*a*) Momentum of the ball is conserved

(*b*) Mechanical energy of the ball is conserved

(*c*) Momentum of ball-earth system is conserved

(*d*) The kinetic energy of ball-earth system is conserved.

75. A mass of 16 kg moving with a speed of 5 m/s collides with another stationary mass of 4 kg. As a result of the collision, the two masses stick together. The kinetic energy of the composite mass will be: -

(*a*) 200 J (*b*) 160 J (*c*) 320 J (*d*) 128 J

76. A bullet of mass m is fired from a gun of mass M. The recoiling gun compresses a spring of force constant k by a distance d. Then the velocity of the bullet is :-

(*a*) $kd\sqrt{M/m}$ (*b*) $\frac{d}{M}\sqrt{km}$

(*c*) $\left(\frac{d}{m}\right)\sqrt{kM}$ (*d*) $\frac{kM}{m}\sqrt{d}$

77. An artillery piece of mass m_1 fires a shell of mass m_2 horizontally after the firing, the ratio of kinetic energy of the artillery and that of shell is:

(*a*) $\frac{m_1}{m_1+m_2}$ (*b*) $\frac{m_2}{m_1}$ (*c*) $\frac{m_1}{m_2}$ (*d*) $\frac{m_2}{m_1+m_2}$

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Explosion

78. A shell following a parabolic path explodes somewhere in its flight due to some internal forces. The centre of mass of fragments will move in

(*a*) Vertical direction (*b*) Any direction
(*c*) Horizontal direction (*d*) Same parabolic path

79. A body at rest explodes into two pieces of unequal mass. The part will move

(*a*) Arbitrarily
(*b*) In the same direction
(*c*) In opposite direction with equal speeds
(*d*) In opposite direction with unequal speeds.

80. A ball of mass M moving with velocity v, suddenly break into two part of rati 2 : 3. If smaller mass comes to at rest then velocity of other mass.

81. A body falling vertically downwards under gravity breaks in two parts of unequal masses. The centre of mass of the two parts together

(*a*) Shifts horizontally towards heavier piece
(*b*) Shifts horizontally towards light pieces
(*c*) Doesn't shift horizontally
(*d*) Shifts horizontally if initial speed is zero

82. A stationary particle explode into two part in mass m_1 & m_2 then Ratio of their K.E.??

83. A body of mass 3m at rest explodes into three-identical pieces. Two of the pieces move with a speed v each in mutually perpendicular directions. The total kinetic energy released is: -

84. A bomb initially at rest explodes by itself into three equal mass fragments. The velocities of two fragments are $(2\hat{i} + 3\hat{j})$ m/s and $(\hat{i} - 2\hat{j})$ m/s. The velocity of the third fragment is

85. A bomb of mass 12 kg explodes into two pieces of 4 kg and 8 kg. The velocity of 4 kg piece is 24 m/s. The kinetic energy of 8 kg piece is :-

(*a*) 192 J (*b*) 786 J (*c*) 576 J (*d*) 687 J

86. A bomb of mass m = 1 kg thrown vertically upwards with a speed u = 100 m/s explodes into two parts after t = 5s. A fragment of mass m_1 = 400g moves downwards with a speed v_1 = 25 m/s then speed v_2 and direction of another mass m_2 will be :-

(*a*) 40 m/s downwards (*b*) 40 m/s upwards
(*c*) 60 m/s upwards (*d*) 100 m/s upwards

87. A 1kg stationary bomb is exploded in three parts having mass ratio 4:4:7. Parts having same mass move in perpendicular directions with velocity 70 m/s, then the velocity of bigger part will be :-

(*a*) $40\sqrt{2}$m/s (*b*) $40/\sqrt{2}$m/s
(*c*) $20\sqrt{2}$m/s (*d*) $20/\sqrt{2}$m/s

88. A cannon ball is fired with a velocity 200 m/s at an angle of 60° with the horizontal. At the highest point of its flight, it explodes into 3 equal fragments, one going vertically upwards with a velocity 100 m/s, the second one falling vertically downwards with a velocity 100 m/s. The third fragment will be moving with a velocity;

(*a*) 100 m/s in the horizontal direction
(*b*) 300 m/s in the horizontal direction
(*c*) 300 m/s in a direction making an angle of 60° with the horizontal
(*d*) 200 m/s in a direction making an angle of 60° with the horizontal

89. A projectile is projected at a speed u at an angle θ with horizontal. At the highest point projectile splits into two fragments of mass ratio 1:2. The smaller fragment coming to rest. Then consider following statements:-

(A) In a given time both parts will cover equal vertical displacement.
(B) COM of two fragments will follow the same path as the object would have followed if not exploded.
(C) Linear momentum is conserved in vertical direction only.

Which of the following is correct?

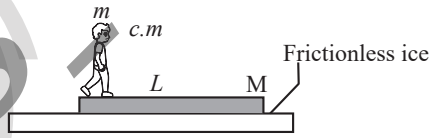
(*a*) A, B, C (*b*) A, B (*c*) B, C (*d*) A, C

90. A shell of mass 200 gm is ejected from a gun of mass 4 kg by an explosion that generates 1.05 kJ of energy. The initial velocity of the shell is

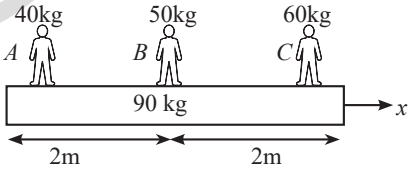
(*a*) 40 ms^{-1} (*b*) 120 ms^{-1} (*c*) 102 ms^{-1} (*d*) 80 ms^{-1}

Man-Plank Problems

91. A man of mass m stand at the left end of a uniform plank of length L and mass M, which lies on a frictionless surface of ice. If the man walks to the other end of the plank, then by what distance does the plank slide on the ice?



92. Three men, A, B, and C, each with masses of 40 kg, 50 kg, and 60 kg respectively, are standing on a plank of mass 90 kg, placed on a smooth horizontal surface. If A and C exchange their positions, what will be the shift in the position of man B.



Collision

93. Internal force can change velocity of centre of mass

(*a*) True (*b*) False

94. If external force is zero then location of COM will not change

(*a*) True (*b*) False

95. Internal force can change momentum of COM

(*a*) True (*b*) False

96. Internal force can charge K.E. of the COM

(*a*) True (*b*) False

97. Centre of mass is a point who divide system in two equal mass

(*a*) True (*b*) False

98. In every collision momentum is conserved all the time.

(*a*) True (*b*) False

99. In elastic collision K.E. is conserved all the time.

(*a*) True (*b*) False

100. In elastic collision of two object of same mass, speed will interchange

(*a*) True (*b*) False

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101. In ball-earth collision, momentum of ball remains conserved

(*a*) True (*b*) False

102. A batsman hits back a ball of mass 0.4 kg straight in the direction of the bowler without changing its initial kinetic energy of 45 joule. The impulse imparted to the ball is –Ns

103. A ball of mass *m* moving with velocity *v* collides head-on with the second ball of mass *m* at rest. If the coefficient of restitution is e and velocity of first ball after collision is v_1 and velocity of second ball after collision is v_2 then

(*a*) $v_1 = \frac{(1-e)u}{2}, v_2 = \frac{(1+e)u}{2}$

(*b*) $v_1 = \frac{(1+e)u}{2}, v_2 = \frac{(1-e)u}{2}$

(*c*) $v_1 = \frac{u}{2}, v_2 = -\frac{u}{2}$

(*d*) $v_1 = (1+e)\,u,\ v_2 = (1-e)u$

104. Two particles of masses m_1 and m_2 move with initial velocities u_1 and u_2. On collision, one of the particles get excited to higher level, after absorbing energy *e*. If final velocities of particles be v_1 and v_2 then we must have

(*a*) $\frac{1}{2}m_1^2u_1^2 + \frac{1}{2}m_2^2u_2^2 + \varepsilon = \frac{1}{2}m_1^2v_1^2 + \frac{1}{2}m_2^2v_2^2$

(*b*) $m_1^2u_1 + m_2^2u_2 - \varepsilon = m_1^2v_1 + m_2^2v_2$

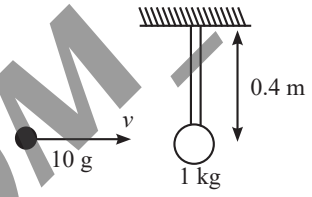
(*c*) $\frac{1}{2}m_1u_1^2 + \frac{1}{2}m_2u_2^2 = \frac{1}{2}m_1v_1^2 + \frac{1}{2}m_2v_2^2 - \varepsilon$

(*d*) $\frac{1}{2}m_1u_1^2 + \frac{1}{2}m_2u_2^2 - \varepsilon = \frac{1}{2}m_1v_1^2 + \frac{1}{2}m_2v_2^2$

105. A ball of mass 4 kg moving on a smooth horizontal surface makes an elastic collision with another ball of mass *m* at rest in the line of motion of first ball. If after collision first ball moves in the same direction with one fourth of its velocity collision, then mass of second ball is

(*a*) 4 kg (*b*) 4.4 kg (*c*) 2.4 kg (*d*) 2 kg

106. A bullet of 10g, moving with velocity *v*, collides head-on with the stationary bob attached to massless rod and recoils with velocity 100 m/s. The length of the rod is 0.4 m and mass of the bob is 1 kg. The minimum value of *v* = ... m/s so that pendulum describes a circle



107. A heavy vehicle moving with velocity 15 m/s strikes an object of very small mass at rest head on elasticity. Velocity of object after collision is

(*a*) 15 m/s (*b*) 25 m/s (*c*) 20 m/s (*d*) 30 m/s

108. A ball falls from a height such that it strikes the floor of lift at 10 m/s. If lift is moving in the upward direction with a velocity 1 m/s, then velocity with which the ball rebounds after elastic collision will be

(*a*) 11 m/s (*b*) 12 m/s (*c*) 13 m/s (*d*) 9 m/s

109. A proton is moving with velocity *u* and collide with a nucleus of mass number *A* at rest then find fraction of retained K.E. if collision is elastic

110. A metal ball of mass 2 kg moving with speed of 36 km/h has a head on collision with a stationary ball of mass 3 kg. If after collision, both the balls move together, then the loss in K.E. due to collision is

(*a*) 100 J (*b*) 140 J (*c*) 40 J (*d*) 60 J

111. Two steel balls A and B of mass 10 kg and 10g rolls towards each other with 5 m/s and 1 m/s respectively on a smooth floor. After collision; with what speed *B* moves [perfectly elastic collision]?

(*a*) 8 m/s (*b*) 10 m/s (*c*) 11 m/s (*d*) Zero

112. Three objects *A, B* and *C* are kept in a straight line on a frictionless horizontal surface. The masses of *A, B* and *C* are *m*,m and 2m respectively. *A* moves towards *B* with speed of 9 m/s and makes collision in which coefficient of restitution is zero. Thereafter they makes a elastic collision with *C*. The final speed of *C* is $\frac{x}{2}$ m/s find *x*

113. *A* neutron makes a head on elastic collision with a stationary deuteron. The fractional energy loss of the neutron in the collision is :-

(*a*) $\frac{16}{82}$ (*b*) $\frac{8}{9}$ (*c*) $\frac{8}{27}$ (*d*) $\frac{2}{3}$

114. A particle of mass m_1 moves with velocity v_1 and collides with another particle at rest of equal mass. The velocity of the second particle after the elastic collision is

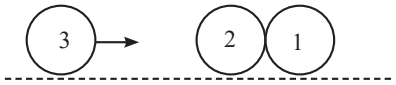
(*a*) $2v_1$ (*b*) v_1 (*c*) $-v_1$ (*d*) 0

115. Two identical balls *A* and *B* collide head-on elastically. If velocities of *A* and *B*, before the collision, are + 0.5 m/s and -0.3 m/s respectively then their velocities, after the collision, are respectively

(*a*) –0.5 m/s and +0.3 m/s (*b*) + 0.5 m/s and +0.3 m/s

(*c*) +0.3 m/s and –0.5 m/s (*d*) –0.3 m/s and + 0.5 m/s

116. Two ivory balls are placed together at rest. *A* third identical ball moving with velocity *u* in line of first two balls; as shown in figure collide head on elastically then



(*a*) Third ball comes to rest with second ball while first ball moves with speed *u*

(*b*) Third bail comes to rest and other two move together with speed *u*/2

(*c*) All three ball move together with speed *u*/3

(*d*) All three ball move in such a manner each makes angle 120° to each other

117. The coefficient of restitution *e*, for a perfectly elastic collision is

(*a*) 0 (*b*) -1 (*c*) 1 (*d*) ∞

118. A bullet weighing 10g and moving with a velocity 300 m/s strikes a 5 kg block of ice and drop dead. The ice block is kept on smooth surface. The speed of the block after the collision is

(*a*) 6 cm/s (*b*) 60 cm/s (*c*) 6 m/s (*d*) 0.6 cm/s

119. A ball moving with velocity 2 m/s collides head on with another stationary ball of double the mass. If the coefficient of restitution is 0.5 then their velocities (in m/s) after collision will be

(*a*) 0,2 (*b*) 0,1 (*c*) 1,1 (*d*) 1,0.5

120. A bullet of mass *m* moving with a velocity *u* strikes a block of mass *M* at rest and gets embedded in the block. The loss of kinetic energy in the impact is

(*a*) $\frac{1}{2}mMu^2$ (*b*) $\frac{1}{2}(m+M)u^2$

(*c*) $\frac{mMu^2}{2(m+M)}$ (*d*) $\left(\frac{m+M}{2mM}\right)u^2$

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121. Two balls of equal mass undergo head on collision while each was moving with speed 6 m/s. If the coefficient of restitution is 1/3, the speed of each ball after impact will be

(*a*) 18 m/s (*b*) 2 m/s (*c*) 6 m/s (*d*) 4 m/s

122. An object of mass 80 kg moving with velocity 2 m/s^{-1} hit by collides with another object of mass 20 kg moving with velocity 4 m/s^{-1}. Find the loss of energy assuming a perfectly inelastic collision

(*a*) 12 J (*b*) 24 J (*c*) 30 J (*d*) 32 J

123. A body of mass 10 kg moving with speed of 3 m/s^{-1} collides with another stationary body of mass 5 kg. As a result, the two bodies stick together. The KE of composite mass will be

(*a*) 30 J (*b*) 60 J (*c*) 90 J (*d*) 120 J

124. Particle A makes a perfectly elastic collision with another particle B at rest. They fly apart in opposite direction with equal speeds. If their masses are m_A & m_B respectively, then

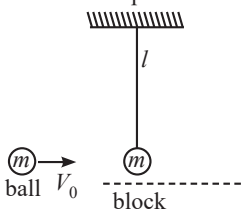
(*a*) $2\,m_A = m_B$ (*b*) $3\,m_A = m_B$

(*c*) $4\,m_A = m_B$ (*d*) $\sqrt{3}m_A = m_B$

125. A ball of mass *M* moving with speed *v* collides perfectly inelastically with another ball of mass *m* at rest. The magnitude of impulse imparted to the first ball is

(*a*) Mv (*b*) Mv^2 (*c*) $\frac{Mm}{M+m}v$ (*d*) $\frac{M^2}{M+m}v$

126. If collision is elastic then find maximum height attain by block just after collision from mean position??

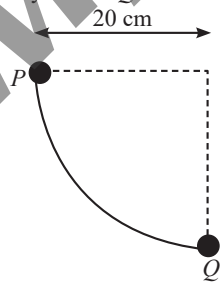


127. A bullet of mass *m* moving with velocity *v* strikes a suspended wooden block of mass *M*. If the block rises to height *h*, the initial velocity of the bullet will be

(*a*) $\sqrt{2gh}$ (*b*) $\frac{M+m}{m}\sqrt{2gh}$

(*c*) $\frac{m}{M+m}\sqrt{2gh}$ (*d*) $\frac{M+m}{M}\sqrt{2gh}$

128. As per the given figure, a small ball *P* slides down the quadrant of a circle and hits other ball *Q* of equal mass which is initially at rest. Neglecting the effect of friction and assume the collision to be elastic the velocity of ball *Q* after collision will be:



(*a*) 0.25 m/s (*b*) 4 m/s (*c*) 0 (*d*) 2 m/s

129. A ball is dropped from height *h* on the ground level. If the coefficient of restitution is e then the height upto which the ball will go after n^{th} jump will be:

(*a*) $\frac{h}{e^{2n}}$ (*b*) $\frac{e^{2n}}{h}$ (*c*) he^n (*d*) he^{2n}

130. A stone is dropped from a height *h*. It hits the ground with a certain momentum *P*. If the same stone is dropped from a height 100%_ more than the previous height, the momentum when it hits the ground will change by

(*a*) 68 % (*b*) 41% (*c*) 200% (*d*) 100%

131. A body of mass *m* falls from height *h* on ground. If *e* be the coefficient of restitution of collision between the body and ground, then the distance travelled by body before it comes to rest is

(*a*) $h\left\{\frac{1+e^2}{1-e^2}\right\}$ (*b*) $h\left\{\frac{1-e^2}{1+e^2}\right\}$ (*c*) $\frac{2eh}{1+e^2}$ (*d*) $\frac{2eh}{1-e^2}$

132. A body of mass *m* falls from height *h* on ground. If *e* be the coefficient of restitution of collision between the body and ground, then, total time taken by body before it comes to rest is

(*a*) $\sqrt{\frac{2H}{g}}\left\{\frac{1+e^2}{1-e^2}\right\}$ (*b*) $\sqrt{\frac{2H}{g}}\left\{\frac{1-e^2}{1+e^2}\right\}$

(*c*) $\sqrt{\frac{2H}{g}}\left\{\frac{1-e}{1+e}\right\}$ (*d*) $\sqrt{\frac{2H}{g}}\left\{\frac{1+e}{1-e}\right\}$

133. A rubber ball is dropped from a height of 5 m on a plane, where the acceleration due to gravity is not known. On bouncing, it rises to 1.8 m. The ball loses its velocity on bouncing by a factor of

(*a*) $\frac{3}{5}$ (*b*) $\frac{2}{5}$ (*c*) $\frac{16}{25}$ (*d*) $\frac{9}{25}$

134. A ball is allowed to fall from a height of 10 there is 40% loss of energy due to impact, after one impact ball will go up by

(*a*) 10 m (*b*) 8 m (*c*) 4 m (*d*) 6 m

135. A ball is dropped from a height of 20 m. If the ratio of velocity of separation to velocity of approach between ball and floor is 0.5. After hitting the floor, the ball rebounds to a height of____*m*.

136. A particle of mass m moving with a velocity $(3\hat{i}+2\hat{j})$ m/s collides with stationary body of mass M and finally moves with velocity $(-2\hat{i}+\hat{j})$ m/s then

(A) Impulse received by $m = m(5\hat{i}-5\hat{j})$

(B) Impulse received by $m = m(-5\hat{i}-\hat{j})$

(C) Impulse received by $M = m(5\hat{i}+\hat{j})$

(D) Impulse received by $M = m(5\hat{i}-\hat{j})$

then correct statements are

(*a*) B, C (*b*) A, C (*c*) B, D (*d*) A, D

137. A 1 kg ball falls from a height of 25 cm and rebounds upto a height of 9 *cm*. The coefficient of restitution is

(*a*) 0.6 (*b*) 0.32 (*c*) 0.40 (*d*) 0.56

138. A bullet of mass 10 g moving horizontally with a velocity of 400 m/s strikes a wooden block of mass 2 kg which is suspended by a light inextensible string of length 5 m. As a result, the centre of gravity the block is found to rise a vertical distance of 10 cm. The speed of the bullet after it emerges out horizontally from the block will be:

(*a*) 120 m/s (*b*) 160 m/s

(*c*) 100 m/s (*d*) 80 m/s

139. A moving block having mass *m*, collides with another stationary block having mass 4 m. The lighter block comes to rest after collision. When the initial velocity of the lighter block is *v*, then the value of coefficient of restitution (*e*) will be:

(*a*) 0.8 (*b*) 0.5

(*c*) 0.4 (*d*) 0.25

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140. **Assertion (A):** Two particles moving in the same direction do not lose all their energy in a completely inelastic collision,

Reason (R): Principle of conservation of momentum holds true for all kinds of collisions.

(*a*) Both A and R are correct and R is correct explanation of A

(*b*) Both A and R are correct and R is not the correct explanation of A

(*c*) A is correct and R is incorrect

(*d*) R is correct and A is incorrect

141. Which of following statement is false

(*a*) KE in an elastic collision between two bodies remains same before and after collision

(*b*) There may or may not be physical contact between two bodies for collision to occur.

(*c*) KE of two object system remains conserved during collision in elastic collision

(*d*) None of the above

142. Particle of mass *m*, kinetic energy K and momentum P collides head on elastically with another particle of mass 2m at rest. After collision. Match column-I with column-II

Column-I		Column-II	
(A)	Momentum of 1st particle	P	$\frac{4}{3}P$
(B)	Momentum of 2nd particle	Q	$\frac{K}{9}$
(C)	KE of 1st particle	R	$\frac{8K}{9}$
(D)	KE of 2nd particle	S	$\frac{P}{3}$

(*a*) A → S; B → P, C → Q, D → R

(*b*) A → P; B → S, C → Q, D → R

(*c*) A → P; B → S, C → R, D → Q

(*d*) A → S; B → P, C → R, D → Q

143. A particle of mass *m* with an initial velocity $u\hat{i}$ collides perfectly elastically with a mass 3 m at rest. It moves with a velocity $\hat{v}j$ after collision, then, *v* is given by

(*a*) $v = \frac{1}{\sqrt{6}}u$ (*b*) $v = \frac{u}{\sqrt{3}}$

(*c*) $v = \sqrt{\frac{2}{3}}u$ (*d*) $v = \frac{u}{\sqrt{2}}$

144. A ball of mass 200 g rests on a vertical post of height 20 m. A bullet of mass 10 g, travelling in horizontal direction, hits the centre of ball. After collision both travels independently. The ball hits the ground at distance 30 m and bullet at 120 m distance from the foot of post. The value of initial velocity of bullet will be:

(*a*) 120 m/s (*b*) 400 m/s

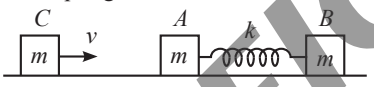
(*c*) 360 m/s (*d*) 60 m/s

145. What percentage of kinetic energy of a moving particle is transferred to a stationary particle when it strikes the stationary particle of 5 times its mass? (Assume the collision to be head-on elastic collision)

(*a*) 50% (*b*) 66.6%

(*c*) 55.6% (*d*) 33.3%

146. Two identical blocks *A* and *B* each of mass *m* resting on the smooth horizontal floor connected by a light spring of natural length *L* and spring constant *K*. *A* third block *C* of mass *m* moving with speed *v* along the line joining *A* and *B* slides with *A*. The maximum compression in spring is



(*a*) $\sqrt{\frac{mv}{k}}$ (*b*) $\sqrt{\frac{m}{2kv}}$

(*c*) $\sqrt{\frac{mv}{2k}}$ (*d*) $v\sqrt{\frac{m}{2k}}$

147. **Assertion (A):** Body '*P*' having mass *M* moving with speed '*u*' has head on collision elastically with Another body '*Q*' having mass '*m*' initially at rest. If $m << M$, body '*Q*' will have maximum speed equal to '2*u*' after collision.

Reason (R): During elastic collision, the momentum and kinetic energy are Both conserved

(*a*) Both *A* and *R* are correct and *R* is correct explanation of *A*

(*b*) Both A and R are correct and R is not the correct explanation of A

(*c*) A is correct and R is incorrect

(*d*) R is correct and A is incorrect

148. Body of mass 1 kg collides head on elastically with a stationary body of mass 3 kg After collision, the smaller body reverses its direction of motion and moves with speed of 2 m/s. The Initial speed of the smaller body before collision is _____ms^1.

149. **Assertion (A):** Two particles moving in the same direction do not lose all their energy in a completely inelastic collision,

Reason (R): Principle of conservation of momentum holds true for all kinds of collisions.

(*a*) Both A and R are correct and R is correct explanation of A

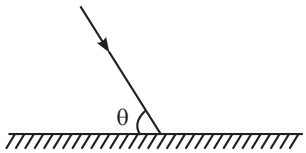
(*b*) Both A and R are correct and R is not the correct explanation of A

(*c*) A is correct and R is incorrect

(*d*) R is correct and A is incorrect

Oblique Collision

150. A ball of mass *m* moving with speed *u* collides with a smooth horizontal surface at angle θ with it as shown in figure. The magnitude of impulse imparted to surface by ball is [Coefficient of restitution of collision is *e*]



(*a*) $mu(1 + e)\cos\theta$ (*b*) $mu(1 - e)\sin\theta$

(*c*) $mu(1 - e)\cos\theta$ (*d*) $mu(1 + e)\sin\theta$

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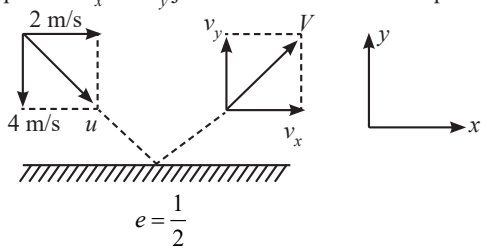
151. In the figure shown, a small ball hits obliquely a smooth and horizontal surface with speed u whose x and y components are indicated. If the coefficient of restitution is $\frac{1}{2}$, then its x and y components v_x and v_y just after 2 collision are respectively

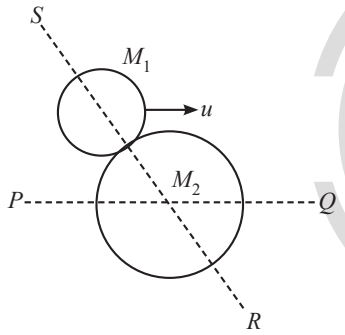


(*a*) 4 m/s, 1 m/s (*b*) 2 m/s, 1 m/s
(*c*) 2 m/s, 2 m/s (*d*) 4 m/s, 2 m/s

152. Two balls of masses m each are moving at right angle to each other with velocities 6 m/s and 8 m/s respectively. If collision between them is perfectly inelastic, the velocity of combined mass is

(*a*) 15 m/s (*b*) 10 m/s (*c*) 5 m/s (*d*) 2.5 m/s

153. An object of mass M_1 moving horizontally with speed u collides elastically with another object of mass M_2 at rest. Select correct statement.



(*a*) The momentum of system is conserved only in direction PQ
(*b*) Momentum of M_1 is conserved in direction perpendicular to SR
(*c*) Momentum of M_2 will change in direction normal to CR
(*d*) All of these

154. If a mass m collides elastically with another identical mass at rest in oblique manner, if direction of velocity of one ball after collision makes an angle 30° with horizontal direction, then angle made by another ball with horizontal direction will be

(*a*) 30° (*b*) 45°
(*c*) 60° (*d*) 90°

155. A particle of mass m moving eastward with a speed v collides with another particle of the same mass moving northwards with same speed v. The two particles coalesce on collision. The new particle of mass 2m will move with velocity

(*a*) $\frac{v}{2}$, North-East (*b*) $\frac{v}{\sqrt{2}}$, South-West
(*c*) $\frac{v}{2}$, North-West (*d*) $\frac{v}{\sqrt{2}}$, Noth-East

156. Two spheres A and B of masses m_1 and m_2 respectively collide. A is at rest initially and B is moving with velocity v along x-axis. After collision B has a velocity $\frac{v}{2}$ in *a* direction perpendicular to the original direction. The mass A moves after collision in the direction

(*a*) $\theta = \tan^{-1}\left(\frac{1}{2}\right)$ to the x-axis
(*b*) $\theta = \tan^{-1}\left(-\frac{1}{2}\right)$ to the x-axis
(*c*) Same as that of B
(*d*) Opposite to that of B

157. Two particles of equal mass m have respective initial velocities $\hat{i}$ and $u\left(\frac{\hat{i}+\hat{j}}{2}\right)$ They collide completely inelastically. The energy lost in process is:

(*a*) $\frac{1}{3}mu^2$ (*b*) $\frac{1}{8}mu^2$
(*c*) $\frac{3}{4}mu^2$ (*d*) $\sqrt{\frac{2}{3}mu^2}$

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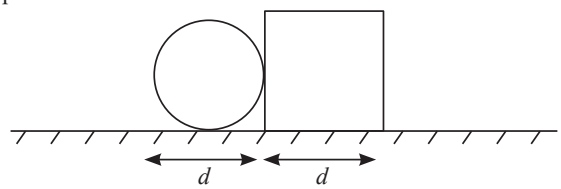
1. **Statement I:** If All the particles of a Body are situated at a distance R from the origin. The distance of the Centre of mass of body from origin will be less than or equal to R.

   Statement II: A circular disc of diameter d is kept in contact with square plate of edge d as Shown. The density and Thickness being the same, The Centre of mass of system will be inside the square plate.



2. **Statement I:** Consider a system of Two identical particles. One of particles is at rest and other has an acceleration *a* The Centre of mass the accelerating particle. of mass will also have an acceleration *a* Because of accelerating particle.

   Statement II: Internal forces can change the kinetic energy but Not the linear Momentum.

3. **Statement I:** A uniform sphere is placed on smooth horizontal surface and horizontal force F is applied on it at a distance h above the surface. The acceleration of centre will be independent of h.

   Statement II: A Body falling vertically downwards under gravity breaks in two parts of unequal masses. The centre of mass of Two parts taken Together will shifts horizontally towards heavier piece.

4. **Statement I:** A Ball kept in a closed box moves in the box making collisions with walls. The Box is Kept on smooth surface. The Velocity of Centre of mass of box plus ball system will Remain constant.

   Statement II: A Body at Rest Breaks into Two pieces of different masses The parts will move in opposite direction with equal speeds.

5. **Statement I:** In an elastic collision the kinetic energy remains constant throughout.

   Statement II: If The centre of mass of system of particles is at origin, then The Total mass of particles to right of origin Must be same as Total mass to left of the origin.

6. **Statement II:** If the external forces acting on a system have zero Resultant, the Centre of mass must Not move.

   Statement II: If Nonzero external force acts on a system of particles. It is not impossible that velocity of c.o.m is zero But acceleration of c.o.m is non zero.

7. **Statement II:** If Two Balls are Thrown Simultaneously in air, Then acceleration of c.o.m of Two Balls while in air does depend on masses of Two Balls.

   Statement II: In an elastic collision of Two particles, the final linear momentum of each particle must be equal to their respective initial linear momentum.

8. **Statement II:** A Ball hits a floor and rebounds after an inelastic collision. In This Case The Total Momentum of Ball and earth is conserved.

   Statement II: A Body moving towards a finite body at Rest collides with it. It is possible that the stationary body remains stationary and the Moving body changes it's velocity.

9. **Statement II:** A Body Moving towards a finite body at Rest collides with it. It is possible that Both the Bodies come to Rest.

   Statement II: In a head-on elastic collision of Two bodies of equal masses, the fastest body slows dawn and the slower body speed ups.

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Answer Key

1. $x_{cm_1} = \frac{m_2 r}{m_1 + m_2}, x_{cm_2} = \frac{m_1 r}{m_1 + m_2}$ **2.** (*b*) **3.** (*a*) **4.** (*b*) **5.** (*c*) **6.** (*b*) **7.** (*c*) **8.** (*a*)

9. (*a*) **10.** (*a*) **11.** $\frac{3\hat{i} + 10\hat{j}}{3}$ **12.** $\frac{-132}{15}$ **13.** $\frac{16\hat{i} + 20\hat{j}}{15}$ **14.** $\frac{6a\hat{i} + 8a\hat{j}}{11}$ **15.** $\frac{7b\hat{i} + 3\sqrt{3}b\hat{j}}{12}$

16. $m = 2$ **17.** $x = 2$ **18.** $2\hat{i} - 2\hat{j} + \frac{2}{3}\hat{k}$ **19.** (*b*) **20.** $\frac{18a}{15}$ **21.** (*d*) **22.** (*b*) **23.** (*b*)

24. $x = 3$cm **25.** (*b*) **26.** (*b*) **27.** (*b*) **28.** $\frac{L}{2\sqrt{2}}$ **29.** (*b*) **30.** (*a*) **31.** (*a*) **32.** (*c*) **33.** (*a*)

34. (*c*) **35.** (*b*) **36.** (*a*) **37.** $\left(\frac{7a}{6}, \frac{5a}{6}\right)$ **38.** 2R **39.** (*b*) **40.** 8 **41.** $\sqrt{3}R$ **42.** (*b*)

43. $x = \frac{R}{6}$ **44.** At Centre **45.** $\left(x = -\frac{R}{20}\right)$ **46.** $X_{com} = \frac{cb^2}{a^2 - b^2}$ **47.** $-\frac{3R}{56}\hat{i} - \frac{3R}{56}\hat{j}$ **48.** 2.25 m

49. $\frac{10\hat{i}}{3}$ m/s **50.** $\frac{14\hat{i} - 2\hat{j}}{3}$ **51.** (*b*) **52.** $\frac{5\sqrt{2}}{6}$ m/s^2 **53.** $\vec{a}_{cm} = \frac{-5\hat{i} + 2\hat{j} + 2\hat{k}}{4}$ **54.** $a = \left(\frac{m_2 - m_1}{m_2 + m_1}\right)^2 g$

55. (*a*) **56.** (*b*) **57.** (*a*) **58.** (*b*) **59.** Yes **60.** No **61.** Yes **62.** (*b*) **63.** (*a*) **64.** (*c*)

65. (*a*) **66.** (*c*) **67.** 13.3 cms **68.** (*b*) **69.** (*d*) **70.** (*b*) **71.** 6 m/s **72.** (*b*) **73.** (*d*)

74. (*c*) **75.** (*b*) **76.** (*c*) **77.** (*b*) **78.** (*d*) **79.** (*d*) **80.** $V = \frac{5u}{3}$ **81.** (*c*) **82.** $\frac{K.E_1}{K.E_2} = \frac{m_2}{m_1}$

83. 2mv^2 **84.** $V_3 = -3\hat{i} - \hat{j}$ **85.** (*c*) **86.** (*d*) **87.** (*a*) **88.** (*b*) **89.** (*b*) **90.** (*c*)

91. $\frac{mL}{M + m}$ **92.** $\frac{1}{3}$m Towards right **93.** (*b*) **94.** (*b*) **95.** (*b*) **96.** (*b*) **97.** (*b*) **98.** (*a*) **99.** (*a*)

100. (*a*) **101.** (*b*) **102.** 12 **103.** (*a*) **104.** (*d*) **105.** (*c*) **106.** 300 m/s **107.** (*d*) **108.** (*b*)

109. $\left(\frac{1 - A}{1 + A}\right)^2$ **110.** (*d*) **111.** (*c*) **112.** $x = 9$ **113.** (*b*) **114.** (*b*) **115.** (*d*) **116.** (*a*) **117.** (*c*)

118. (*b*) **119.** (*b*) **120.** (*c*) **121.** (*b*) **122.** (*d*) **123.** (*a*) **124.** (*b*) **125.** (*c*) **126.** $h = \frac{4m^2 V_0^2}{2g(M + m)^2}$

127. (*b*) **128.** (*d*) **129.** (*d*) **130.** (*b*) **131.** (*a*) **132.** (*d*) **133.** (*b*) **134.** (*d*) **135.** 5 **136.** (*a*)

137. (*a*) **138.** (*a*) **139.** (*d*) **140.** (*a*) **141.** (*c*) **142.** (*a*) **143.** (*d*) **144.** (*c*) **145.** (*c*) **146.** (*d*)

147. (*a*) **148.** 4 **149.** (*a*) **150.** (*d*) **151.** (*c*) **152.** (*c*) **153.** (*b*) **154.** (*c*) **155.** (*d*) **156.** (*b*)

157. (*b*)

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1. Both are True **2.** I = False, II = True **3.** I = True, II = False **4.** I = True, II = False

5. Both are False **6.** I = False, II = True **7.** Both are False **8.** I = True, II = False

9. I = False, II = True

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MR PHYSICS for questions practice

Motion in a Plane

(Practice Questions)

General Motion in 2D

1. If initial velocity of object $\vec{u} = 3\hat{i} + 4\hat{j}$ and after some time its velocity $v = 4\hat{i} + 3\hat{j}$ then find

(i) magnitude of change in velocity

(ii) change in magnitude of velocity.

2. Position of object $\vec{r} = 3t^2\hat{i} + (6t - t^2)\hat{j}$, then find velocity and acceleration at t = 1 sec.

3. x and y -coordinates of the particle at any time are $x = 5t - 2t^2$ and $y = 10t$, where x and y. Acceleration of the particle at t = 2s.

4. A particle has initial velocity $2\hat{i} + 3\hat{j}$ and acceleration $(0.3\hat{i} + 0.2\hat{j})$. Magnitude of velocity after 10 sec.

5. A position vector of a particle $r = 15t^2\hat{i} + \left(4 - 20t^2\right)\hat{j}\Big)$ Find acceleration at t = 1 sec

(*a*) 25 (*b*) 40

(*c*) 100 (*d*) 50

6. A particle moving in plane such that $y = \frac{x^2}{4}$ and $x = \frac{t}{2}$ then find speed at t = 2 sec.

7. A particle starting from origin moves in straight line and reach at a point $(\sqrt{3}, 3)$ then path makes an angle.

8. Object starts from the point $(2\hat{i}, 4\hat{j})$m at t = 0 with velocity $(5\hat{i} + 4\hat{j})$ with constant acceleration $(4\hat{i} + 4\hat{j})$m/s^2. What is distance of particle from origin at t = 2 sec.

9. Potion of object $\vec{r} = (t^2 - 38t)\hat{i} + 2t^3\hat{j}$ find instant when velocity and acceleration are perpendicular.

10. A car starts from rest and acceleration 5m/s^2 at t = 4 s. A ball is dropped out of a window by a person sitting in the car. What is the velocity and acceleration of the ball at t = 6s?

(*a*) $20\sqrt{2}$ m / s, 10 m / s^2, $t = 0$ (*b*) 20 m/s, 5 m/s^2

(*c*) 20 m/s,0 (*d*) $20\sqrt{2}$m/s, 0

11. A particle starts from origin with velocity $3\hat{i}$ m / s and acceleration $(6\hat{i} + 4\hat{j})$. Then find x-coordinates of particle when y -coordinates is 32 .

12. Object is moving with velocity $V = 3\sin(\omega t)\hat{i} + 3\cos(\omega t)\hat{j}$ then find distance moved by object in 2 sec.

13. At time t = 0 a particle starts travelling from a height $7\hat{z}$ cm in a plane keeping z coordinate constant. At any instant of time it's position along the $\hat{x}$ and $\hat{y}$ directions are defined as $3t$ and $5t^3$ respectively. At t = 1s acceleration of the particle will be

(*a*) $-30\hat{y}$ (*b*) $30\hat{y}$

(*c*) $3\hat{x} + 15\hat{y}$ (*d*) $3\hat{x} + 15\hat{y} + 7\hat{z}$

14. Initial velocity of object is 5m/s in east and acceleration of object is 2.5 ms^2 north then find speed of object at t = 2 sec.

15. Acceleration of object $a = 2\hat{i} + 3t^2\hat{j}$, then find velocity at t = 1 sec it initial velocity of object is zero.

16. Initial velocity of object $(4\hat{i} + 8\hat{j})$m/s and acceleration $a = -4$ m / s$^2\hat{j}$, then find velocity after t = 2sec and displacement in 3 sec.

17. Match column-I with Column-II:

Column-I (Condition)		Column-II (Result)	
		(*i*)	Velocity constant
(A)	$\vec{v} \cdot \vec{a} = +ve$	(*ii*)	Speed constant
(B)	$\vec{v} \cdot \vec{a} = -ve$	(*iii*)	Speed increases
(C)	$\vec{v} \cdot \vec{a} = 0$	(*iv*)	Speed decrease

18. **Assertion (A):** If acceleration is present, it will surely change the speed of the object.

Reason (R): Acceleration is rate of change in velocity.

(*a*) A is false but R is true

(*b*) Both A and R are true but R is NOT the correct explanation of A

(*c*) A is true but R is false

(*d*) Both A and R are true and R is the correct explanation of A

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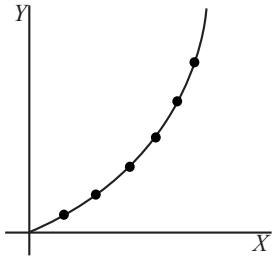
19. For initial velocity $(\vec{v}_i) = 3\hat{i} - 4\hat{j}$ and find velocity $(\vec{v}_f) = 3\hat{i} - 4\hat{j}$

(A)	$\lvert \Delta\vec{v} \rvert$	(i)	$8\hat{j}$
(B)	$\Delta \lvert \vec{v} \rvert$	(ii)	$6\hat{i}$
(C)	$\vec{v}_f - \vec{v}_i$	(iii)	0
(D)	$\vec{v}_f + \vec{v}_i$	(iv)	8

(*a*) (A)-(iii); (B)-(iv); (C)-(ii); (D)-(i)
(*b*) (A)-(iii); (B)-(iv); (C)-(i); (D)-(ii)
(*c*) (A)-(iv); (B)-(iii); (C)-(ii); (D)-(i)
(*d*) (A)-(iv); (B)-(ii); (C)-(i); (D)-(ii)

Equation of Trajectory

20. Position of object at time $'t', \vec{r} = 2t\hat{i} + 4t^2\hat{j}$, then find equation of trajectory.



21. If position of object $\vec{r} = 3\sin(\omega t)\hat{i} + 3\cos(\omega t)\hat{j}$, then object is moving on.

22. If position of object $\vec{r} = 4\sin(\omega t)i + 3\cos(\omega t)\hat{j}$, then object is moving on

23. If position of object $\vec{r} = 4\sin(\omega t)\hat{i} + 3\sin(\omega t)\hat{j}$, then object is moving on

(*a*) ellipse (*b*) circle
(*c*) parallel (*d*) straight line

24. Velocity of object $\vec{V} = 2\hat{i} + x\hat{j}$ then equation of trajectory.

25. A particle moving with velocity $V = y\hat{i} + x\hat{j}$ then find equation of trajectory.

Ground to Ground Projectile Motion

26. A bullet is fired from a gun at the speed of 280 ms^{-1} in the direction 30° above the horizontal. The maximum height attained by the bullet is... (g = 10 m/s^2, sin 30° = 0.5)

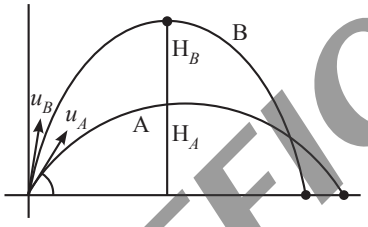
(*a*) 2000 m (*b*) 1000 m
(*c*) 3000 m (*d*) 2800 m

27. Velocity of projection $\vec{u} = 40\hat{i} + 30\hat{j}$ then find H, T, R and angle of project.

28. The horizontal range and the maximum height of a projectile are equal. The angle of projection of the projectile

(*a*) $\theta = \tan^{-1}$ (*b*) $\theta = 45^o$
(*c*) $\theta = \tan^{-1}\left(\frac{1}{4}\right)$ (*d*) $\theta = \tan^{-1}(4)$

29. Find the relation between time of flight from a given path as shown in fig.



(*a*) $T_A = T_B$ (*b*) $T_A > T_B$
(*c*) $T_A < T_B$ (*d*) Can't Say

30. The range of a projectile when fired at with the horizontal 75° is 1km what will be it's range when fired at 15° with same speed :-

(*a*) 0.5 km (*b*) 1.0 km
(*c*) 1.5 km (*d*) 2.0 km

31. An arrow is shot into the air. Its range is 200 metres and its time of flight is 5 s. If the value of *g* is assumed to be $10ms^{-2}$ then the horizontal component of the velocity of arrow is :-

(*a*) 25 m /s (*b*) 40 m /s
(*c*) 31.25 m/s (*d*) 12.5 m/s

32. Two projectiles of same mass and with same velocity are thrown at an angle 60° & 30° with the horizontal, then which quantity will remain same:

(*a*) Time of flight
(*b*) Horizontal range of projectile
(*c*) Max height acquired
(*d*) All of them

33. For angles of projection of a projectile at angles (45° – θ) and (45° + θ), the horizontal ranges described by the projectile are in the ratio of :

(*a*) 1 : 1 (*b*) 2 : 3
(*c*) 1 : 2 (*d*) 2 : 1

34. A projectile is thrown into space so as to have the maximum possible horizontal range equal to 400m . Taking the point of projection as the origin, the coordinates of the point where the velocity of the projectile is minimum are :-

(*a*) (400, 100) (*b*) (200, 100)
(*c*) (400, 200) (*d*) (200, 200)

35. Two stones are projected with the same speed but making different angles with the horizontal. Their ranges are equal. If the angle of projection of one is π/3 and its maximum height is y_1 then the maximum height of the other will be :

(*a*) $3y_1$ (*b*) $2y_1$
(*c*) $y_1/2$ (*d*) $y_1/3$

36. A projectile has same range at two different angle if time of flight are t_1 and t_2 then range of the projectile will be?

37. The horizontal range of a projectile is $4\sqrt{3}$ times its maximum height. Its angle of projectile will be:

(*a*) 45° (*b*) 60°
(*c*) 90° (*d*) 30°

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38. Two bodies are thrown up at angles of 45° and 60° respectively, with the horizontal. If both bodies attain same vertical height, then the ratio of velocities with which these are thrown is :

(*a*) $\sqrt{\frac{2}{3}}$ (*b*) $\frac{2}{\sqrt{3}}$

(*c*) $\sqrt{\frac{3}{2}}$ (*d*) $4\frac{\sqrt{3}}{2}$

39. A projectile is fired from the surface of the earth with a velocity of 5 ms^{-1} and angle θ with the horizontal. Another projectile fired from another planet with a velocity of 3ms^{-1} at the same angle follows a trajectory which is identical with the trajectory of the projectile fired from the earth. The value of the acceleration due to gravity on the planet is (in ms^{-2}) is: (given g = 9.8 $m.s^2$)

(*a*) 3.5 (*b*) 5.9

(*c*) 16.3 (*d*) 110.8

40. The equation of projectile is $y = \sqrt{3}x - \frac{gx^2}{2}$ the angle of projection is :

(*a*) 30° (*b*) 60°

(*c*) 45° (*d*) none

41. The equation of projectile is $y = 16x - \frac{x^2}{4}$ the horizontal range is

(*a*) 16 m (*b*) 8 m

(*c*) 64 m (*d*) 12.8 m

42. The equation of trajectory of a projectile thrown from a level ground near the surface of earth is given by $y = ax - bx^2$ with *y*-axis in vertical direction and *x*-axis in horizontal direction, *a* and *b* are constants. Then,

(*i*) The range of the projectile is *a* / *b*.

(*ii*) At $x - a/2b$, the velocity of projectile becomes zero.

(*iii*) The maximum height attained by projectile is $a^2/4b$.

(*iv*) The angle of projectile is $\tan^{-1}(a)$

(*a*) (i) and (ii) (*b*) (ii) and (iii)

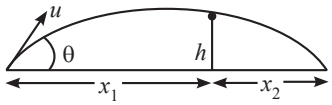
(*c*) (i), (iii) and (iv) (*d*) All above

43. Position of projected object at time *t* is $\vec{s} = 30t\hat{i} + (40t - 5t)\hat{j}$ then find (i) Angle of Projection (ii) H_{max} (iii) *R* & T_f

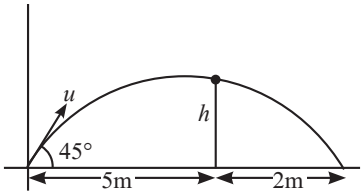
44. Particle is projected and its velocity at time 't' is $\vec{v} = \alpha\hat{i} + (\beta - rt)\hat{j}$ then find H,R,T angle of projection.

45. Particle is projected at other planets & its position at time 't' is $\vec{r} = 3t\hat{i} + (4t - 2t^2)\hat{j}$ find t_f(Time of flight), H (maximum height) and R (range)

46. Find relation between x_1, x_2 and *h*; if the ball is projected with speed *u* at angle θ.



47. A projectile is launched at an angle of 45° with an initial velocity u from the ground. The horizontal distance traveled by the projectile is 7 meters (5 meters to the highest point and 2 meters from the highest point to the landing point). Find the maximum height *h* attained by the projectile.



48. Ball is projected, with speed u at angle θ then find time after which ball will be moving perpendicular to the initial direction of projection.

49. A ball is thrown vertically upwards from the top of a cliff. Take starting position of motion as origin and upward direction as positive. Column-I specifies the position, velocity and for acceleration of the particle at any instant column-II gives their sign (+) or (–) at that moment.

Column –1		Column –II	
i.	When the ball is above point of projection, its displacement is	A	Always (+)
ii.	When the ball is above point of projection, its velocity is	B.	Always (–)
iii.	When the ball is above point of projection, its acceleration is	C.	May be (+)
iv.	When the ball is below point of projection, its acceleration is	D.	May be zero

(*a*) (i)–A; (ii)–C, D; (iii) –B; (iv)–B

(*b*) (i)–B; (ii)–A, (iii) –D; (iv)–C

(*c*) (i)–C; (ii)–B, (iii) –C, D; (iv)–B

(*d*) (i)–A; (ii)–C, (iii) –C; (iv)–B

50. The path of projectile is represented by $y = Px - Qx^2$.

Column –1		Column –II	
i.	Range	A	P/Q
ii.	Maximum height	B.	P
iii.	Time of flight	C.	$P^2/4Q$
iv.	Tangent of angle of projection is	D.	$\sqrt{\frac{2P}{Qg}}$

(*a*) (i)–D, (ii)–A, (iii) –B, (iv)–C

(*b*) (i)–C, (ii)–A, (iii) –D; (iv)–B

(*c*) (i)–A, (ii)–C, (iii) –D, (iv)–B

(*d*) (i)–B; (ii)–C, (iii) –A; (iv)–C

51. At maximum height of projectile motion velocity is minimum and perpendicular to acceleration.

(*a*) True (*b*) False

52. Tangential acceleration in projectile motion 1st decreases then increases during motion.

(*a*) True (*b*) False

53. The rate of change in velocity is constant in projectile motion.

(*a*) True (*b*) False

54. Speed, velocity and acceleration are variable in projectile motion.

(*a*) True (*b*) False

55. If air friction is not ignored in projectile motion angle of projection is less than angle of collision.

(*a*) True (*b*) False

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56. Ball is projected at angle θ then total angular displacement of ball is 2θ in time of flight of Projectile motion.

(*a*) True (*b*) False

57. Projectile motion is non-uniform motion with non-uniform acceleration.

(*a*) True (*b*) False

58. At point of projectile centripetal acceleration of object is g cos θ.

(*a*) True (*b*) False

59. Total change in momentum(2 mu sin θ) in projectile motion.

(*a*) True (*b*) False

60. Average velocity in projectile motion between any two point is u cosθ.

(*a*) True (*b*) False

61. Horizontal component of projectile motion is uniform and y^{th} component is nonuniform motion

(*a*) True (*b*) False

62. Path of on projectile with respect to another projectile is always straight line.

(*a*) True (*b*) False

63. The maximum vertical height to which a man can throw a ball is 136 m The maximum horizontal distance unto which he can throw the same ball is

(*a*) 136 m (*b*) 272 m

(*c*) 68 m (*d*) 192 m

64. A projectile is projected at 60° from vertical with initial velocity $40 ms^{-1}$. The velocity of projectile at $t = 2s$ from the start will be :

(*a*) Zero (*b*) $20\sqrt{3}$ m / s

(*c*) 20 m/s (*d*) $40\sqrt{3}$m/s

65. The trajectory of projectile, projected from the ground is given by $y = x - \frac{x^2}{20}$, where *x* and *y* are measured in meter. The maximum height attained by the projectile will be :

(*a*) 10 m (*b*) 5 m

(*c*) 200 m (*d*) $10\sqrt{2}$m

66. **Assertion (A):** When a body is projected at an angle 45°, it's range is maximum.

Reason (R): For maximum range, the value of sin (2θ) should be equal to one.

(*a*) A is false but *R* is true

(*b*) Both A and R are true but R is NOT the correct explanation of A

(*c*) A is true but *R* is false

(*d*) Both A and R are true and R is the correct explanation of A

67. A ball is projected from the ground with a speed 15 m /s at an angle θ with horizontal so that its range and maximum height are equal, then 'sin θ' 'will be equal to :

(*a*) 1/4 (*b*) 4

(*c*) $4/\sqrt{17}$ (*d*) 1/2

68. A projectile is projected with velocity of 25 m/s at an angle θ with the horizontal. After *t* seconds its inclination with horizontal becomes zero. If R represent horizontal range of projectile, the value of θ will be :

(*a*) $\frac{1}{2}\sin^{-1}\left(\frac{5t^2}{4R}\right)$ (*b*) $\tan^{-1}\left(\frac{4t^2}{5R}\right)$

(*c*) $\frac{1}{2}\sin^{-1}\left(\frac{4R}{5t^2}\right)$ (*d*) $\cot^{-1}\left(\frac{R}{20t^2}\right)$

69. The ranges and heights for two projectiles projected with the same initial velocity at angles 42° and 48° with horizontal are R_1, R_2 and H_1, H_2 respectively. Choose the correct option :

(*a*) $R_1 > R_2$ and $H_1 = H_2$ (*b*) $R_1 = R_2$ and $H_1 < H_2$

(*c*) $R_1 < R_2$ and $H_1 < H_2$ (*d*) $R_1 = R_2$ and $H_1 = H_2$

70. **Assertion (A):** If a body of mass *m* is projected upwards with a speed *v* making an angle θ with horizontal, then the change in momentum of body along *x* -axis will be zero.

Reason (R): Mass of body remains constant along *x*-axis.

(*a*) A is false but R is true

(*b*) Both A and R are true but R is NOT the correct explanation of A

(*c*) A is true but R is false

(*d*) Both A and R are true and R is the correct explanation of A

71. Average velocity of a particle in projectile motion between its starting point and the highest point of its trajectory is (projection speed = *u* , angle projection from horizontal = θ)

(*a*) $\frac{u}{2}\sqrt{1+2\cos^2\theta}$ (*b*) $\frac{u}{2}\sqrt{1-2\cos^2\theta}$

(*c*) $\frac{u}{2}\sqrt{1+3\cos^2\theta}$ (*d*) $u \cos\theta$

72. A particle is projected vertically upward from ground with initial velocity u such that it clears the top of a pole of height *h* after time t_1 in its path. It takes further time t_2 to reach the ground

(A)	*u*	(i)	$\frac{(t_1+t_2)^2}{8}g$
(B)	*h*	(ii)	$(t_{1+}t_2)$
(C)	Time of flight	(iii)	$\frac{1}{2}g(t_1+t_2)$
(D)	Maximum height	(iv)	$\frac{1}{2}gt_1t_2$

(*a*) (A)-(ii); (B)-(i); (C)-(iii); (D)-(iv)

(*b*) (A)-(i); (B)-(ii); (C)-(iii) (D)-(iv)

(*c*) (A)-(iii); (B)-(iv);(C)-(ii) (D)-(i)

(*d*) (A)-(iv); (B)-(iii); (C)-(ii); (D)-(1)

73. For ground to ground projectile motion with intitial velocity *u* at angle θ from horizontal

(A)	Change in speed from initial to final point	(i)	u-u cos θ
(B)	Magnitude of change in velocity from initial to final point	(ii)	u sin θ
(C)	Change in speed from initial to top	(iii)	2u sin θ
(D)	Magnitude of change in velocity from initial to top	(iv)	zero

(*a*) (A)-(i); (B)-(ii); (C)-(iii); (D)-(iv)

(*b*) (A)-(iv); (B)-(ii); (C)-(i); (D)-(iii)

(*c*) (A)-(iv); (B)-(iii); (C)-(1); (D)-(ii)

(*d*) (A)-(iv); (B)-(iii); (C)-(ii); (D)-(i)

74. A projectile is fired at an angle of θ with the horizontal. What will be the elevation angle α of the projectile at its heighest point as seen form the point of projection?

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Horizontal Projectile Motion

75. When a particle is thrown horizontally, with initial velocity 'u' the resultant velocity of the projectile at any time t is given by:

(*a*) gt (*b*) $\frac{1}{2}gt^2$

(*c*) $\sqrt{u^2+g^2t^2}$ (*d*) $4\sqrt{u^2-g^2t^2}$

76. A bomber is flying horizontally with a constant speed of 15 m/s at a height of 78.4 m . The pilot has to drop a bomb at the enemy target. At what horizontal distance from the target should he release the bomb:

(*a*) Zero (*b*) 30 m

(*c*) 60 m (*d*) 75 m

77. A body is thrown horizontally from the top of a tower of height 5 m. It touches the ground at a distance of 10 m from the foot of the tower. The initial velocity of the body is ($g = 10\ m/s^2$)

(*a*) $2.5\ ms^{-1}$ (*b*) $5\ ms^{-1}$

(*c*) $10\ ms^{-1}$ (*d*) $20\ ms^{-1}$

78. A body is thrown horizontally with a velocity $\sqrt{2gh}$ from the top of a tower of height h. It strikes the level ground through the foot of the tower at a distance x from the tower. The value of x is:

(*a*) h (*b*) $h/2$

(*c*) $2h$ (*d*) $2h/3$

79. Ball is projected with 30 m/s in horizontal direction from some height. Find time when it is 45° from horizontal.

80. A bullet is fired in a horizontal direction from a tower while a stone is simultaneously dropped from the same point then:

(*a*) The bullet and the stone will reach the ground simultaneously.

(*b*) The stone will reach earlier.

(*c*) The bullet will reach earlier.

(*d*) Nothing can be predicted.

81. A ball is projected upwards from the top of the tower with a velocity $50\ ms^{-1}$ making an angle 30° with the horizontal. The height of tower is 70 m. After how many seconds the ball will strike the ground?

(*a*) 3 s (*b*) 5 s

(*c*) 7 s (*d*) 9 s

Direction for questions from 82-85

A body x is dropped from the top of a tower. At the same time, another body y is thrown horizontally from the same position with a velocity U.

82. Both bodies will reach the ground at same time.

(*a*) True (*b*) False

83. A particle is projected from height h with horizontal velocity u, then range of particle is $u\sqrt{\frac{2H}{g}}$

(*a*) True (*b*) False

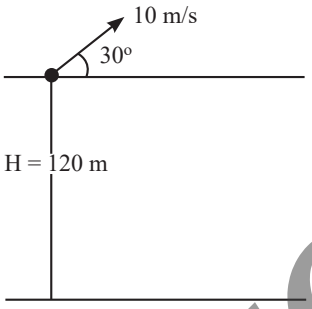
84. At the highest point of the path of projectile speed is zero.

(*a*) True (*b*) False

85. Horizontal velocity in projectile motion is zero at the highest point

(*a*) True (*b*) False

86. Find time of flight.



(*a*) 3 sec (*b*) 6 sec

(*c*) 4 sec (*d*) 7 sec

87. **Assertion :** Two bodies of different masses are projected horizontally with different speeds, they reach the ground simultaneously.

Reason : For both bodies, the vertical component of initial velocity is zero.

(*a*) Both the assertion and reason are correct, and the reason is the correct explanation of the assertion.

(*b*) Both the assertion and reason are correct, but the reason is not the correct explanation of the assertion.

(*c*) The assertion is correct, but the reason is incorrect.

(*d*) The assertion is incorrect, but the reason is correct.

88. **Assertion :** Mass of the projectile does not affect the maximum height

Reason: Heavier the body, greater is the force required project it.

(*a*) Both the assertion and reason are correct, and the reason is the correct explanation of the assertion.

(*b*) Both the assertion and reason are correct, but the reason is not the correct explanation of the assertion.

(*c*) The assertion is correct, but the reason is incorrect.

(*d*) The assertion is incorrect, but the reason is correct

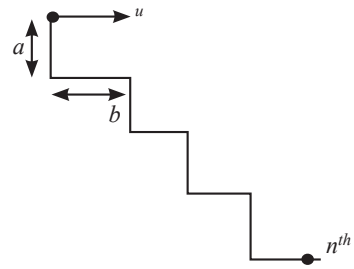
89. A bomber plane moves horizontally with a speed of 500 m/s and a bomb released from it, strikes the ground in 10 sec . Angle at which it strikes the ground will be ($g = 10\ m/s^2$)

(*a*) $\tan^{-1}\left(\frac{1}{5}\right)$ (*b*) $\tan\left(\frac{1}{5}\right)$

(*c*) $\tan^{-1}(1)$ (*d*) $\tan^{-1}(5)$

90. Ball is Projected in Horizontal direction with speed u then find its speed when it is at a point where horizontal and vertical displacement is same.

91. Find velocity so that ball will fall on n^{th} step



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Relative Motion in a Plane

92. Velocity of Ramlal $\vec{V}_R = -3\hat{i} + 4\hat{j}$ and velocity of Pinky $\vec{V}_P = 4\hat{i} + 3\hat{j}$ then find velocity of Ramlal with respect to Pinky.

93. Suppose you are riding a bike with a speed of 10 m /s due east relative to a person A who is walking on ground towards east. If your friend B walking on the ground due west measures your speed as 15m/ s , find the relative velocity between two reference frames A and B.

(*a*) Velocity of A w.r.t. B will be 5m /s due west.
(*b*) Velocity of B w.r.t. A will be 5m /s due east.
(*c*) Velocity of A w.r.t. B will be 25m /s due west.
(*d*) Velocity of A w.r.t. B will be 5m /s due east.

94. Ship is travelling due east at 10km/h. A ship heading 30° east of north is always due north from the first ship. The speed of the second ship in km / h is -

(*a*) $20\sqrt{2}$ (*b*) $20\sqrt{3/2}$
(*c*) 20 (*d*) $20/\sqrt{2}$

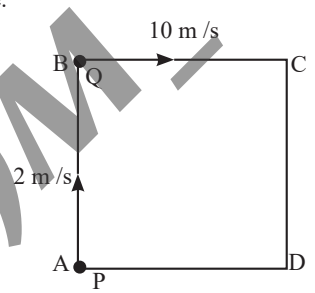
95. Car is moving with 30 m/s along east and truck is moving with speed 40 m/s at 30° north of east w.r.t. car then find velocity of truck.

96. A man 'A' moves in the north direction with a speed 10 m/s and another man B moves in E-30° – N with 10 m/s find the relative velocity of B w.r.t. A.

97. A bird is flying with a speed of 40km / hr. in the north direction. A train is moving with a speed of 40km / hr. in the west direction. A passenger sitting in the train will see the bird moving with velocity

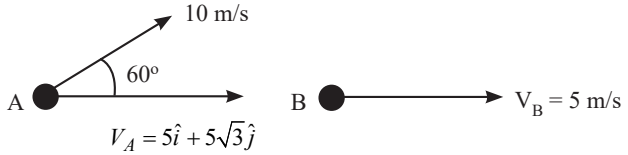
(*a*) 40 km/ hr in NE direction
(*b*) $40\sqrt{2}$ km / hr in NE direction
(*c*) 40 km/ hr in NW direction
(*d*) $40\sqrt{2}$ km / hr in NW direction

98. Two men P & Q are standing at corners A & B of square $ABCD$ of side 8 m . They start moving along the track with constant speed 2 m/s and 10m/s respectively. Find the time when they will meet for the first time.

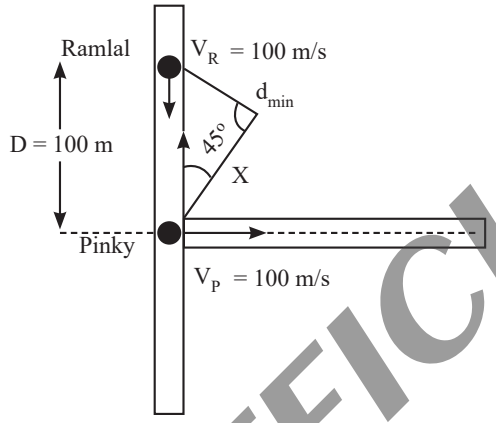


(*a*) 2 *s* (*b*) 3 *s*
(*c*) 1 *s* (*d*) 6 *s*

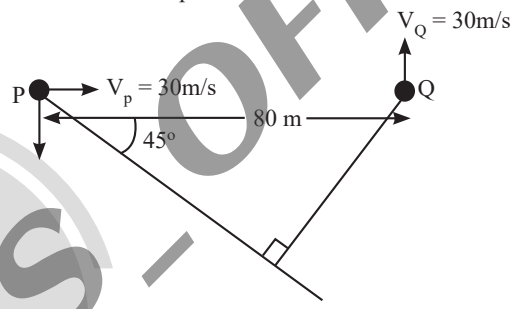
99. Find velocity of A with respect to B.



100. Find minimum separation between Ramlal and Pinky.



101. Find minimum separation between them.



102. Two particles A and B moving in $x - y$ plane are at origin at $t = 0$ sec. The initial velocity vectors of A and B are $\vec{u}_A = 8\hat{i}\,\text{m/s}$ and $\vec{u}_B = 8\hat{j}\,\text{m/s}$. The acceleration of A and B are constant and are $\vec{a}_A = -2\hat{i}\,\text{m/s}^2$ and $\vec{a}_B = -2\hat{i}\,\text{m/s}^2$. Column-I gives certain statements regarding particle A and B Column-I gives corresponding results. Match the statements in Column-I with corresponding results in Column-II.

Column-I		Column-II	
i	The time (in sec.) at which velocity of A relative to B is zero	A.	$16\sqrt{2}$
ii	The distance (in metres) between A and B when their relative velocity is zero	B.	$8\sqrt{2}$
iii	The time (in sec.) after $t = 0$ sec, at which A and B are at same position	C.	8
iv	The magnitude of relative velocity of A and B at instant when they are at same position	D.	4 sec

River Swimmer Problem

103. A river is flowing from east to west at a speed of 5m/min. A man on south bank of river, capable of swimming 10m/min. in still water, wants to swim across the river in shortest time should swim

(*a*) Due north
(*b*) Due north-east
(*c*) Due north-east with double the speed of river
(*d*) None of the above

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104. A boat is sailing at a velocity $\left(3\hat{i}+4\hat{j}\right)$ with respect to ground and water in river is flowing with a velocity $\left(-3\hat{i}-4\hat{j}\right)$ Relative velocity of the boat with respect to water is

(*a*) $8\hat{j}$ (*b*) $5\sqrt{2}$

(*c*) $6\hat{i}+8\hat{j}$ (*d*) $-6\hat{i}-8\hat{j}$

105. A boat takes 2 hours to go 8 km and come back in still water lake. With water velocity of 4 km / hr, the time taken for going upstream of 8 km and coming back is :-

(*a*) 140 min (*b*) 150 min

(*c*) 160 min (*d*) 60 min

106. A boat, which has a speed of 5 km/h in still water, crosses a river of width 1 km along the shortest possible path in 15 minutes. The velocity of the river water in km/h is

(*a*) 1 (*b*) 3

(*c*) 4 (*d*) $\sqrt{41}$

107. A man wishes to swim across a river 0.5 km . wide. If he can swim at the rate of 2 km /h. in still water and the river flows at the rate of 1 km /h . The angle (w.r.t. the flow of the river) along which he should swim so as to reach a point exactly opposite his starting point, should be

(*a*) 60º (*b*) 120º

(*c*) 145º (*d*) 90º

108. A man is crossing a river flowing with velocity of 5 m/s. He reaches a point directly across at distance of 60 m in 5 s . His velocity in still water should be:

(*a*) 12 m/s (*b*) 13 m/s

(*c*) 5 m/s (*d*) 10 m/s

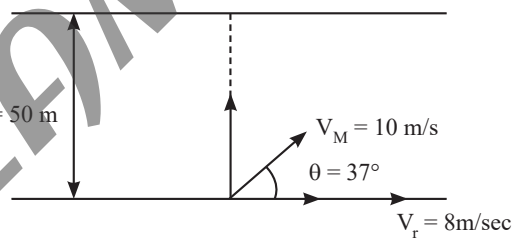
109. A person, reaches a point directly opposite on the other bank of a flowing river, while swimming at a speed of 5 m/s at an angle of 120º with the flow. The speed of the flow must be

(*a*) 2.5 m/s (*b*) 3 m/s

(*c*) 4 m/s (*d*) 1.5 m/s

110. River is flowing with speed 20 m/s a man can swim in flowing river with speed 10 m/s then find drift in a case of minimum time while the width of river is 60 m.

111. Find drift and time taken to cross the river.



112. Flow of rives is 20 m/s and Man can swim in rives with speed 10 m/s, then find angle at Which man have to swim to counter the river's flow and reach the exact opposite point with zero drift, following the minimum path?

(*a*) 30º (*b*) 60°

(*c*) 120° (*d*) None of these

113. Flow of river is 200 m/s and man can swim in river with speed 10m/s then find angle at which man have to swin for minimum time

(*a*) 30º (*b*) 90°

(*c*) 120° (*d*) None of these

114. A boat moving towards east with velocity 4m/s with respect to still water and river is flowing towards north with velocity 2 m/s and the wind is blowing towards north with velocity 6 m/s. The direction of the flag blown over by the wind hoisted on the boat is

(*a*) North - west (*b*) south-east

(*c*) $\tan^{-1}(1/2)$ with east (*d*) North

115. A man swims from a point A on one bank of a river of width 100 m . When he swims perpendicular to water current, he reaches the other bank 50 m downstream. The angle to the bank at which he should swim, to reach the directly opposite point B on other bank is

(*a*) 10º upstream (*b*) 20º upstream

(*c*) 30º upstream (*d*) 60º upstream

116. A river flows with a speed more than the maximum speed with which a person can swim in still water. He intends to cross the river by the shortest possible path [*i.e.* he wants to reach the point on the opposite bank which directly opposite to starting point). Which of the following is correct?

(*a*) He should start normal to river bank.

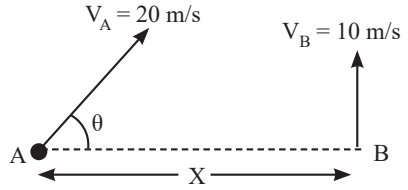
(*b*) He should start in such away that he moves normal to bank, relative to bank.

(*c*) He should start in particular calculated direction making an obtuse angle with downstream.

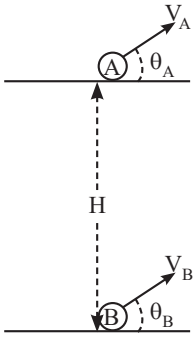
(*d*) The man cannot cross the river in that way.

Condition of Collision

117. Two particles A and B are projected from the ground simultaneously in the directions shown in the figure with initial velocities V_A = 20 m /s and V_B = 10 m/s respectively. They collide after 0.5 s . Find out the angle θ and the distance *x*.



118. Two balls are projected as shown in figure, find time of collision and condition of collision?



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119. Two particles having position vectors $\vec{r}_1 = \left(3\hat{i} + 5\hat{j}\right)$ meters and $\vec{r}_2 = \left(-5\hat{i} - 3\hat{j}\right)$ meres are moving with velocities $\vec{v}_1 = \left(2\hat{i} + 3\hat{j}\right)$ m/s and $v_2 = \left(\alpha\hat{i} + 7\hat{j}\right)$ m/s. If they collide after 2 seconds, the value of 'α' is:

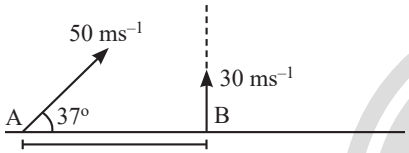
(*a*) 2 (*b*) 4
(*c*) 6 (*d*) 8

120. Two boys are standing at the ends A and B of a ground where AB = *a*. The boy at B starts running in a direction perpendicular to AB with velocity v_1. The boy at A starts running simultaneously with velocity *v* and catches the other boy in a time *t*, where *t* is-

(*a*) $\dfrac{a}{\sqrt{v^2 + v_1^2}}$ (*b*) $\dfrac{a}{\sqrt{v^2 - v_1^2}}$

(*c*) $\dfrac{a}{(v - v_1)}$ (*d*) $\dfrac{a}{(v + v_1)}$

121. Balls A and B are thrown from two points lying on the same horizontal plane separated by a distance of 120 m. Which of the following statements is correct?



(*a*) The balls can never meet
(*b*) The balls can meet if the ball B is thrown 1 s later
(*c*) The two balls meet at a height of 45 m
(*d*) None of the above

122. Four persons P, Q, R and S are initially at the four corners of a square of side *d*. Each person now moves with a constant speed *v* in such a way that P always moves directly towards Q, Q towards R, R towards S, and S towards P. The four persons will meet after time

(*a*) $\dfrac{d}{2v}$ (*b*) $\dfrac{d}{v}$

(*c*) $\dfrac{3d}{2v}$ (*d*) The will never meet

123. A 2m wide truck is moving with a uniform speed V_o = 8 ms^{-1} along a straight horizontal road. A man starts to cross the road with a uniform speed *v*, when the truck is 4 m away from him. The minimum value of *v* so that he can cross the road safely is

(*a*) 2.62 ms^{-1} (*b*) 4.6 m^{-1}
(*c*) 3.57 ms^{-1} (*d*) 1.414 ms^{-1}

Rain Man Problem

124. Rain is falling vertically with a speed of 30 ms^{-1}. A woman rides a bicycle with a speed of 10 ms^{-1}. in the north direction. What is the direction in which she should hold her umbrella?

125. Man is at rest and find rain is falling with speed 50m/s at angle 37° from vertical; now man starts moving with speed V_m, then find V_m so that rain appears to falling vertical downward with respect to moving man; also find V_{rm}/V_r

126. A man standing on a road has to hold his umbrella at 30° with the vertical to keep the rain away. He throws the umbrella and starts running at 10 km/hr then he finds that rain drops are hitting his head vertically, then speed of rain drops with respect to moving man:-

(*a*) 20 km/hr (*b*) $10\sqrt{3}$ km/hr
(*c*) $10\sqrt{3}$ km/hr (*d*) 10 km/hr

127. A man walks in rain with a velocity of 5 kmh^{-1}. The rain drops strike at him at an angle of 45° with the horizontal. Velocity of rain if it is falling vertically downward-

(*a*) 5 kmh^{-1} (*b*) 4 kmh^{-1}
(*c*) 3 kmh^{-1} (*d*) 1 kmh^{-1}

128. A car with vertical windshield moves in a rain storm at a speed of 40 km/hr. The rain drops fall vertically with constant speed of 20 m/s. The angle at which rain drops strike the windshield is

(*a*) $\tan^{-1}\dfrac{5}{9}$ (*b*) $\tan^{-1}\dfrac{9}{95}$

(*c*) $\tan^{-1}\dfrac{3}{2}$ (*d*) $\tan^{-1}\dfrac{2}{3}$

129. A man sitting in a bus travelling in a direction from west to east with a speed of 40 km/h observes that the rain-drops are falling vertically downwards. To another man standing on ground the rain will appear.

(*a*) To fall vertically downwards
(*b*) To fall at an angle going from west to east
(*c*) To fall at an angle going from east to west
(*d*) The information given is insufficient to decide the direction of the rain

Kinematics of Circular Motion

130. Find angular and linear displacement in one revolution.

131. Find angle rotated by angular displacement vector in one rotation.

132. Find angular displacement of hr. hand, minute hand and second hand of clock in 12 hr.

133. A fly wheel is accelerated uniformly from rest and rotates through 5 rad in the first second. The angle rotated by the fly wheel in the next second, will be:

(*a*) 7.5 rad (*b*) 15 rad
(*c*) 20 rad (*d*) 30 rad

134. Angular velocity of minute hand of a clock is:-

(*a*) $\dfrac{2\pi}{1800}$ rad/s (*b*) 8π rad/s

(*c*) $\dfrac{\pi}{1800}$ rad/s (*d*) $\dfrac{\pi}{30}$ rad/s

135. Angular displacement of object $\theta = t^2 + 2t + 5$ then, find angular speed at 2 sec and in 2-sec.?

136. Angular velocity of a rotating object is given by the equation: $\omega = 6t - t^2 + 6$ Find the time at which the angular acceleration becomes zero?

137. Object completes 7 rotation in 22 sec on circular path of radius 1 m then find angular speed.??

138. A body performing uniform circular motion completed 140 revolution in a second. Its angular speed is

(*a*) 880 rad/s (*b*) 440 rad/s
(*c*) 220 rad/s (*d*) 240 rad/s

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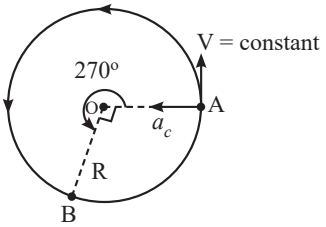
139. Find average acceleration between A and B.



140. Find angular speed of hr. hand

141. Body moving in uniform circular motion rotated by 120° then find change in velocity.

142. In uniform circular motion acceleration is:?

(*a*) Constant (*b*) Variable

143. Angular speed of a uniformly circulating body with time period T is

(*a*) $2\pi T$ (*b*) $\frac{2\pi}{T}$

(*c*) πT (*d*) $\frac{\pi}{T}$

144. An object moving in a circular path at constant speed has constant

(*a*) Energy (*b*) Velocity

(*c*) Acceleration (*d*) Displacement

145. The angle between velocity vector and acceleration vector in uniform circular motion is

(*a*) 0° (*b*) 180°

(*c*) 90° (*d*) 45°

146. Two cyclists cycle along circular tracks of radii R_1 and R_2 at uniform rates. If both of them take same time to complete one revolution, then their angular speeds are in the ratio

(*a*) $R_1 : R_2$ (*b*) $R_2 : R$

(*c*) 1 : 1 (*d*) $R_1R_2 : 1$

147. Speed of an object moving in circular path of radius 10 m with angular speed 2 rad/s is

(*a*) 10 m/s (*b*) 5 m/s

(*c*) 20 m/s (*d*) 30 m/s

148. Centripetal acceleration of a cyclist completing acceleration of a cyclist completing 7 rounds in a minute along a circular track of radius 5 m with a constant speed, is

(*a*) 2.7 m/s^2 (*b*) 4 m/s^2

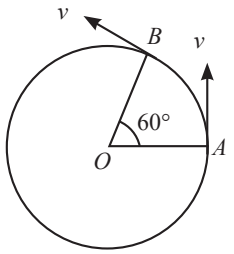
(*c*) 3.78 m/s^2 (*d*) 6 m/s^2

149. If the frequency of an object in uniform circular motion is doubled, its acceleration becomes

(*a*) Two times (*b*) Four times

(*c*) Half (*d*) One fourth

150. A particles is moving in a circle of radius *r* having centre at O, with a constant speed *v*. The magnitude of change in velocity in moving from A to B is



(*a*) $2v$ (*b*) 0

(*c*) $\sqrt{3}v$ (*d*) v

151. A particle is moving with constant speed in a circular path. When the particle turns by an angle 90°, the ratio of instantaneous velocity is $\pi : x\sqrt{2}$. The value of *x* will be

(*a*) 2 (*b*) 5

(*c*) 1 (*d*) 7

152. A body revolves with constant speed *v* in a circular path of radius *r*. The magnitude of its average acceleration during motion between two points in diametrically opposite direction is

(*a*) 0 (*b*) $\frac{v^2}{r}$

(*c*) $\frac{2v^2}{\pi r}$ (*d*) $\frac{v^2}{2r}$

153. A body is moving on a circle of radius 80 m with a speed 20 m/s which is decreasing at the rate 5 m/s^2 at an instant. The angle made by its acceleration with its velocity is

(*a*) 45° (*b*) 90°

(*c*) 135° (*d*) 0°

154. A car is moving at a speed of 40 m/s on a circular track of radius 400 m. This speed is increasing at the rate of 3 m/s^2. The acceleration of car is

(*a*) 4 m/s^2 (*b*) 7 m/s^2

(*c*) 5 m/s^2 (*d*) 3 m/s^2

155. A car travelling with linear velocity *v* on circular path of radius *r* its speed increasing at rate α, then find acceleration.

156. The distance of a particle moving on a circle of radius 12 m measured from a fixed point on the circle and measured along the circle is given by $s = 2t^3$ (in meters). The ratio of its tangential to centripetal acceleration at $t = 2$sec.

(*a*) 4 : 1 (*b*) 1 : 2

(*c*) 2 : 1 (*d*) 3 : 1

157. A car is going round a circle of radius R_1 with constant speed. Another car is going round a circle or radius R_2 with constant speed. If both of them take same time to complete the circles, the ratio of their angular speeds and linear speeds will be

(*a*) $\sqrt{\frac{R_1}{R_2}}, \frac{R_1}{R_2}$ (*b*) 1, 1

(*c*) $1, \frac{R_1}{R_2}$ (*d*) $\frac{R_1}{R_2}$

158. If θ is angle between the velocity and acceleration of a particle moving on a circular path with decreasing speed, then

(*a*) $\theta = 90°$ (*b*) $0° < \theta < 90°$

(*c*) $90° < \theta < 180°$ (*d*) $0° \le \theta \le 180°$

159. If speed of an object revolving in a circular path is doubled angular speed is reduced to half of original value, then centripetal acceleration will become/remain

(*a*) Same (*b*) Double

(*c*) Half (*d*) Quadruple

160. A motor car is travelling at 30 m/sec on a circular road of radius 500 m. It is increasing its speed at the rate of 2.0 ms^{-2}. The total acceleration is:

(*a*) 1.8 ms^{-2} (*b*) 2 ms^{-2}

(*c*) 3.8 ms^{-2} (*d*) 2.7 ms^{-2}

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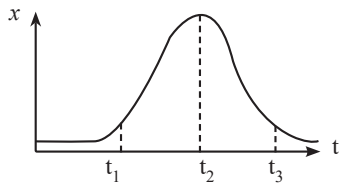
1. **Statement I:** When a particle moves with constant velocity, its average velocity, it's instantaneous velocity and it's speed are all equal.

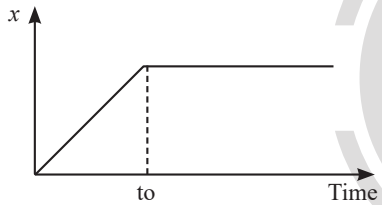
   Statement II: If a particle is accelerating, it is either speeding up or speeding down.

2. Given figure shows the x-coordinate of particle is function of time.



   (*i*) Sign of velocity at time t_1 = _____.
   (*ii*) Sign of acceleration at time t_2 = _____.
   (*iii*) Sign of velocity at time t_3 = _____.
   (*iv*) sign of acceleration at time t_3 = _____.

3. For a given figure



   Statement I: The velocity increases up to a time to, and then becomes constant.

   Statement II: The particle moves at a constant velocity up to a time to, and then stops.

4. A stone is released from an elevator going up with an acceleration *a* The acceleration of the stone before and after the release is _____ and _____ respectively.

5. *A* person standing near the edge of the top of a building has two balls *A* and *B*. The ball *A* is thrown vertically upward and *B* is released at the same time. If ball *A* hits ground with speed V_A and ball *B* hits ground with speed V_s then we have

   (*a*) $V_A = V_B$
   (*b*) $V_A > V_B$
   (*c*) $V_B > V_A$
   (*d*) Relation between V_A & V_B depends upon height of building

6. Two bullets are fired simultaneously, horizontally and with different speeds from the same place. Then which of the following statements is correct.

   (*a*) Both bullet will hit the ground simultaneously and with some speed
   (*b*) Bullet with faster speed will hit ground first.
   (*c*) Both bullet will hit ground simultaneously, will have different vertical component of velocity while hitting ground.
   (*d*) Both bullet will hit ground simultaneously, will have some vertical component of velocity but they will hit ground with different net speed.

7. **Statement I:** It is possible to have a situation in which $\left|\frac{d\vec{v}}{dt} \neq 0\right|$ but $\frac{d|\vec{v}|}{dt} = 0$.

   Statement II: The average velocity of particle moving on a straight line is zero in time interval. It is possible that the instantaneous velocity is never zero in the interval.

8. An object may have_____Without having_____.

   (*a*) Varying speed, varying velocity.
   (*b*) Varying velocity, varying speed.
   (*c*) Non zero acceleration, varying velocity.
   (*d*) Both (*b*) and (*d*)

9. **Statement I:** For motion in straight line, if the position and velocity have same sign, the particle is moving towards the origin.

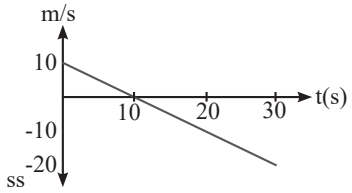
   Statement II: If the velocity is zero for a time interval, the acceleration in zero at any instant within the time interval.

   Statement III: The velocity of a particle is zero at t = 0, then acceleration at t = 0 must be zero.

10. **Statement I:** The magnitude of average velocity in an interval is always equal to its average speed in that interval.

    Statement II: If is not impossible to have a situation in which is which the speed of the particle is never zero but the average speed in an interval is zero.

11. For given graph



    Statement I: The particle has never turned around.

    Statement II: The average speed in the interval 0 to 10 seconds is the same as average speed in interval 10s to 20s.

12. **Statement I:** If the acceleration of a particle as seen from two frames S_1 and S_2 have equal magnitude of 5 m/s², then frames must be at rest with respect to each other.

    Statement II: for above given case, acceleration of S_2 with respect to S_1 May be anything between zero and 10 m/s²

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Answer Key

1. (i) $\sqrt{2}$ m/s, (ii) 0 m/s **2.** $\vec{v} = 6\hat{i} + 4\hat{j}, \vec{a} = 6\hat{i} + -2\hat{j}$ **3.** $\vec{a} = -4\text{m/s}^2$ **4.** $5\sqrt{2}$ m/s **5.** (*d*) **6.** $\frac{\sqrt{5}}{4}$

7. $\theta = 60°$ **8.** $20\sqrt{2}$ **9.** 1 s **10.** (*a*) **11.** (60) **12.** $\vec{a} = \frac{5}{2}\hat{i} + \frac{5}{2}\hat{j}$ **13.** (*b*) **14.** $5\sqrt{2}$ **15.** $\sqrt{5}$

16. $(4\hat{i} - 4\hat{j})\,m/s, (12\hat{i} + 6\hat{i})m$ **17.** A → III, B → IV, C → II **18.** (*a*) **19.** (*d*) **20.** $y = x^2$

21. $x^2 + y^2 = 3^2$ (Circle) **22.** $\frac{x^2}{16} + \frac{y^2}{9} = 1$ (ellipse) **3.** (*d*) **24.** $y = \frac{x^2}{4}$ **25.** $x^2 - y^2 = K$ **26.** (*b*)

27. $\mu = 45$m, $T = 6$s, $R = 240$ m, $\theta = 37°$ **28.** (*d*) **29.** (*c*) **30.** (*b*) **31.** (*b*) **32.** (*b*) **33.** (*a*) **34.** (*b*)

35. (*d*) **36.** $R = \frac{1}{2} g\, t_1 . t_2$ **37.** (*d*) **38.** (*c*) **39.** (*a*) **40.** (*b*) **41.** (*c*) **42.** (*c*)

43. $\theta = 53$, $T_f = 8$, R = 240m **44.** $\theta = \tan^{-1}(\beta/\alpha)$, $R = \frac{2\alpha\beta}{r}, H = \frac{\beta^2}{2r}$ **45.** $t_f = 2$sec, H = 2m, R = 6m **46.** $h = \frac{x_1 x_2 \tan\theta}{x_1 + x_2}$

47. $h = \frac{10}{7} m$ **48.** $t = \frac{u}{g\sin\theta}$ **49.** (*a*) **50.** (*c*) **51.** (*a*) **52.** (*a*) **53.** (*a*) **54.** (*b*)

55. (*a*) **56.** (*a*) **57.** (*b*) **58.** (*a*) **59.** (*a*) **60.** (*b*) **61.** (*a*) **62.** (*a*) **63.** (*b*) **64.** (*b*)

65. (*b*) **66.** (*b*) **67.** (*c*) **68.** (*d*) **69.** (*b*) **70.** (*b*) **71.** (*c*) **72.** (*c*) **73.** (*c*)

74. $\tan\alpha = \frac{\tan\theta}{2}$ **75.** (*c*) **76.** (*c*) **77.** (*c*) **78.** (*c*) **79.** $t = 3$ sec. **80.** (*a*) **81.** (*c*) **82.** (*a*)

83. (*a*) **84.** (*b*) **85.** (*b*) **86.** (*b*) **87.** (*a*) **88.** (*b*) **89.** (*a*) **90.** $|u| = (\sqrt{5})u$ **91.** $u = \sqrt{\frac{nb^2 g}{2a}}$

92. $\vec{V}_{RP} = -7\hat{i} + \hat{j}$ **93.** (*d*) **94.** (*c*) **95.** $\vec{u}_r = (20\sqrt{3} + 30)\hat{i} + 20\hat{j}$ **96.** 10 m/s **97.** (*b*) **98.** (*b*)

99. $\vec{U}_{AB} = 5\sqrt{3}\hat{j}$ **100.** $D_{min} = 50\sqrt{2}$ m **101.** $40\sqrt{2}$ m **102.** (i) –D, (ii) –A, (iii) –C, (iv) –B **103.** (*a*)

104. (*c*) **105.** (*c*) **106.** (*b*) **107.** (*b*) **108.** (*b*) **109.** (*a*) **110.** 120 m

111. 8.33 sec, Drift = $(8 + V_m \cos 37°)$ time **112.** (*d*) **113.** (*b*) **114.** (*a*) **115.** (*d*) **116.** (*d*)

117. 30°, $x = 5\sqrt{3}$ m **118.** $t = \frac{H}{V_B \sin\theta_B - V_A \sin\theta_A}$, $V_A \cos\theta_A = V_B \cos\theta_B$ **119.** (*c*) **120.** (*b*) **121.** (*c*) **122.** (*b*)

123. (*c*) **124.** $\theta = \tan^{-1}\left(\frac{1}{3}\right)$ from vertical **125.** $V_m = 30$ m/s, $V_{rm}/V_r = \frac{4}{5}$ **126.** (*b*) **127.** (*a*) **128.** (*a*)

129. (*b*) **130.** $\theta = 2\pi$ radian, linear displacement = 0 **131.** (0°)

132. $\theta_{Hr.\ hand} = 2\pi$ rad, $\theta_{Mn.\ hand} = 24\pi$ rad, $\theta_{Sec.\ hand} = 1440\pi$ rad **133.** (*b*) **134.** (*c*) **135.** 6 rad/s **136.** t = 3 sec, 4rad/sec

137. 2 rad/s **138.** (*a*) **139.** $\frac{4v^2}{3\sqrt{2}\pi R}$ **140.** $\frac{2\pi}{60}$ rad/s **141.** $v\sqrt{3}$ m/s **142.** (*b*) **143.** (*b*)

144. (*a*) **145.** (*c*) **146.** (*c*) **147.** (*c*) **148.** (*c*) **149.** (*b*) **150.** (*d*) **151.** (*a*) **152.** (*c*) **153.** (*c*)

154. (*c*) **155.** $\sqrt{\left(\frac{u^2}{r}\right)^2 + \alpha^2}$ **156.** (*b*) **157.** (*c*) **158.** (*c*) **159.** (*a*) **160.** (*d*)

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1. I. True, II. False **2.** (i) Positive, (ii) Negative, (iii) Negative, (iv) Positive **3.** I. False, II. True

4. *a* upwards, g downwards **5.** (*b*) **6.** (*d*) **7.** I. True, II. False **8.** (*d*)

9. I. False, II. True, III. False **10.** Both are False. **11.** I. False, II. True **12.** I. False, II. True

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Dual Nature of Radiation and Matter

(Practice Questions)

Frequency

1. If a photon has velocity c and frequency v, which of the following represents its wavelength?

(*a*) $\frac{hv}{c^2}$ (*b*) hv

(*c*) $\frac{hc}{v}$ (*d*) $\frac{c}{v}$

2. Find frequency of 1 MeV Photon?

3. The velocity of photons is proportional to (where υ = frequency)

(*a*) $\frac{1}{\sqrt{\upsilon}}$ (*b*) υ^2

(*c*) υ^0 (*d*) $\sqrt{\upsilon}$

Energy of Photon

4. Energy of a quanta of frequency 10^{15} Hz and $h = 6.6 \times 10^{-34}$ Js will be:

(*a*) 6.6×10^{-19} J (*b*) 6.6×10^{-12} J

(*c*) 6.6×10^{-49} J (*d*) 6.6×10^{-41} J

5. If radiation of energy E and number of photon n then find effective moving mass of photon.

(*a*) $\frac{E}{C}$ (*b*) $\frac{E}{C^2}$

(*c*) $\frac{E}{nC^2}$ (*d*) $\frac{nE}{C^2}$

6. A photon in motion has a mass:

(*a*) $\frac{c}{hv}$ (*b*) $\frac{h}{v}$

(*c*) hv (*d*) $\frac{hv}{c^2}$

Power of Light

7. If Green light and Red light having same power then which have large number of photon.

(*a*) $n_R = n_G$ (*b*) $(n_R > n_G)$

(*c*) $n_R < n_G$ (*d*) Can't say

8. If power of light 10 kW and wavelength 300 nm then find number of photon per sec?

9. Two sources of light emit with a power of 200 W. The ratio of number of photons of visible light emitted by each source having wavelengths 300 nm and 500 nm respectively, will be:

(*a*) 1 : 5 (*b*) 1 : 3

(*c*) 5 : 3 (*d*) 3 : 5

10. Monochromatic light of frequency 6×10^{14} Hz is produced by a laser. The power emitted is 2×10^{-3} W. How many photons per second on an average, are emitted by source?

(Given $h = 6.63 \times 10^{-34}$ Js)

(*a*) 9×10^{18} (*b*) 6×10^{15}

(*c*) 5×10^{15} (*d*) 7×10^{16}

11. The number of electrons flowing per second in the filament of a 110 W bulb operating at 220 V is: (Given $e = 1.6 \times 10^{-19}$ C)

(*a*) 31.25×10^{17} (*b*) 6.25×10^{18}

(*c*) 6.25×10^{17} (*d*) 1.25×10^{19}

12. If a source of electromagnetic radiation having power 15 kW reduces 10^{16} photons per second, the radiation belongs to a part of spectrum is:

(Take Planck constant $h = 6 \times 10^{-34}$ Js)

(*a*) Micro waves (*b*) Ultraviolet rays

(*c*) Gamma rays (*d*) Radio waves

Intensity of Light Beam

13. If intensity becomes double then number of photon will be?

(*a*) Same (*b*) Double

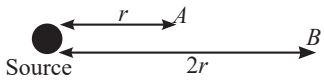
(*c*) Half (*d*) Four time

14. If frequency and intensity both becomes double then number of photon will be.

(*a*) Same (*b*) Double

(*c*) Half (*d*) Four time

15. Find: (*i*) $\left(\frac{f_A}{f_B}\right)_{\text{Photon}}$ (*ii*) $\left(\frac{I_A}{I_B}\right)_{\text{Light}}$



(*iii*) Ratio of number of Photon per unit Area

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16. Consider a parallel beam of light of wavelength 600 nm and intensity 100 W/m^2. How many photons cross 1 cm^2 area perpendicular to beam in one second?

(*a*) 3×10^{16} (*b*) 3×10^{14}
(*c*) 3×10^{9} (*d*) 3×10^{4}

17. Monochromatic light of wavelength 3000 Å is incident on a surface area 4 cm^2. If intensity of light is 150 W/m^2, find the rate at which photons strike the target.

Radiation Pressure

18. If intensity of light is *I* and 75% radiation is absorbed then find radiation pressure?

19. Radiation pressure in terms of absorption coefficient and Reflection coefficient?

20. A plate of Mass 10 g is in equilibrium in air due to light bean on plate then power of beam, if surface area of plates is A and complete reflecting.

Momentum

21. The momentum of the photon of wavelength 5000 Å will be:

(*a*) 1.3×10^{-27} kg-m/s (*b*) 1.3×10^{-28} kg-m/s
(*c*) 4×10^{-29} kg-m/s (*d*) 4×10^{-18} kg-m/s

22. If the total energy transferred to a surface in time *t* is 6.48×10^5 J, then the magnitude of the total momentum delivered to this surface for complete absorption will be:

(*a*) 2.46×10^{-3} kg-m/s (*b*) 2.16×10^{-3} kg-m/s
(*c*) 1.58×10^{-3} kg-m/s (*d*) 4.32×10^{-3} kg-m/s

23. Given below are two statements:

Statement-I: Two photons having equal linear momenta have equal wavelengths.

Statement-II: If the wavelength of photon is decreased, then the momentum and energy of a photon will also decease.

Statement-III: Photon having same wavelength have equal momentum

(*a*) TFF (*b*) FTF
(*c*) FFT (*d*) FFF

Photoelectric Effect

24. Which one among the following shows particle nature of light?

(*a*) Photoelectric effect
(*b*) Interference (Wave)
(*c*) Refraction (Wave)
(*d*) Polarization (Transverse wave)

25. In photo electric effect:

A. The photocurrent is proportional to the intensity of the incident radiation.
B. Maximum kinetic energy with which photoelectrons are emitted depends on the intensity of incident light.
C. Max. K.E with which photoelectrons are emitted depends on the frequency of incident light.
D. The emission of photoelectrons require a minimum threshold intensity of incident radiation.
E. Max. K.E of the photoelectrons is independent of the frequency of the incident light.

Choose the correct answer from the options given below:

(*a*) A and C only (*b*) A and E only
(*c*) B and C only (*d*) A and B only

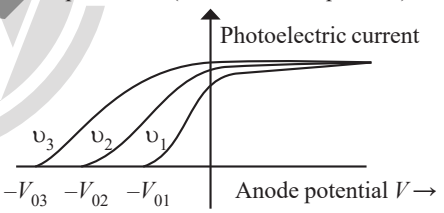
26. When light of wavelength 300 nm falls on a photoelectric emitter, photoelectrons are just liberated. For another emitter, light of wavelength 600 nm is just sufficient for liberating photoelectrons. The ratio of the work function of the two emitters is:

(*a*) 1 : 2 (*b*) 2 : 1
(*c*) 4 : 1 (*d*) 1 : 4

27. A 2 mW laser operates at a wavelength of 500 nm. The number of photons that will be emitted per second is:
(Given Planck's constant $h = 6.6 \times 10^{-34}$ Js)

(*a*) 2×10^{16} (*b*) 1.5×10^{16}
(*c*) 5×10^{15} (*d*) 1×10^{16}

28. In photoelectric effect, the curve between photoelectric current and anode potential *V* (for different frequencies) is shown in figure, then:



(*a*) $\upsilon_1 > \upsilon_2 > \upsilon_3$ (*b*) $\upsilon_1 < \upsilon_2 < \upsilon_3$
(*c*) $\upsilon_1 = \upsilon_2 = \upsilon_3$ (*d*) $\upsilon_1 > \upsilon_2 < \upsilon_3$

29. Light of frequency 1.5 times the threshold frequency is incident on photo-sensitive material. If the frequency is halved and intensity is doubled, the photo current becomes:

(*a*) Quadrupled (*b*) Doubled
(*c*) Halved (*d*) Zero

30. For a certain metal, *v* is five times the v_0 and the maximum velocity of coming out photo electrons is 8×10^6. If $v = 2v_0$ the maximum velocity of photo electrons will be:

(*a*) 4×10^6 m/s (*b*) 6×10^6 m/s
(*c*) 8×10^6 m/s (*d*) 1×10^6 m/s

31. From the photoelectric effect experiment, following observations are made. Identify which of these are correct.

A. The stopping potential depends only on the work function of the metal.
B. The saturation current increases as the intensity of incident light increases.
C. The maximum kinetic energy of a photo electron depends on the intensity of the incident light.
D. Photoelectric effect can be explained using wave theory of light.

Choose the correct answer from the options given below:

(*a*) 2, 3 only (*b*) 1, 3, 4 only
(*c*) 2 only (*d*) 1, 2, 4 only

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32. A metallic surface is illuminated with radiation of wavelength λ, the stopping potential is V_0. If the same surface is illuminated with radiation of wavelength 2λ, the stopping potential becomes $V_0/4$. The threshold wavelength for this metallic surface will be:

(*a*) $\frac{\lambda}{4}$ (*b*) 4λ

(*c*) $\frac{3}{2\lambda}$ (*d*) 3λ

33. When photon of energy 3.8 eV falls on metallic surface of work function 2.8 eV, then the kinetic energy of emitted electrons are:

(*a*) 1 eV (*b*) 6.6 eV

(*c*) 0 to 1 eV (*d*) 2.8 eV

34. A monochromatic point source of light is placed at a distance *d* from a metal surface. Photo electrons are ejected at a rate *n* per second, and with maximum kinetic energy *E*. If the source is brought nearer to distance *d*/2, the rate and the maximum kinetic energy per photoelectron become nearly.

(*a*) 2*n* and 2*E* (*b*) 4*n* and 4*E*

(*c*) 4*n* and *E* (*d*) *n* and 4*E*

35. The photoelectric work function:

(*a*) Is different for different materials.

(*b*) Is same for all metals.

(*c*) Depends upon frequency of the incident light

(*d*) Depends upon intensity of the incident light

36. Two identical photocathodes receive the light of frequencies f_1 and f_2 respectively. If the velocities of the photo-electrons coming out are v_1 and v_2 respectively, then:

(*a*) $v_1^2 - v_2^2 = \frac{2h}{m}[f_1 - f_2]$ (*b*) $v_1^2 + v_2^2 = \frac{2h}{m}[f_1 + f_2]$

(*c*) $v_1 + v_2 = \left[\frac{2h}{m}(f_1 + f_2)\right]^{\frac{1}{2}}$ (*d*) $v_1 - v_2 = \left[\frac{2h}{m}(f_1 - f_2)\right]^{\frac{1}{2}}$

37. If the frequency of light incident on a metallic plate the doubled, how will the maximum kinetic energy of the photoelectrons change?

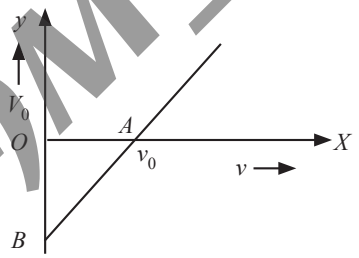
(*a*) It becomes more than double

(*b*) It becomes less than double

(*c*) It becomes exactly double

(*d*) It does not change

38. In an experiment on photoelectric effect the frequency *f* of the incident light is plotted against the stopping potential V_0. The work function of the photoelectric surface is given by (*e* is electronic charge).



(*a*) *OB* × *e* in *eV* (*b*) *OB* in volt

(*c*) *OA* in *eV* (*d*) The slope of the line *AB*

39. Two streams of photons, possessing energies equal to five and ten times the work function of metal are incident on the metal surface successively. The ratio of maximum velocities of the photoelectron emitted, in the two cases respectively, will be:

(*a*) 1 : 2 (*b*) 1 : 3

(*c*) 2 : 3 (*d*) 3 : 2

40. In photoelectric effect, the slope of stopping potential versus frequency of incident light for a given surface will be:

(*a*) $h\,e^{-1}$ (*b*) *e h*

(*c*) *e* (*d*) *h*

41. Wave nature of light cannot explain photoelectric effect because in photoelectric effect, it is seen that:

(*a*) For the frequency of light below a certain value, the photoelectric effect does not take place, irrespective of intensity.

(*b*) Maximum kinetic energy of ejected electrons is independent of intensity of radiation.

(*c*) There is no time lag between the incidence of radiation and emission of electrons.

(*d*) All of these

42. The work function of a substance is 4eV. The longest wavelength of light that can cause the emission of photoelectrons from this substance is approximately.

(*a*) 540 nm (*b*) 400 nm

(*c*) 310 nm (*d*) 220 nm

43. Two radiations of photons energies 1 eV and 2.5 eV, successively illuminate a photosensitive metallic surface of work function 0.5 eV. The ratio of the maximum speeds of the emitted electrons is:

(*a*) 1 : 4 (*b*) 1 : 2

(*c*) 1 : 1 (*d*) 1 : 5

44. The work functions of Aluminium and Gold are 4.1 eV and 5.1 eV respectively. The ratio of the slope of the stopping potential versus frequency plot for Gold to that of Aluminium is:

(*a*) 1.24 (*b*) 2

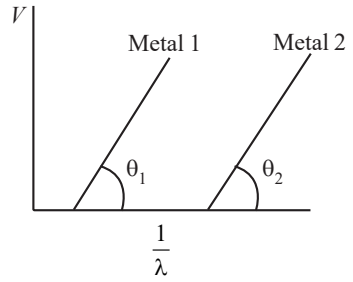
(*c*) 1 (*d*) 1.5

45. A source S_1 is producing 10^{15} photons per second of wavelength 5000 Å. Another source S_2 is producing 1.02×10^{15} photons per second of wavelength 5100 Å. Then (power of S_2)/(power of S_1) is equal to:

(*a*) 0.98 (*b*) 1.00

(*c*) 1.02 (*d*) 1.04

46. V (stopping potential) is plotted against 1/λ, where λ is wavelength of incident radiations, for two metals:



(*a*) Metal 1 may be gold and metal 2 may be cesium

(*b*) $\theta_1 > \theta_2$, if metal-1 is gold and metal-2 is cesium

(*c*) $\theta_1 = \theta_2$, for any two metals

(*d*) $\theta_1 > \theta_2$, if metal-1 and metal-2 are gold and copper respectively.

47. The cathode of photocell is changed such that the work function changes from w_1 ($w_2 > w_1$). If the saturation currents before and after the change are I_1 and I_2 and all other conditions are unchanged, then (assuming $h\nu > w_2$).

(*a*) $I_1 = I_2$ (*b*) $I_1 < I_2$

(*c*) $I_1 > I_2$ (*d*) $I_1 < I_2 > 2I_2$

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48. The difference between threshold wavelength for two metal surfaces A and B having work function $\phi_A = 9$ eV and $\phi_B = 4.5$ eV in nm is:

(*a*) 264 (*b*) 138

(*c*) 276 (*d*) 540

49. If the two metals *A* and *B* are exposed to radiation of wavelength 350 nm. The work functions of metals *A* and *B* are 4.8 eV and 2.2 eV. Then choose the correct option.

(*a*) Metal *B* will not emit photo-electrons.

(*b*) Both metals *A* and *B* will emit photo-electrons.

(*c*) Both metals *A* and *B* will not emit photoelectrons.

(*d*) Metal *A* will not emit photo-electrons.

50. The threshold frequency of metals is f_0. When the light of frequency $2f_0$ is incident on the metal plate, the maximum velocity of photoelectron is v_1. When the frequency of incident radiation is increased to $5f_0$. The maximum velocity of photoelectrons emitted is v_2. The rato of v_1 to v_2 is:

(*a*) $\frac{v_1}{v_2} = \frac{1}{2}$ (*b*) $\frac{v_1}{v_2} = \frac{1}{8}$

(*c*) $\frac{v_1}{v_2} = \frac{1}{16}$ (*d*) $\frac{v_1}{v_2} = \frac{1}{4}$

51. Given below are two statements:

Assertion (A): The photoelectric effect does not takes place, if the energy of the incident radiation is less than the work function of metal.

Reason (R): Kinetic energy of the photoelectrons is zero, if the energy of the incident radiation is equal to the work function of a metal.

In the light of the above statements, choose the most appropriate answer from the options given below:

(*a*) Both (A) and (R) are correct and (R) is the correct explanation of (A).

(*b*) Both (A) and (R) are correct but (R) is the correct explanation of (A).

(*c*) (A) is correct but (R) is not correct.

(*d*) (A) is not correct but (R) is correct.

52. The kinetic energy of emitted electron is *E* when the light incident on the metal has wavelength λ To double the kinetic energy, the incident light must have wavelength:

(*a*) $\frac{hc}{E\lambda - hc}$ (*b*) $\frac{hc\lambda}{E\lambda + hc}$

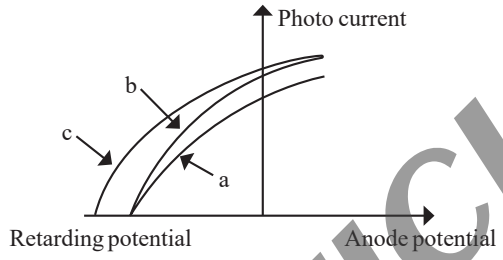
(*c*) $\frac{h\lambda}{E\lambda + hc}$ (*d*) $\frac{hc\lambda}{E\lambda - hc}$

53. The light of two different frequencies whose photons have energies 3.8 eV and 1.4 eV respectively, illuminate a metallic surface whose work function is 0.6 eV successively. The ratio of maximum speed of emitted electrons for the two frequencies respectively will be:

(*a*) 1 : 1 (*b*) 2 : 1

(*c*) 4 : 1 (*d*) 1 : 4

54. The figure shows a plot of photo current versus anode potential for a photosensitive surface for three different radiations. Which one of the following is a correct statement?



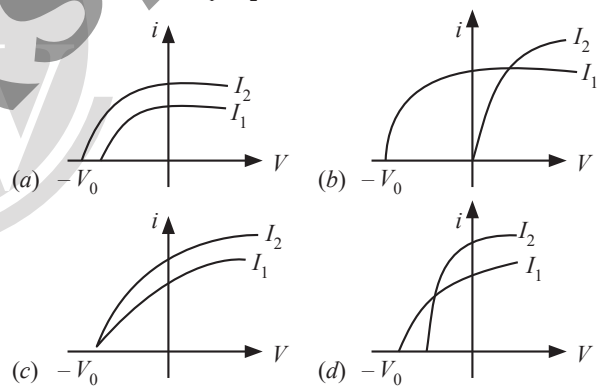
(*a*) Curves (*b*) and (*c*) represent incident radiations of same frequency having same intensity.

(*b*) Curves (*a*) and (*b*) represent incident radiations of different frequencies and different intensities.

(*c*) Curves (*a*) and (*b*) represent incident radiations of same frequency but of different intensities.

(*d*) Curves (*b*) and (*c*) represent incident radiations of different frequencies and different intensities.

55. Which figure shows the correct variation of applied potential difference (*V*) with photoelectric current (I) at two different intensities of light ($I_1 < I_2$) of same wavelengths:



56. Given below are two statements: One is labelled as Assertion (A) and the other is labelled as Reason (R).

Assertion (A): Number of photons increases with increase in frequency of light.

Reason (R): Maximum kinetic energy of emitted electrons increases with the frequency of incident radiation.

In the light of the above statements, choose the most appropriate answer from the options given below:

(*a*) Both (A) and (R) are correct and (R) is not correct explanation of (A).

(*b*) (A) is correct but (R) is not correct.

(*c*) Both (A) and (R) are correct and (R) is the correct explanation of (A).

(*d*) (A) is not correct but (R) is correct.

57. As the intensity of incident light increases:

(*a*) kinetic energy of emitted photoelectrons increases.

(*b*) photoelectric current decreases.

(*c*) photoelectric current increases.

(*d*) kinetic energy of emitted photoelectrons decreases.

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58. Which of the following statement is correct?

(*a*) The photocurrent increases with intensity of light.

(*b*) The stopping potential increases with increase of intensity light.

(*c*) The current in photocell increases with increasing frequency.

(*d*) The photocurrent is proportional to the applied voltage.

59. A photocell employs photoelectric effect to convert:

(*a*) change in the frequency of light into a change in the electric current.

(*b*) change in the frequency of light into a change in electric voltage.

(*c*) change in the intensity of illumination into a change in photoelectric current.

(*d*) change in the intensity of illumination into a change in the work function of the photocathode.

60. In a photoelectric experiment, increasing the intensity of incident light:

(*a*) Increases the number of photons incident and also increases the K.E of the ejected electrons.

(*b*) Increases the number of photons incident and the K.E. of the ejected electrons remains unchanged.

(*c*) Increases the frequency of photons incident and increases the K.E of the ejected electrons.

(*d*) Increases the frequency of photons incident and the K.E. of the ejected electrons remains unchanged.

61. When a metallic surface is illuminated with radiation of wavelength λ, the stopping potential is V. If the same surface is illuminated with radiation of wavelength 2λ, the stopping potential is $V/4$. The threshold wavelength for the metallic surface is:

(*a*) $5/2\ \lambda$ (*b*) $3\ \lambda$

(*c*) $4\ \lambda$ (*d*) $5\ \lambda$

62. A photoelectric surface is illuminated successively by monochromatic light of wavelength λ and $\lambda/2$. If the maximum kinetic energy of the emitted photoelectrons in the second case is 3 times that in the first case, the work function of the surface of the material is (h = Planck's constant, c = speed of light).

(*a*) $2hc/\lambda$ (*b*) $hc/3\lambda$

(*c*) $hc/2\lambda$ (*d*) hc/λ

63. A 200 W sodium street lamp emits yellow light of wavelength 0.6 mm. Assuming it to be 25% efficient in converting electrical energy to light, the number of photons of yellow light it emits per second is:

(*a*) 1.5×10^{23} (*b*) 6×10^{18}

(*c*) 62×10^{20} (*d*) 3×10^{19}

64. Given below are two statements: One is labelled as Assertion (A) and the other is labelled as Reason (R).

Assertion (A): Two photons each of energy 3 eV, can't eject electrons from a surface of work function 5 eV.

Reason (R): Only a photon of energy greater than work function may emit photoelectron.

In the light of the above statements, choose the most appropriate answer from the options given below:

(*a*) Both (A) and (R) are true and (R) is the correct explanation of (A).

(*b*) Both (A) and (R) are true and (R) is Not the correct explanation of (A).

(*c*) (A) is true but (R) is false.

(*d*) (A) is false but (R) is true.

65. On a photosensitive surface of threshold wavelength 6λ, two different monochromatic beams of wavelengths 4λ and 2λ are incident, one after another, then match the ratio of physical quantities specified in column-I to the ratio values given in column-II.

Column-I		Column-II	
(*i*)	Maximum KE of photo electrons	A.	1 : 2
(*ii*)	Speed of incident photons	B.	1 : 4
(*iii*)	Momentum of incident photons	C.	1 : 2
(*iv*)	Fastest speeds of photo electrons	D.	1 : 1

Choose the correct answer from the option given below:

(*a*) i - C, ii - B, iii - A, iv - D

(*b*) i - B, ii - D, iii - C, iv - A

(*c*) i - B, ii - D, iii - A, iv - C

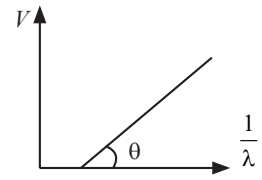
(*d*) i - A, ii - B, iii - D, iv - C

66. In a photoelectric experiment, the wavelength of the light incident on a metal is changed from 300 nm to 400 nm. The decrease in the stopping potential is close to $\left(\frac{hc}{e} = 1240\ nm - V\right)$

(*a*) $0.5V$ (*b*) $1.5V$

(*c*) $1.0V$ (*d*) $2.0V$

67. In photoelectric effect experiment, the graph of stopping potential V versus reciprocal of wavelength obtained is shown in the figure. As the intensity of incident radiation is increased:



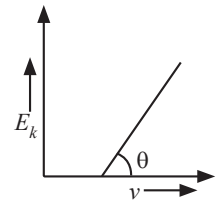
(*a*) Slope of the straight line get more steep

(*b*) Straight line shifts to left

(*c*) Straight line shifts to right

(*d*) Graph does not change

68. For the photoelectric effect, the maximum kinetic energy (E_k) of the photoelectrons is plotted against the frequency (v) of the incident photons as shown in figure. The slope of the graph gives:



(*a*) Ratio of Planck's constant to electric charge.

(*b*) Work function of the metal

(*c*) Charge of electron

(*d*) Planck's constant

69. Which of the following statement is not true about stopping potential (V_0)?

(*a*) It depends on the nature of emitter material.

(*b*) It depends upon frequency of the incident light.

(*c*) It increases with increase in intensity of the incident light.

(*d*) It is $1/e$ times the maximum kinetic energy of electrons emitted.

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70. In photoelectric experiment energy of 2.48 eV irradiates a photo sensitive material. The stopping potential was measured to be 0.5 V. Work function of the photo sensitive material is:

(*a*) 0.5 eV (*b*) 1.68 eV
(*c*) 2.48 eV (*d*) 1.98 eV

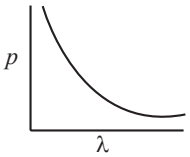
71. The work function of a substance is 3.0 eV. The longest wavelength of light that can cause the emission of photoelectrons from this substance is approximately:

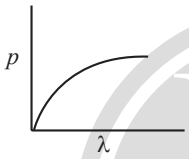
(*a*) 215 nm (*b*) 414 nm
(*c*) 400 nm (*d*) 200 nm

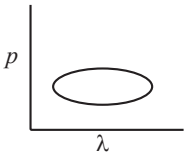
De - Broglie Wavelength

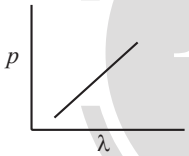
72. Find the ratio of velocities of proton and α-particle if the de-Broglie wavelengths of both the particles is same.

73. Variation of momentum of particle (p) with associated de-Broglie wavelength (λ) is shown correctly by:

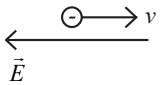
(*a*) 

(*b*) 

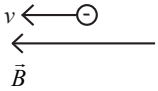
(*c*) 

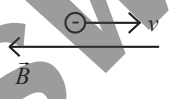
(*d*) 

74. Figure shows four situations in which an electron is moving in electric / magnetic field. In which case the de-Broglie wavelength of electron is increasing?

(*a*) 

(*b*)

(*c*) 

(*d*) 

75. The de-Broglie wavelength of a particle accelerated with 150 volt potential is 10^{-10} m. Find the wavelength of the particle if it is accelerated by 600 volt potential difference.

76. The de-Broglie wavelength of a neutron at 27°C is λ. What will be it wavelength at 927°C?

(*a*) λ/2 (*b*) λ/3
(*c*) λ/4 (*d*) λ/9

77. An electron of mass m, when accelerated through a potential difference V, has de-Broglie wavelength λ. The de-Broglie wavelength associated with a proton of mass M accelerated through the same potential difference, will be.

(*a*) $\lambda\frac{M}{m}$ (*b*) $\lambda\frac{m}{M}$

(*c*) $\lambda\sqrt{\frac{M}{m}}$ (*d*) $\lambda\sqrt{\frac{m}{M}}$

78. Proton and α-particle are accelerated through the same potential. The ratio of wavelengths is:

(*a*) 2 (*b*) $\sqrt{2}$
(*c*) 4 (*d*) $2\sqrt{2}$

79. If the velocity of an electron is doubled, its de-Broglie frequency will:

(*a*) Be halved (*b*) Remain same
(*c*) Be doubled (*d*) Become four times

80. A photon and a proton have equal energy E. Ratio of wavelengths $\frac{\lambda_{photon}}{\lambda_{proton}}$ is proportional to:

(*a*) E (*b*) $\sqrt{E}$

(*c*) $\frac{1}{\sqrt{E}}$ (*d*) E^0

81. An α-particle moves in a circular path of radius 0.83 cm in the presence of a magnetic field of 0.25 Wb/m^2. The de-Broglie wavelength associated with the particle will be:

(*a*) 10 Å (*b*) 0.01 Å
(*c*) 1 Å (*d*) 0.1 Å

82. De-Broglie wavelength associated with an electron revolving in the nth state of hydrogen atom is directly proportional to:

(*a*) n (*b*) $1/n$
(*c*) n^2 (*d*) $1/n^2$

83. A proton is accelerated through 225 V. Its de-Broglie wavelength is:

(*a*) 0.1 nm (*b*) 0.2 nm
(*c*) 0.3 nm (*d*) 0.4 nm

84. An electron of mass m and a photon have same energy E. The ratio of de-Broglie wavelengths associated with them is:

(*a*) $c(2mE)^{\frac{1}{2}}$ (*b*) $\frac{1}{c}\left(\frac{2m}{E}\right)^{\frac{1}{2}}$

(*c*) $\frac{1}{c}\left(\frac{E}{2m}\right)^{\frac{1}{2}}$ (*d*) $\left(\frac{E}{2m}\right)^{\frac{1}{2}}$

85. The wavelength λ_e of an electron and λ_p of a photon of same energy E are related by:

(*a*) $\lambda_p \propto \sqrt{\lambda_e}$ (*b*) $\lambda_p \propto \frac{1}{\sqrt{\lambda_e}}$

(*c*) $\lambda_p \propto \lambda_e^2$ (*d*) $\lambda_p \propto \lambda_e$

86. Of the following having the same kinetic energy, the one which has the largest wavelength is:

(*a*) An alpha particle (*b*) A neutron
(*c*) A proton (*d*) An electron

87. The de-Broglie wavelength λ associated with a proton increases by 25%, if its momentum is decreased by p_0. The initial momentum was:

(*a*) $4p_0$ (*b*) $\frac{p_0}{4}$

(*c*) $5p_0$ (*d*) $\frac{p_0}{5}$

88. The de-Broglie wavelength of an electron in the 3rd Bohr orbit is related to the radius R of the orbit as:

(*a*) $3\lambda = \pi R$ (*b*) $\lambda = \frac{3}{2}\pi R$

(*c*) $3\lambda = 2\pi R$ (*d*) $3\lambda = 4\pi R$

89. When the momentum of a proton is changed by an amount p_0 the corresponding change in the de-Broglie wavelength is found to be 0.25%. Find the original momentum of the photon.

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90. An electron (mass m) with an initial velocity $\vec{v} = v_0\hat{i}$ $(v_0 > 0)$ is moving in an electronic field $\vec{E} = -E_0\hat{i}$ $(E_0 > 0)$ where E_0 is constant. if at $t = 0$ de-Broglie wavelength is $\lambda_0 = \frac{h}{mv_0}$, then its de-Broglie wavelength after time t is given by:

(*a*) λ_0 (*b*) $\lambda_0\left(1+\frac{eE_0t}{mv_0}\right)$

(*c*) $\lambda_0 t$ (*d*) $\frac{\lambda_0}{\left(1+\frac{eE_0t}{mv_0}\right)}$

91. An electron of mass m and magnitude of charge $|e|$ initially at rest gets accelerated by a constant electric field E. The rate of change of de-Broglie wavelength of this electron at time t ignoring relativistic effects is:

(*a*) $-\frac{h}{|e|Et}$ (*b*) $-\frac{h}{|e|E\sqrt{t}}$

(*c*) $\frac{-h}{|e|Et^2}$ (*d*) $\frac{|e|Et}{h}$

92. An electron is moving initially with velocity $v_0\hat{i} + v_0\hat{j}$ in uniform electric field $\vec{E} = -E_0\hat{k}$. If initial wavelength of electron is λ_0 and mass of electron is m. Find wavelength of electron as a funcion of:

(*a*) $\frac{\lambda_0}{\sqrt{1+\frac{e^2E_0^2}{2m^2v_0^2}t^2}}$ (*b*) $\frac{\lambda_0}{\sqrt{2+\frac{e^2E_0^2}{m^2v_0^2}t^2}}$

(*c*) $\frac{\lambda_0 mv_0}{eE_0t}$ (*d*) $\frac{2\lambda_0 mv_0}{eE_0t}$

93. A particle of mass M is at rest, and exploid into two mass of ratio 2:3 then find ratio of de-Broglie wavelength of the two mass:

(*a*) 2 : 3 (*b*) 3 : 2

(*c*) 1 : 1 (*d*) 4 : 9

94. Proton, deutron, α-particle are moving with same momentum (m, e), ($2m$, e), ($4m$, $2e$) then find ratio of their de-Broglie wavelength?

95. Proton, deutron, α-particle are moving with same speed (m, e), ($2m$, e), ($4m$, $2e$) then find ratio of their de-Broglie wavelength?

96. Proton, deutron, α-particle are moving with same speed *K.E.* (m, e), ($2m$, e), ($4m$, $2e$) then find ratio of their de-Broglie wavelength?

97. Proton, deutron, α-particle are accelerated with same potential difference then find ratio of de-Broglie?

98. De-Broglie wavelength of a body of mass 1 kg moving with velocity of 2000 m/s is:

(*a*) 3.32×10^{-27} Å (*b*) 1.5×10^{7} Å

(*c*) 0.55×10^{-22} Å (*d*) 2×10^{20} Å

99. The de-Broglie wavelength of an electron and the wavelength of a photon are the same. The ratio between the energy of that photon and the momentum of that electron is:

(*a*) h (*b*) c

(*c*) $\frac{1}{h}$ (*d*) $\frac{1}{c}$

100. Which one of the following statements is not true about de-Broglie waves?

(*a*) All atomic particles in motion have wave character associated with them.

(*b*) The higher the momentum, the longer is the wave-length.

(*c*) The faster the particle, the shorter is the wavelength.

(*d*) For the same velocity, a heavier particle has a shorter wavelength.

101. A nucleus A, with a finite de-Broglie wavelength λ_A, undergoes spontaneous fission into two nuclie B and C of equal mass. B flies in the same direction as that of A, while C flies in the opposite direction with a velocity equal to half of that of B. The de-Broglie wavelengths λ_B and λ_C of B and C are respectively:

(*a*) $2\lambda_A, \lambda_A$ (*b*) $\lambda_A, 2\lambda_A$

(*c*) $\lambda_A, \frac{\lambda_A}{2}$ (*d*) $\frac{\lambda_A}{2}, \lambda_A$

102. Two particles move at right angle to each other. Their de-Broglie wavelengths are λ_1 and λ_2 respectively. The particles suffer perfectly inelastic collision. The de-Broglie wavelength λ, of the final particle, is given by:

(*a*) $\lambda = \frac{\lambda_1+\lambda_2}{2}$ (*b*) $\frac{2}{\lambda} = \frac{1}{\lambda_1} + \frac{1}{\lambda_2}$

(*c*) $\lambda = \sqrt{\lambda_1\lambda_2}$ (*d*) $\frac{1}{\lambda^2} = \frac{1}{\lambda_1^2} + \frac{1}{\lambda_2^2}$

103. An electron moving with speed v and a photon moving with speed c, have same d-Broglie wavelength. The ratio of kinetic energy of electron to that of photon is:

(*a*) $\frac{v}{2c}$ (*b*) $\frac{2c}{v}$

(*c*) $\frac{v}{3c}$ (*d*) $\frac{3c}{v}$

104. An electron with speed v and *a* photon with speed c have the same de-Broglie wavelength. If the kinetic energy and momentum of electron are E_e and p_e and that of photon are E_{ph} and p_{ph} respectively.

Which of the following is correct?

(*a*) $\frac{E_e}{E_{ph}} = \frac{2c}{v}$ (*b*) $\frac{E_e}{E_{ph}} = \frac{v}{2c}$

(*c*) $\frac{p_e}{p_{ph}} = \frac{2c}{v}$ (*d*) $\frac{p_e}{p_{ph}} = \frac{v}{2c}$

105. The kinetic energy of an electron, α-particle and a proton are given as $4K$, $2K$ and K respectively. The de-Broglie wavelength associated with electron (λ_e) α-particle (λ_α) and the proton (λ_p) are as follows:

(*a*) $\lambda_\alpha = \lambda_p < \lambda_e$ (*b*) $\lambda_\alpha > \lambda_p < \lambda_e$

(*c*) $\lambda_\alpha < \lambda_p < \lambda_e$ (*d*) $\lambda_\alpha = \lambda_p < \lambda_e$

106. Electron beam used in an electron microscope, accelerated by a voltage of 20kV has a de-Broglie wavelength of λ_0. If the voltage is increased to 40kV then the de-Broglie wavelength associated with the electron beam would be:

(*a*) $3\lambda_0$ (*b*) $9\lambda_0$

(*c*) $\frac{\lambda_0}{2}$ (*d*) $\frac{\lambda_0}{\sqrt{2}}$

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107. The de-Broglie wavelength of an electron is the same as that of a photon. If velocity of electron is 25% of the velocity of light, then the ratio of K.E. of electron and K.E. of photon will be:

(*a*) $\frac{1}{1}$ (*b*) $\frac{1}{8}$

(*c*) $\frac{8}{1}$ (*d*) $\frac{1}{4}$

108. The de-Broglie wavelengths of a proton and an α-particle are λ and 2λ respectively. The ratio of the velocities of proton and α-particle will be:

(*a*) 1 : 8 (*b*) 1 : 2

(*c*) 4 : 1 (*d*) 8 : 1

109. Let K_1 and K_2 be the maximum kinetic energies of photo-electrons emitted when two monochromatic beams of wavelength λ_1 and λ_2, respectively are incident on a metallic surface. If $\lambda_1 = 3\lambda_2$ then:

(*a*) $K_1 > \frac{K_2}{3}$ (*b*) $K_1 < \frac{K_2}{3}$

(*c*) $K_1 = \frac{K_2}{3}$ (*d*) $K_2 = \frac{K_1}{3}$

MR* CORNER

1. **Statement I:** Two photons having equal frequencies, will have equal linear momenta.

   Statement II: Two photons having equal wavelengths, will have equal linear momenta.

2. Let P and E denote the linear momentum and energy of a photon. If the wavelength is decreased, P will____ whereas E will____

3. **Statement I:** The number of photons emitted by a red bulb and a blue bulb of equal power in a given time will be equal.

   Statement II: The equation E = pc is valid for a photon but not for an electron.

4. **Statement I:** When stopping potential is applied in an experiment on photoelectric effect, no photocurrent is observed. This means that the emission of photoelectrons is stopped.

   Statement II: Light of wavelength λ falls on metal having work function hc/λ_o. Photoelectric effect will take place only $\lambda \geq \lambda_o$

5. **Statement I:** The frequency and intensity of light source are both doubled. Then saturation photocurrent remains almost the same.

   Statement II: For above given case, the stopping potential will Become more than double.

6. **Statement I:** A non-monochromatic light is used in an experiment on photoelectric effect. The stopping potential will be related to the longest wavelength.

   Statement II: The De-Broglie wavelength of electron will be greater as compared to that of a proton if they are accelerated by the Same potential difference.

7. **Statement I:** When the intensity of a light source is increased, the Total Energy of the photons emitted per unit time increases.

   Statement II: Photoelectric effect supports quantum nature of light because electric charge of the photoelectrons is quantized.

8. **Statement I:** A photon of energy hν is absorbed by a free electron of a metal having work function $\phi < h\nu$, then the electron is sure to come out.

   Statement II: For above given case, the electron is sure to come out with a kinetic energy of $h\nu - \phi$.

9. **Statement I:** If the wavelength of light in an experiment on photoelectric effect is doubled, the stopping potential will decrease.

   Statement II: The photocurrent in an experiment on photoelectric effect increases if the exposure time is increased.

10. **Statement I:** The collector plate in experiment on photoelectric effect is kept vertically above the emitter plate. If electric field is switch on which has a vertically downward direction, then the kinetic energy of electrons will increase.

    Statement II: In case of two particles fallen through same height, the heavier of two particles will possess smaller de Broglie wavelength.

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Answer Key

1. (*d*) **2.** 2.4×10^{20}Hz **3.** (*c*) **4.** (*a*) **5.** (*c*) **6.** (*d*) **7.** (*b*) **8.** 15×10^{21} **9.** (d)

10. (*c*) **11.** (*a*) **12.** (*a*) **13.** (*b*) **14.** (*a*) **15.** (i) 1 : 1 , (ii) 4 : 1, (iii) 4 : 1 **16.** (a)

17. 9×10^{13} sec^{-1} ^{2} **18.** $\frac{5I}{4c}$ **19.** $P = \frac{I}{C}(\text{Absorption}),\ P = \frac{2I}{C}(\text{Reflection})$ **20.** 15 MW **21.** (*a*) **22.** (b)

23. (*a*) **24.** (*a*) **25.** (*a*) **26.** (*b*) **27.** (*c*) **28.** (*b*) **29.** (*d*) **30.** (*a*) **31.** (*c*) **32.** (d)

33. (*c*) **34.** (*c*) **35.** (*a*) **36.** (*a*) **37.** (*a*) **38.** (*a*) **39.** (*c*) **40.** (*a*) **41.** (*d*) **42.** (c)

43. (*b*) **44.** (*c*) **45.** (*b*) **46.** (*c*) **47.** (*a*) **48.** (*b*) **49.** (*d*) **50.** (*a*) **51.** (*b*) **52.** (b)

53. (*b*) **54.** (*c*) **55.** (*c*) **56.** (*d*) **57.** (*c*) **58.** (*a*) **59.** (*c*) **60.** (*b*) **61.** (*b*) **62.** (c)

63. (*a*) **64.** (*a*) **65.** (*c*) **66.** (*c*) **67.** (*d*) **68.** (*a*) **69.** (*c*) **70.** (*d*) **71.** (*b*) **72.** 4 : 1

73. (*a*) **74.** (*b*) **75.** **0.**5×10^{-10} m **76.** (*a*) **77.** (*d*) **78.** (*d*) **79.** (*c*) **80.** (*c*) **81.** (b)

82. (*a*) **83.** (*d*) **84.** (*c*) **85.** (*c*) **86.** (*d*) **87.** (*c*) **88.** (*c*) **89.** $400p_0$ **90.** (*d*) **91.** (c)

92. (*a*) **93.** (*c*) **94.** (1 : 1 : 1) **95.** (4 : 2 : 1) **96.** $2 : \sqrt{2} : 1$ **97.** $2\sqrt{2} : 2 : 1$ **98.** (a)

99. (*b*) **100.** (*b*) **101.** (*d*) **102.** (*d*) **103.** (*a*) **104.** (*b*) **105.** (*c*) **106.** (*d*) **107.** (*b*) **108.** (*d*)

109. (*b*)

MR* CORNER

1. Both False **2.** Increase, Increase. **3.** I. False, II. True **4.** I. Both False **5.** Both are True.
6. I. False, II. True **7.** I. True, II. False **8.** Both False **9.** I. True, II. False **10.** Both True

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MR PHYSICS for questions practice

30 Electromagnetic Induction (Practice Questions)

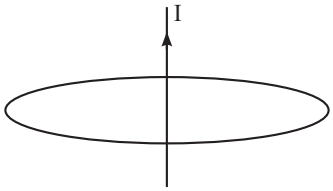
Magnetic Flux

1. Magnetic field B making an angle 30º form surface of surface area A then find magnetic flux.

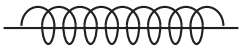
2. A uniform magnetic field exists in the space $\vec{B} = B_1\hat{i} + B_2\hat{j} - B_3\hat{k}$. find the magnetic flux through an area $\vec{S}$ in

(*i*) $x - y$ plane, (*ii*) $y - z$ plane, (*iii*) $z - x$ plane

3. A loop is placed perpendicular to the current carrying wire then find flux passing through loop as shown in figure.



4. A rectangular loop placed parallel to axis of solenoid then flux through loop.



5. A coil is placed in magnetic field such that plane of coil is perpendicular to the direction of magnetic field. The magnetic flux through a coil can be changed:

A. By changing the magnitude of the magnetic field within the coil.

B. By changing the area of coil within the magnetic field.

C. By changing the angle between the direction of magnetic field and the plane of the coil.

D. By reversing the magnetic field direction abruptly without changing its magnitude.

Choose the most appropriate answer from the options given below:

(*a*) A and B only (*b*) A, B and C only

(*c*) A, B and D only (*d*) A and C only

Lenz Law

6. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).

Assertion (A): The direction of induced current is always such as to oppose the change that causes it.

Reason (R): The direction of induced current is given by Lenz's law.

In the light of the above statements, choose the most appropriate answer from the options given below:

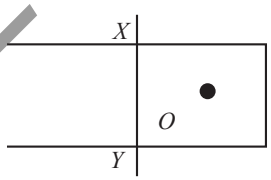
(*a*) Both (A) and (R) are true and (R) is the correct explanation of (A).

(*b*) Both (A) and (R) are true and (R) is NOT the correct explanation of (A).

(*c*) (A) is true but (R) is false.

(*d*) (A) is false but (R) is true.

7. When a conducting wire XY is moved towards the right, a current flows in the anti-clockwise direction. Direction of magnetic field at point O is



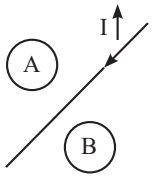
(*a*) Parallel to motion of wire

(*b*) Along XY

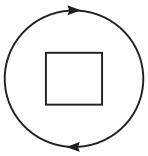
(*c*) Perpendicular outside the paper

(*d*) Perpendicular inside the paper

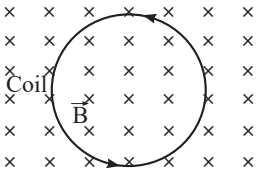
8. Find direction of induced current in loop A & B.



9. An increasing current flowing in circular loop counter clock wise as shown in figure, find direction of induced current in square loop.



10. A coil is placed in magnetic field as shown below:



A current is induced in coil because $\vec{B}$ is :

(*a*) Outward and decreasing with time.

(*b*) Parallel to plane of coil and decreasing with time.

(*c*) Outward and increasing with time.

(*d*) Parallel to plane of coil and increasing with time.

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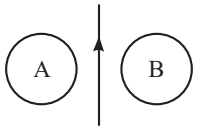
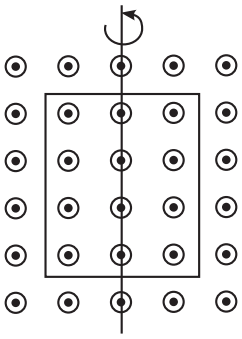
11. A and B are two metallic rings placed at opposite sides of an infinitely long straight conducting wire, as shown. If current in the wire is slowly decreased, the directions of induced current will be



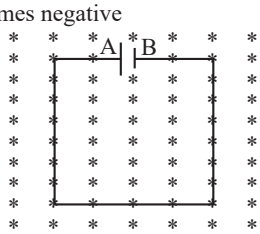
(*a*) clockwise in A and anticlockwise in B
(*b*) anticlockwise in A and clockwise in B
(*c*) clockwise in both A and B
(*d*) anticlockwise in both A and B

12. Direction of induced current when angle between area & magnetic field changing



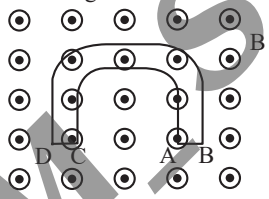
(*i*) $\theta = 0$ to $\theta = 90^o$, (*ii*) $\theta = 90^o$ to $\theta = 180^o$

13. Magnetic field is Increasing with time then which plate of Capacitor becomes negative

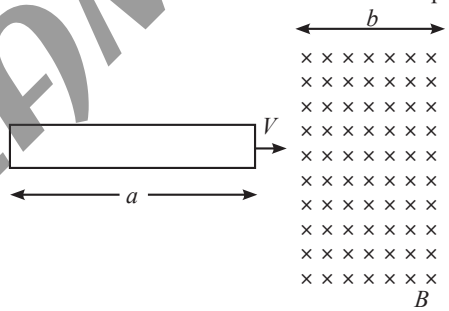


(*a*) A (*b*) B
(*c*) None of these (*c*) Can't say

14. Magnetic field increasing then direction of current in AB and CD .



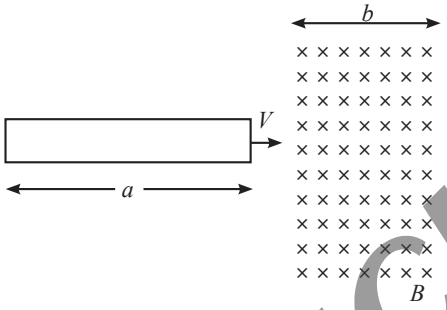
15. Find time for which current will Induced in the loop. ($a > b$)



(*a*) $t = \frac{b}{\mathbf{v}}$ (*b*) $t = \frac{a+b}{V}$

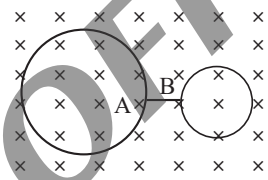
(*c*) $t = \frac{2b}{V}$ (*d*) $t = \frac{2a}{V}$

16. Find time for which current will Induced in the loop. ($a < b$)



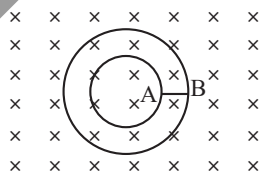
(*a*) $t = \frac{b}{V}$ (*b*) $t = \frac{a+b}{V}$ (*c*) $t = \frac{2b}{V}$ (*d*) $t = \frac{2a}{V}$

17. If Magnetic field is continuously increasing then find direction of current in AB.

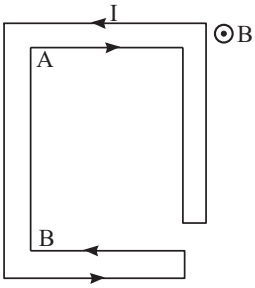


(*a*) A to B (*b*) B to A (*c*) Zero (*d*) Can't say

18. If Magnetic field is continuously increasing then find direction of current in AB.

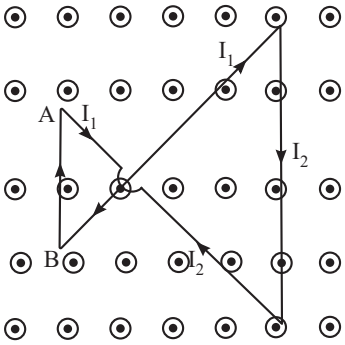


19. Magnetic field B is decreasing then direction of current in AB wire.



(*a*) A to B (*b*) B to A
(*c*) Zero (*d*) None of these

20. Magnetic field B is increasing. Find direction of current in wire AB.



(*a*) A to B (*a*) B to A
(*a*) Zero (*a*) None of these

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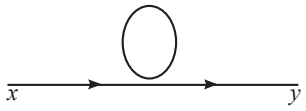
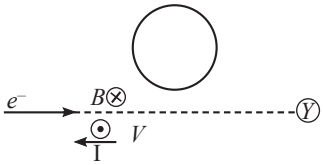
21. One proton is moving along path $x \rightarrow y$ then direction of induced current in loop

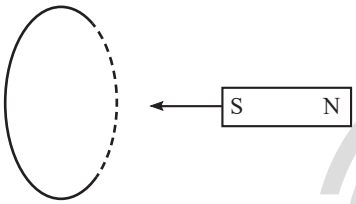


(*a*) Clock - wise
(*b*) Anti - clock wise
(*c*) First clock - wise then anti - clock wise
(*d*) First anti - clock wise then clock - wise

22. Find induced current in loop.

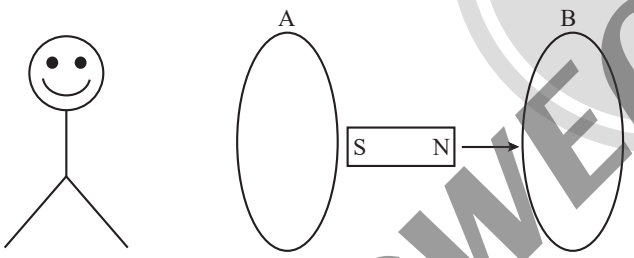


23. Direction of induced current in loop where magnet is moving towards the loop.



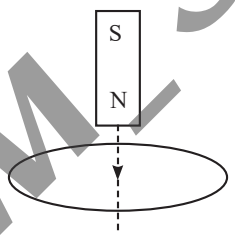
(*a*) Clock - wise (*b*) Anti - clock wise
(*c*) Zero (*d*) Can't say

24. Direction of current induced in the coil.



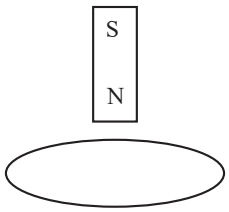
(*a*) $I_A \rightarrow$ C.W, $I_B \rightarrow$ A.C.W (*b*) $I_A \rightarrow$ A.C.W, $I_B \rightarrow$ A.C.W
(*c*) Both C.W (*d*) Both A.C.W

25. What is direction of induce current in the coil.



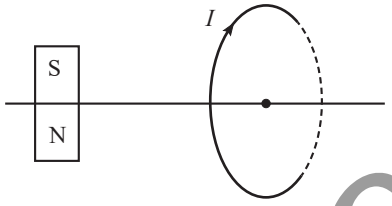
(*a*) 1st C.W then A.C.W (*b*) Always C.W
(*c*) Alway A.C.W (*d*) 1st A.C.W then C.W

26. Magnet is dropped along axis of coil as shown in figure then find acceleration of magnet.



(*a*) $a = g$ (*b*) $a > g$ (*c*) $a < g$ (*d*) Can't say

27. A permanent magnet and current-carrying coil are placed. As shown in figure. If the coil is moved towards magnet, then current in coil (Magnet is symmetrical)

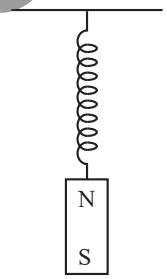


(*a*) increases (*b*) Remains same
(*c*) decreases (*d*) First increases then decreases

28. A metallic ring with a cut is held horizontally and a magnet is allowed to fall vertically through the ring, then the acceleration of this magnet is

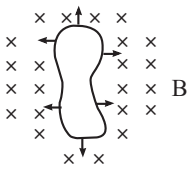
(*a*) Equal to g
(*b*) More than g
(*c*) Less than g
(*d*) Some times less and sometime more than g

29. Magnet is pulled downward and released then magnet will



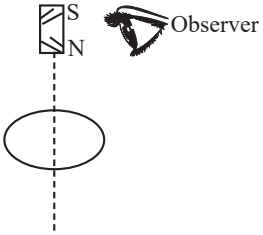
(*a*) Oscillate with constant amplitude.
(*b*) Oscillate with decreasing amplitude and stop.
(*c*) Oscillate with increasing amplitude.
(*d*) None of these.

30. A loop of irregular shape of conducting wire PQRS (as shown in figure) placed in a uniform magnetic field perpendicular to the plane of the paper changes into a circular shape. The direction of induced current will be



(*a*) Clockwise (*b*) Anti-clockwise
(*c*) No current (*d*) None of these

31. A bar magnet is dropped through a horizontal aluminum ring along the axis of the ring. What will be direction of induced current in the loop for the observer shown? What will be the direction of magnetic force experienced by the bar magnet?



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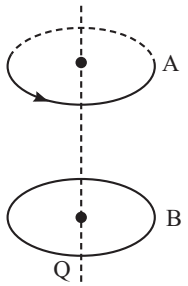
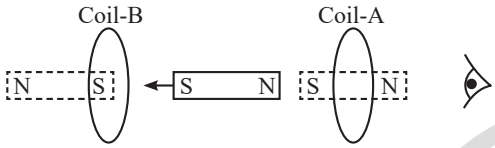
32. There are two loops A and B placed coaxially along vertical line. Loop A is allowed to fall freely towards loop B. If constant current flowing in loop A is as shown in the figure, then find the direction of flow of induced current in loop B as seen from the bottom of loop B



(*a*) Clockwise (*b*) Anti-clockwise
(*c*) No current will induce (*d*) Can't be determine

33. Direction of induced current in A & B:



(*a*) Anti - clock wise in both
(*b*) Clock - wise in both
(*c*) Anti - clock in A and Clock wise in B.
(*d*) Clock - wise in A and Anti - clock wise in B.

34. A bar-magnet is released from rest along the axis of a very long vertical copper tube. After some time the magnet will-
(*a*) Move down with almost constant speed.
(*b*) Oscillate inside the tube.
(*c*) Move down with an acceleration greater than *g*.
(*d*) Move down with an acceleration equal to *g*.

Faraday's Law of Induction

35. The magnetic flux through a circuit of resistance *R* changes by an amount $\Delta\phi$ in a time Δt. Then the total quantity of electric charge *Q* that passes any point in the circuit during the time Δt is represented by

(*a*) $Q = \frac{1}{R}.\frac{\Delta\phi}{\Delta t}$ (*b*) $Q = \frac{\Delta\phi}{R}$
(*c*) $Q = \frac{\Delta\phi}{\Delta t}$ (*d*) $Q = R.\frac{\Delta\phi}{\Delta t}$

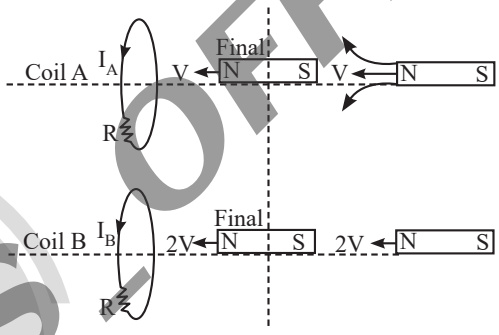
36. The induced emf can be produced in a coil by
A. Moving the coil with uniform speed inside uniform magnetic field
B. Moving the coil with non uniform speed inside uniform magnetic field
C. Rotating the coil inside the uniform magnetic field
D. Changing the area of the coil inside the uniform magnetic field.
Choose the correct answer from the options given below:
(*a*) A and C only (*b*) C and D only
(*c*) B and D only (*d*) B and C only

37. The magnetic flux through a coil perpendicular to its plane is varying according to the relation $\phi = (5t^3 + 4t^2 + 2t - 5)$ Weber. If the resistance of the coil is 5 , then the induced current through the coil at $t = 2s$ will be,
(*a*) 15.6 A (*b*) 16.6 A (*c*) 17.6 A (*d*) 18.6 A

38. A conducting circular loop is placed in $X - Y$, plane in presence of magnetic field $\vec{B} = (3t^3\hat{j} + 3t\hat{k})$ in SI unit. If the radius of the loop is 1m , the induced emf in the loop, at time, $t = 2$ *s* is $n\pi$V. The value of *n* is _____

39. A square loop of area 25 cm^2 has a resistance of 10Ω. The loop is placed in uniform magnetic field of magnitude 40 tesla. The plane of loop is perpendicular to magnetic field. The work done in pulling the loop out of magnetic field slowly and uniformly in 1 sec will be:
(*a*) 1.0×10^{-3} J (*b*) 5×10^{-3} J
(*c*) 2.5×10^{-3} J (*d*) 1×10^{-4} J

40. Induced current in coil *A* & *B* is I_A & I_B and induced charge in *A* & *B* is q_A & q_B. Find relation between them.



(*a*) $q_A = q_B$ (*b*) $q_A > q_B$
(*c*) $q_A < q_B$ (*d*) can't say

41. A conducting ring of radius *r* is placed perpendicularly inside a time varying magnetic field given by $B = B_0 + \alpha t$. B_0 and α are positive constants. E.m.f. induced in the ring is
(*a*) $-\pi\alpha r$ (*b*) $-\pi\alpha r^2$
(*c*) $-\pi\alpha^2 r^2$ (*d*) $-\pi\alpha^2 r$

42. A coil having 500 square loops each of side 10 cm is placed with its plane perpendicular to a magnetic field which increases at a rate of 1.0 tesla/s. The induced e.m.f. (in volts) is
(*a*) 0.5 (*b*) 0.1
(*c*) 1.0 (*d*) 5.0

43. Magnetic flux through a circuit of resistance 20Ω is changed form 20 Wb to 40 Wb in 5 ms. Charge passed through the circuit during this time is
(*a*) 1 C (*b*) 2 C
(*c*) Zero (*d*) 0.5 C

44. Radius of a circular loop placed in a perpendicular uniform magnetic field is increasing at a constant rate of r_0 ms^{-1}. If at any instant radius of the loop is *r*, then emf induced in the loop at that instant will be
(*a*) $-2Brr_0$ (*b*) $-2B\pi r$
(*c*) $-B\pi r_0 r$ (*d*) $-2B\pi r_0 r$

45. A conducting circular loop is placed in a uniform magnetic field,B = 0.025 T with its plane perpendicular to the loop. The radius of the loop is made to shrink at a constant rate of 1mm s^{-1}. The induced emf when the radius is 2 cm is
(*a*) $2\pi\mu$V (*b*) $\pi\ \mu$V
(*c*) $\frac{\pi}{2}\mu$ V (*d*) 2 μV

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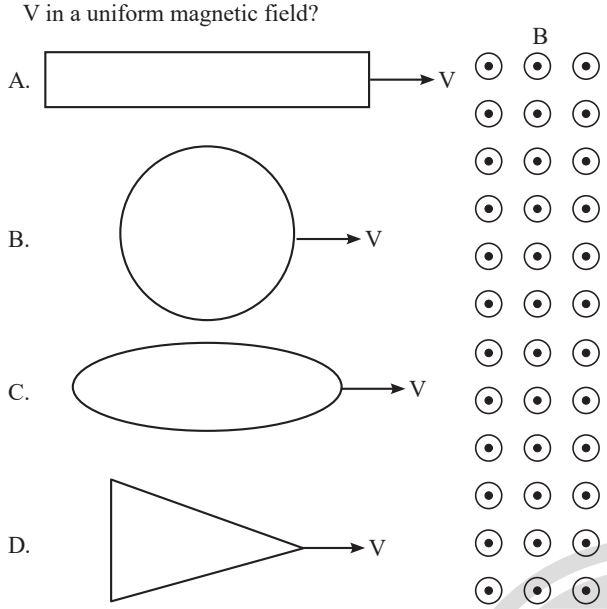
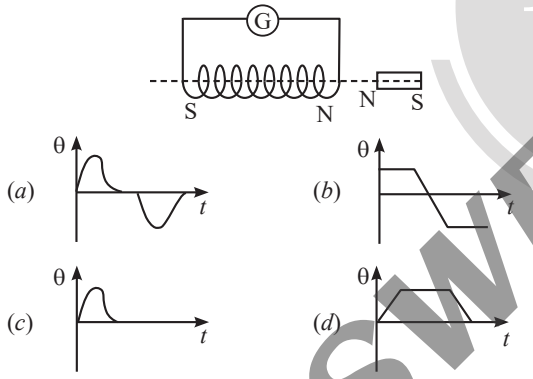
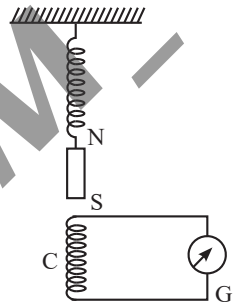
46. Out of the following shapes, which one will produce a constant magnitude of induced current when moving at a constant velocity V in a uniform magnetic field?



47. A short bar magnet passes at a steady speed right through a long solenoid. A galvanometer is connected across the solenoid. Which graph best represents the variation of the galvanometer deflection θ with time *t* ?



48. A magnet N – S is suspended from a spring and when it oscillates, the magnet moves in and out of the coil C. The coil is connected to galvanometer G. Then, as the magnet oscillates, G shows



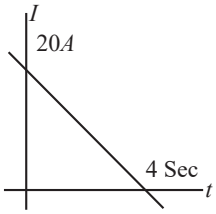
(*a*) No deflection

(*b*) Deflection to the left and right but the amplitude steadily decreases

(*c*) Deflection to the left and right with constant amplitude

(*d*) Deflection on one side

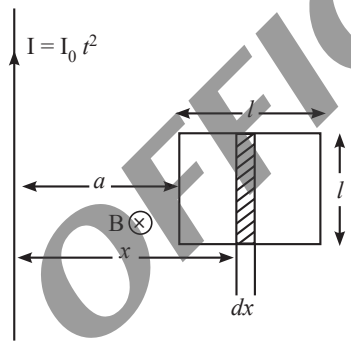
49. In a coil of resistance of 10Ω, the induced current developed by changing magnetic flux through it, is shown in figure as a function of time. The magnitude of change in flux through the coil in Weber is



(*a*) 800 weber (*b*) 200 weber

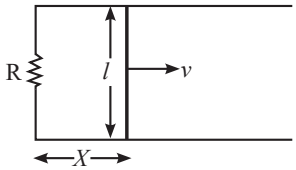
(*c*) 600 weber (*d*) 400 weber

50. Find induced emf in a square loop.

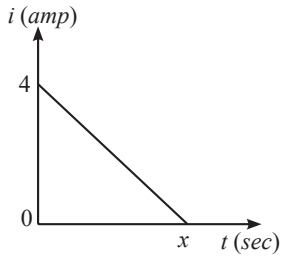


51. A current I = 1.5 A is flowing through a long solenoid of diameter 3.2 cm , having 220 turns per cm. At its centre, a 130 turn closely packed coil of diameter 2.1 cm is placed such that the coil is coaxial with the long solenoid. The current in the solenoid is reduced to zero at a steady rate in 25 ms . What is the magnitude of emf induced in the coil while the current in the solenoid is changing?

52. Find induced emf and current in a loop when rod is at distance *x* from left end.



53. In a coil of resistance 10Ω, the induced current developed by changing magnetic flux through it, is shown in figure as function of time. If magnitude of change in flux through coil is 2 weber then find *x* given in figure.



54. The source of time varying magnetic field may be

A. A permanent magnet

B. An electric field changing linearly with time

C. Direct current

D. A decelerating charge particle

E. X an antenna fed with a digital signal

Choose the correct answer from the options given below:

(*a*) D only (*b*) C and E only

(*c*) A only (*d*) B and D only

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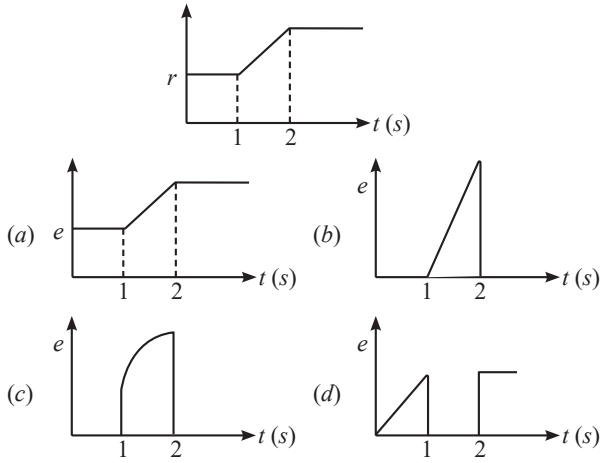
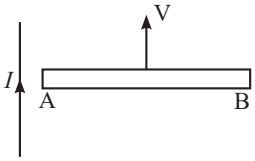
55. A flexible wire bent in the form of a circle is placed in a uniform magnetic field perpendicular to the plane of the coil. The radius of the coil changes with time as shown in the figure. The induced emf in the coil is



Hall Effect (Motional EMF)

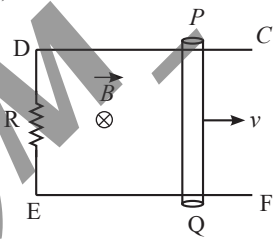
56. How to find which side of rod is at higher potential ?

57. The current carrying wire and the rod AB are in same plane. The rod moves parallel to the wire with a velocity v. Which one of the following statement is true about induced emf in the rod?



(*a*) End A will be at lower potential with respect to B
(*b*) A and B will be at same potential
(*c*) There will be no induced emf in the rod
(*d*) Potential at A will be higher than that at B

58. A frame CDEF is placed in a region where a magnetic field $\vec{B}$ is present. A rod of length one metre moves with constant velocity 20 m/s and strength of magnetic field is one tesla. The power spent in the process is (take R = 0.2 Ω and all other wires and rod have zero resistance)



(*a*) 1 kW (*b*) 2 kW (*c*) 3 kW (*d*) 4 kW

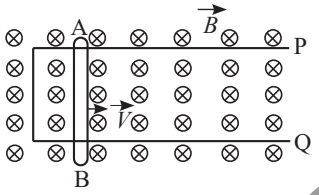
59. An airplane rises vertically with a speed of 100 m/s. The aeroplane has wings span 10 m and horizontal component of earth's magnetic field perpendicular to wings is 5×10^{-3} Wb/m^2. The induced emf across the ends of wings is

(*a*) 50 V (*b*) 0.5 V (*c*) 5 V (*d*) 25 V

60. An emf of 0.08 V is induced in a metal rod of length 10 cm held normal to a uniform magnetic field of 0.4 T , when moves with a velocity of :

(*a*) 2 ms^{-1} (*b*) 3.2 ms^{-1} (*c*) 0.5 ms^{-1} (*d*) 20 ms^{-1}

61. A conducting rod AB of length l is projected on a frictionless frame $PSRQ$ with velocity v_0 at any instant. The velocity of the rod after time t is

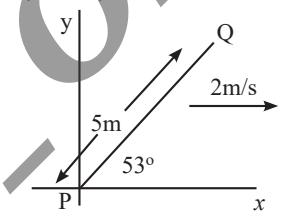


(*a*) $v = v_0$ (*b*) $v > v_0$
(*c*) $v < v_0$ (*d*) None of these

62. A straight conductor of length 0.4 m is moved with a speed of 7 m/s perpendicular to the magnetic field of intensity of 0.9 wb/m^2 The induced emf across the conductor will be:

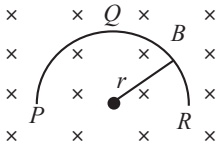
(*a*) 7.25 V (*b*) 3.75 V (*c*) 1.25 V (*d*) 2.52 V

63. A conducting rod PQ of length 5 m oriented as shown in figure is moving with velocity $(2\text{m/s})\hat{i}$ without rotation in a uniform magnetic field $(3\hat{i} + 4\hat{k})$ Tesla. Emf induced in the rod is



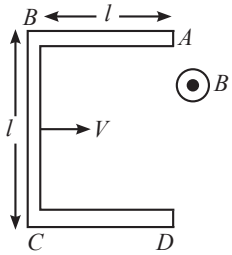
(*a*) 32 Volts (*b*) 250 Volt (*c*) 40 Volt (*d*) 4 None

64. A thin semicircular conducting ring (PQR) of radius r is falling with its plane vertical in a horizontal magnetic field B, as shown in figure. The potential difference developed across the ring when its speed is v is



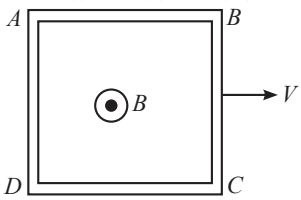
(*a*) Zero
(*b*) $Bv\pi r^2/2$ and P is at higher potential
(*c*) πrBv and R is at higher potential
(*d*) $2\,rBv$ and R is at higher potential

65. Calculate the induced e.m.f. in the wire configuration shown:



(*i*) Complete wire (*ii*) In segment AB
(*iii*) In segment BC (*iv*) In segment CD

66. Find induced emf in (*i*) AB, (*ii*) BC, (*iii*) CD, (*iv*) DA and in loop.



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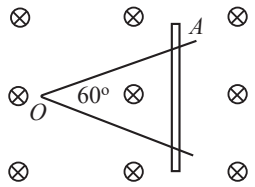
67. *A* rod *AB* slides on *a* V shaped wire with speed *v* as shown, such that at any time OA = OB = *l*. Magnetic field in the region is perpendicular downwards and has strength *B*, induced emf in the rod is



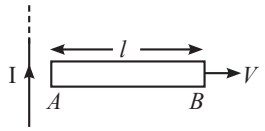
(*a*) Zero (*b*) Bvl (*c*) $\frac{\sqrt{3}Bvl}{2}$ (*d*) $\frac{Bvl}{2}$

68. A rectangular loop of length 2.5 m and width 2 m is placed such that the it's plane is making an angle of 30° to magnetic field of 4 tesla. The loop is removed from field in 10 sec. The average e.m.f induced in the loop during this time is

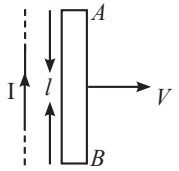
(*a*) $-2v$ (*b*) $+2v$

(*c*) $+1v$ (*d*) $-1v$

69. Find motional e.m.f

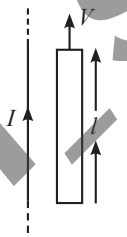


70. Find induced e.m.f. in Rod.

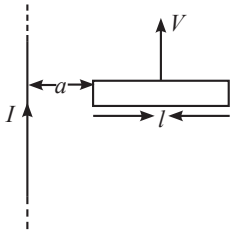


Infinite Wire

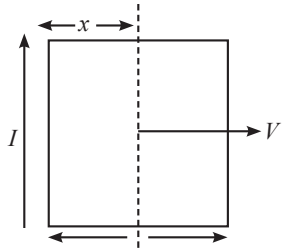
71. Find induced e.m.f. in Rod.



72. Find induced e.m.f. in Rod.



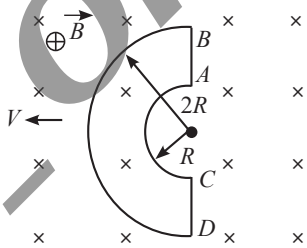
73. A conducting square frame of side *a* and a long straight wire carrying current *I* are located in the same plane as shown in the figure. The frame moves to the right with a constant velocity *V*. The emf induced in the frame will be proportional to



(*a*) $\frac{1}{(2x-a)(2x+a)}$ (*b*) $\frac{1}{x^2}$

(*c*) $\frac{1}{(2x-a)^2}$ (*d*) $\frac{1}{(2x+a)^2}$

74. If given arrangement is moving towards left with speed *v*, then potential difference between *B* and *D* and current in the loop are respectively



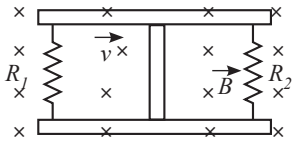
(*a*) *BrR* and non-zero (*b*) 2*BvR* and zero

(*c*) 4 *BvR* and non-zero (*d*) 4 *BvR* and zero

75. A conducting bar of length *L* is free to slide on two parallel conducting rails as shown in the figure.

Two resistors R_1 and R_2 are connected across the ends of the rails. There is a uniform magnetic field $\vec{B}$ pointing into the page. An external agent pulls the bar to the left at a constant speed *v*.

The correct statement about the directions of induced currents I_1 and I_2 flowing through R_1 and R_2 respectively is



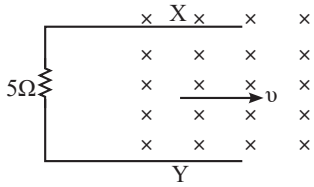
(*a*) I_1 is in anticlockwise direction and I_2 is in clockwise direction

(*b*) Both I_1 and I_2 are in anticlockwise direction

(*c*) Both I_1 and I_2 are in clockwise direction

(*d*) I_1 is in clockwise direction and I_2 is in anticlockwise direction

76. A 1 m long metal rod XY completes the circuit as shown in figure. The plane of the circuit is perpendicular to the magnetic field of flux density 0.15 T . If the resistance of the circuit is 5Ω, the force needed to move the rod in direction, as indicated, with a constant speed of 4m/s will be____$\times 10^{-3}$ N.



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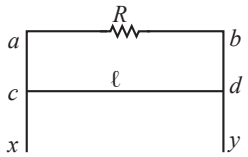
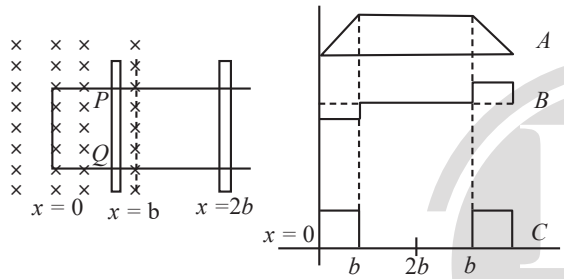
77. A wire *cd* of length ℓ and mass *m* is sliding without friction on conducting rails *ax* and *by*, as shown. The vertical rails are connected to each other with a resistance *R* between *a* and *b*. A uniform magnetic field *B* is applied perpendicular to the plane *abcd* such that *cd* moves with a constant velocity of



(*a*) $\frac{mgR}{B\ell}$ (*b*) $\frac{mgR}{B^2\ell^2}$ (*c*) $\frac{mgR}{B^3\ell^3}$ (*d*) $\frac{mgR}{B^2\ell}$

78. The arm PQ of a rectangular conductor is moving from $x = 0$ to $x = 2b$ outwards and then inwards from $x = 2b$ to $x = 0$ as shown in the figure. A uniform magnetic field perpendicular to the plane is acting from $x = 0$ to $x = b$. Identify the graph the variation of different quantities with distance.



(*a*) A - Flux, B - emf, C - Power dissipated

(*b*) A - emf, B - Power dissipated, C - Flux

(*c*) A - Power dissipated, B - Flux, C - emf

(*d*) A - Flux, B - Power dissipated, C - emf

79. Rectangular, a square, a circular and an elliptical loop, all in the $(x - y)$ plane, are moving out of a uniform magnetic field with a constant velocity, $\vec{v} = v\hat{i}$. The magnetic field is directed along the negative *z* axis direction. The induced emf, during the passage of these loops, out of the field region, will remain constant for :-

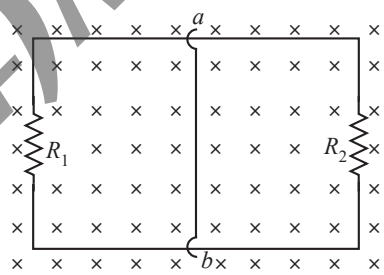
(*a*) any of the four loops

(*b*) the rectangular and square loops

(*c*) the circular and the elliptical loops

(*d*) only the elliptical loop

80. A connector *ab* of length ℓ and resistance *R* slides freely on two horizontally placed rods, the ends of which are connected by resistances R_1 and R_2. The magnetic field *B* is downwards and the velocity of the connector is *v*. The current in the connector is



(*a*) Zero (*b*) $\frac{B\ell v}{R}$

(*c*) $\frac{B\ell v}{R + R_1 + R_2}$ (*d*) $\frac{B\ell v(R_1 + R_2)}{RR_1 + RR_2 + R_1R_2}$

81. A conducting ring of radius *b* is placed coaxially in a long solenoid of radius $a(b < a)$ having *n* turns per unit length. A current $i = i_0 \cos \omega t$ flows through the solenoid. The induced emf in the ring is

(*a*) Zero (*b*) $\mu_0 n i_0 \pi a^2 \omega$

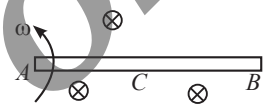
(*c*) $\mu_0 n i_0 \pi a^2 \cos\omega t$ (*d*) $\mu_0 n i_0 \pi\, b^2 \omega \sin\omega t$

Rotational EMF

82. A copper rod of length l is rotated about one end perpendicular to the uniform magnetic field B with constant angular velocity ω. The induced e.m.f. between its two ends is

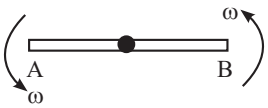
(*a*) $B\omega l^2$ (*b*) $\frac{3}{2}B\omega l^2$ (*c*) $\frac{1}{2}B\omega l^2$ (*d*) $2\,B\omega l^2$

83. A copper rod *AB* of length *l*, pivoted at one end *A*, rotates at constant angular velocity ω, at right angles to a uniform magnetic field of induction *B*. The emf, developed between the mid point *C* of the rod and end *B* is



(*a*) $\frac{B\omega l^2}{8}$ (*b*) $\frac{3}{4}B\omega l^2$ (*c*) $\frac{B\omega l^2}{4}$ (*d*) $\frac{3}{8}B\omega l^2$

84. A copper rod of length *l* is rotating about mid-point of rod, perpendicular to the magnetic field *B* with constant angular velocity ω. The induced emf between the two ends is

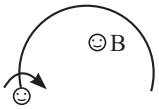


(*a*) $\frac{1}{2}B\omega l^2$ (*b*) $B\omega l^2$ (*c*) $2\,B\omega l^2$ (*d*) Zero

85. A metallic conductor of length 1 *m* rotates in a vertical plane parallel to east-west direction about one of its end with angular velocity 5 rad s^{-1}. If the horizontal component of earth's magnetic field is 0.2×10^{-4} T , then emf induced between the two ends of the conductor is :

(*a*) 5μV (*b*) 50 μV (*c*) 5 mV (*d*) 50 mV

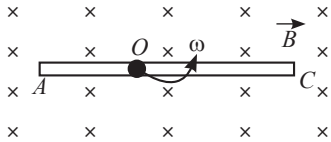
86. A semicircular wire of radius *R* is rotated with constant angular velocity ω about an axis passing through one end and perpendicular to the plane of the wire. There is a uniform magnetic field of strength B. The induced e.m.f. between the ends is :



(*a*) $B\,\omega R^2/2$ (*b*) $2B\,\omega R^2$

(*c*) is variable (*d*) None of these

87. A conducting rod AC of length 4 L is rotated about a point O in a uniform magnetic field $\vec{B}$ directed into the paper. AO = L, OC = 3L



(*a*) $V_A - V_0 = \frac{3B\omega L^2}{2}$ (*b*) $V_0 - V_C = \frac{5}{2}B\omega L^2$

(*c*) $V_A - v_C = 4B\omega L^2$ (*d*) $V_C - V_0 = \frac{3}{2}B\omega L^2$

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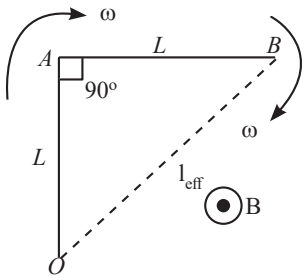
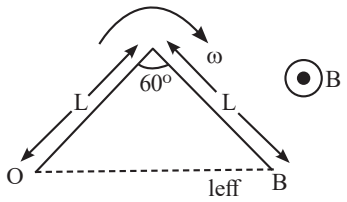
88. Find induced emf between A & B



89. Find induced emf between A & B in given figure.



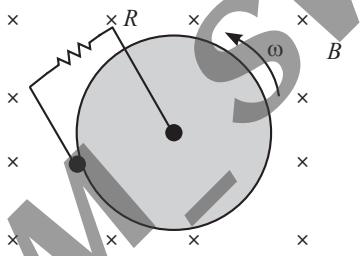
90. A copper disc of radius 0.1 m is rotated about its centre with 10 rev/s in a uniform magnetic field of 0.1 T with its plane perpendicular to field. The emf induced across the radius of disc is

(*a*) $\frac{\pi}{10}$ volt (*b*) $\frac{\pi}{100}$ volt (*c*) $\frac{\pi}{1000}$ volt (*d*) Zero

91. A rod of length *l* rotates with a uniform angular velocity ω about its perpendicular bisector. A uniform magnetic field *B* exists parallel to the axis of rotation. The potential difference between the two ends of the rod is

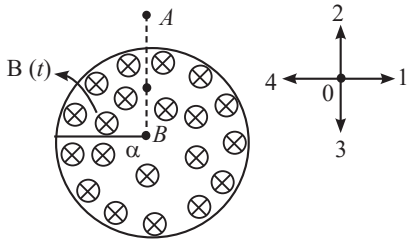
(*a*) Zero (*b*) $\frac{1}{2}Bl\omega^2$ (*c*) $Bl\omega^2$ (*d*) $2\,B\omega l^2$

92. Figure shows a conducting disc rotating about its axis in a perpendicular magnetic field B. A resistor of resistance *R* is connected between the centre and the rim. The radius of the disc is 5.0 cm , angular speed ω = 40 rad/s, B = 0.10 T and R = 1Ω . The current through the resistor is



(*a*) 5 mA (*b*) 50 A (*c*) 5 A (*d*) 10 mA

93. A uniform but time varying magnetic field B(t) exists in a cylindrical region of radius α and is directed into the plane of the paper, as shown in fig. The magnetic field decreases at a constant rate inside the region. If *r* is the distance from the axis of the cylindrical region then match column-I to column-II.



Column-I		Column-II	
I.	Induced electric field at point A	a.	0 to 1
II.	Induced electric field at point B	b.	Zero
III.	Force on an electron placed at point A	c.	0 to 4
IV.	Force on an electron placed at point B	d.	0 to 2

(*i*) I - a, II - d, III - d, IV - a (*ii*) I - d, II - a, III - c, IV - a
(*iii*) I - a, II - b, III - c, IV - d (*iv*) I - a, II - a, III - c, IV - c

94. Match the column.

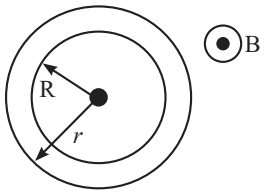
Column-I		Column-II	
(a)	Magnetic field	(p)	$[M^1T^{-2}A^{-1}]$
(b)	Coefficient of self induction	(q)	$[T^2]$
(c)	LC	(r)	$[ML^2T^{-2}A^{-2}]$
(d)	Magnetic flux	(s)	None of these

(*i*) a-p, b-r, c-q, d-s (*ii*) a-p, b-q, c-r, d-s
(*iii*) a-p, b-s, c-q, d-r (*iv*) a-s, b-s, c-s, d-r

95. A coil of 200 turns and area 0.20 m^2 is rotated at half a revolution per second and is placed in uniform magnetic field of 0.01 T perpendicular to axis of rotation of the coil. The maximum voltage generated in the coil is $\frac{2\pi}{\beta}$ volt. The value of β is

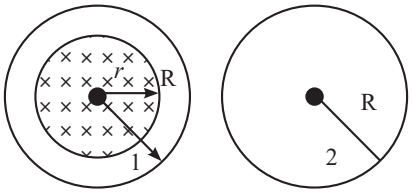
Induced Electric Field

96. A circular region in which magnetic field is changing. Find induced electric field in Inside region at '*r*' as shown in figure



97. There exists a uniform magnetic field in a circular region of radius *R* centred at 0. The field is perpendicular to and out of the plane of paper and its strength varies with time as B = B_0t. Find the induced electric field at a distance *r* from the centre for (1) r < R (2) *r* > R

98. A uniform magnetic field is restricted within a region of radius *r*. The magnetic field changes with time at a rate $\frac{d\vec{B}}{dt}$. Loop 1 of radius R > *r* enclosed the region *r* and loop 2 of radius *R* is outside the region of magnetic field as shown in the figure below. Then the e.m.f. generated is



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(*a*) Zero in loop 1 and zero in loop 2

(*b*) $-\frac{d\vec{B}}{dt}\pi r^2$ in loop 1 and $-\frac{d\vec{B}}{dt}\pi r^2$ in loop 2

(*c*) $-\frac{d\vec{B}}{dt}\pi R^2$ in loop 1 and (zero in loop 2)

(*d*) $-\frac{d\vec{B}}{dt}\pi r^2$ in loop 1 and zero in loop 2

99. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R):

Assertion (A): The electric field created by time-varying magnetic field is non-conservative.

Reason (R): The line integral of induced electric field in a closed loop is always equal to zero.

In the light of the above statements, choose the most appropriate answer from the options given below:

(*a*) Both (A) and (R) are true and (R) is the correct explanation of (A).

(*b*) Both (A) and (R) are true and (R) is NOT the correct explanation of (A).

(*c*) (A) is true but (R) is false.

(*d*) (A) is false but (R) is true.

Eddy Current

100. Eddy currents are induced when

(*a*) A metal block is kept in a changing magnetic field

(*b*) A metal block is kept in a uniform magnetic field

(*c*) A coil is kept in a uniform magnetic field

(*d*) Current is passed in a coil

101. **Assertion (A):** A bar magnet dropped through a metallic cylindrical pipe takes more time to come down compared to a non-magnetic bar with same geometry and mass.

Reason (R): For the magnetic bar, Eddy currents are produced in the metallic pipe which oppose the motion of the magnetic bar.

(*a*) A is true but *R* is false

(*b*) A is false but R is true

(*c*) Both A and R are true but R is not the correct explanation of A.

(*d*) Both A and R are true and R is the correct explatation of A .

AC Generator

102. A coil having number of turns N and area A is rotated in a uniform magnetic field B with angular velocity ω about its diameter. Maximum e.m.f. induced in it is given by

(*a*) NABω (*b*) $\frac{NAB}{\omega}$ (*c*) $\frac{NA\omega}{B}\chi$ (*d*) $\frac{B\omega}{NA}$

103. The number of turns in the coil of an *ac* generator is 5000 and the area of the coil is $0.25m^2$. The coil is rotated at the rate of 100 cycles/ sec in a magnetic field of $0.2\ W/m^2$ The peak value of the emf generated is nearly

(*a*) 786 kV (2) 440 kV

(*c*) 220 kV (4) 157.1 kV

104. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).

Assertion (A) : When a coil is rotated in a uniform magnetic field about an diametrical axis perpendicular to the field, emf is induced in it which is maximum for the orientation of coil in which magnetic flux through the coil is zero.

Reason (R) : In an electric generator, electrical energy is generated by rotating a coil in a magnetic field.

In the light of the above statements, choose the most appropriate answer from the options given below:

(*a*) Both (A) and (R) are true and (R) is the correct explanation of (A).

(*b*) Both (A) and (R) are true and (R) is NOT the correct explanation of (A).

(*c*) (A) is true but (R) is false.

(*d*) (A) is false out (R) is true

Self Inductance of Solenoid

105. When the number of turns in a solenoid are doubled without any change in the length of the solenoid, its self inductance becomes

(*a*) Half (*b*) Double (*c*) Four times (*d*) Eight times

106. A long solenoid has self inductance L. If its length is doubled keeping total number of turns constant then its self inductance will be

(*a*) $\frac{L}{2}$ (*b*) 2L (*c*) L (*d*) $\frac{L}{4}$

107. If Iron is placed inside solenoid then its inductance will be.

108. Why inductor behave as simple wire for DC voltage supply or DC current?

109. If self-inductance of Inductor becomes *n*-times suddenly, then current in solenoid at that instant will be?

110. A long solenoid has 1000 turns. When a current of 4 A flows through it, the magnetic flux linked with each turn of the solenoid is 4×10^{-3} Wb. The self inductance of the solenoid is

(*a*) 1 H (*b*) 4 H (*c*) 3 H (*d*) 2H

111. A toroidal solenoid with an air core has an average radius of 15 cm , area of cross-section 12 cm2, and 1200 turns. Ignoring the field variation across the cross-section of the toroid, the self-inductance of the toroid is

(*a*) 4.6 mH (*b*) 6.9 mH (*c*) 2.3 mH (*d*) 9.2 mH

112. The total number of turns and cross-section area in solenoid is fixed. However, its length L is varied by adjusting the separation between windings. The inductance of solenoid will be proportional to:

(*a*) 1/L (2) L (*c*) $1/L^2$ (4) L^2

113. The number of turns, cross-sectional area and length for four solenoids are given in the following table.

Solenoid	Total turns	Area	Length
A	2 N	2A	ℓ
B	2N	A	ℓ
C	3N	3A	2ℓ
D	2N	2A	ℓ/2

The solenoids with maximum self inductance is :-

(*a*) A (*b*) B (*c*) C (*d*) D

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114. The length of thin wire required to manufacture a solenoid of inductance L and length ℓ, (if the cross-sectional diameter is considered less than its length) is :-

(*a*) $\sqrt{\frac{\pi L\ell}{2\mu_0}}$ (*b*) $\sqrt{\frac{4\pi\ L\ell}{\mu_0}}$ (*c*) $\sqrt{\frac{2\pi\ L\ell}{\mu_0}}$ (*d*) $\sqrt{\frac{\pi L\ell}{\mu_0}}$

Inductor

115. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).

Assertion (A) : A time varying magnetic field induces an electric field.

Reason (R) : An inductor always tends to keep the flux constant.

In the light of the above statements, choose the most appropriate answer from the options given below:

(1) Both (A) and (R) are true and (R) is the correct explanation of (A).

(2) Both (A) and (R) are true and (R) is NOT the correct explanation of (R).

(3) (A) is true but (R) is false.

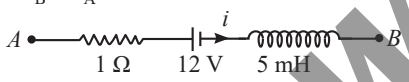
(4) (A) is false but (R) is true.

EMF in Inductor

116. The current passing through a choke coil of self inductance 5 H is decreasing at the rate of 2A/s. The e.m.f. developed across the coil is

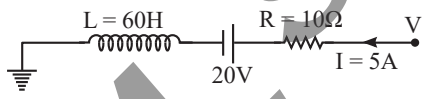
(*a*) 10 V (*b*) –10 V (*c*) -2.5 V (*d*) 2.5 V

117. The network shown in figure is a part of a complete circuit. If at a certain instant, the current *i* is 4 A and is increasing at a rate of 10^3 A/s Then $V_B - V_A$ will be



(*a*) –11 V (*b*) 11 V (*c*) -21 V (*d*) 21 V

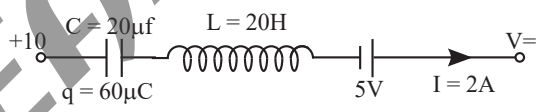
118. Find V. If $\frac{dI}{dt} = 0.2A/s$



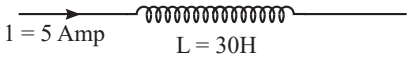
(*a*) 18 V (*b*) 82 V

(*c*) –82 V (*d*) –18 V

119. Find V in given figure If $\frac{dI}{dt} = -0.5A/s$



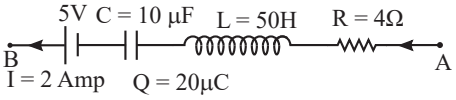
120. Find Back e.m.f. in given inductor, $\frac{dI}{dt} = 0.2A/s$



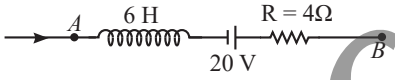
121. In a circular conducting coil, when current increases from 2A to 18 A in 0.05 s , the induced emf is 20 V . The self inductance of the coil is

(*a*) 62.5 mH (*b*) 6.25 mH (*c*) 50 mH (*d*) Zero

122. Find potential different Between A&B. $\frac{dI}{dt} = -0.5A/s$



123. Find $V_A - V_B$, I = 10*A*, $\frac{dI}{dt} = -0.5$ A/s

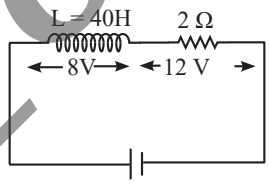


124. In an A.C. sub-circuit as shown in figure, the resistance R = 0.2 Ω. At a certain instant $V_A - V_B$ = 0.5 V, I = 0.5 A,and current is increasing at the rate of ΔI/Δt = 8 A/s The inductance of the coil is

(*a*) 0.01 H (*b*) 0.02 H

(*c*) 0.05 H (*d*) 05 H

125. Find $\frac{dI}{dt}$ in the circuit at a given instant ?



126. A 12 V battery connected to a coil of resistance 6Ω through a switch, drives a constant current in the circuit. The switch is opened in 1 ms. The emf induced across the coil is 20 V. The inductance of the coil is:

(*a*) 5 mH (*b*) 12 mH

(*c*) 8 mH (*d*) 10 mH

127. 12 V battery connected to a coil of Resistance *x*Ω through a switch, drives a constant current in the circuit. The switch is opened in 1 ms. The emf induced across the coil is 20 V . Find *x* if inductance of coil is 10 mH .

Energy Stored in Inductor

128. The magnetic energy stored in a long solenoid of area of cross-section A in a small region of length *L* is

(*a*) $\frac{B^2AL}{2\mu_0^2}$ (*b*) $\frac{AL}{2\mu_0}$

(*c*) $\frac{1}{2}\mu_0 B^2 AL$ (*d*) $\frac{B^2AL}{2\mu_0}$

129. A coil of resistance 20 ohms and inductance 5H has been connected to a 100 volt battery. The energy stored in the coil is

(*a*) 31.25 J (*b*) 62.5 J

(*c*) 125 J (*d*) 250 J

130. The self induced emf of a coil is 25 volts. When the current in it is changed at uniformed rate from 10 A to 25 A in 1s, the change in the energy of the inductances is:

(*a*) 740 J (*b*) 437.5 J

(*c*) 540 J (*d*) 637.5 J

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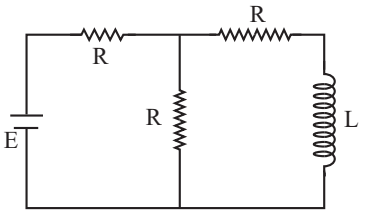
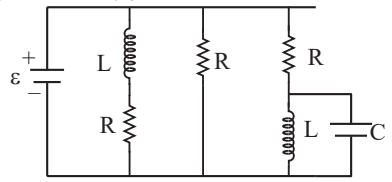
Charging of Inductor

131. Find current at (i) $t = 0$ (ii) t = steady state

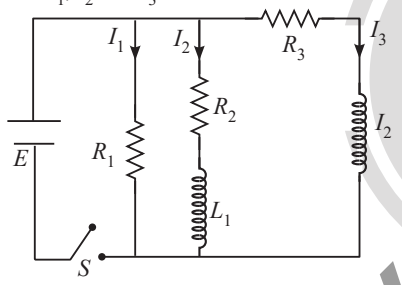


132. Figure shows a circuit contains three identical resistors with resistance R = 9.0Ω each, two identical inductors with inductance L = 2.0 mH each, and an ideal battery with ε = 18 V. The current 'i' through the battery just after the switch closed is



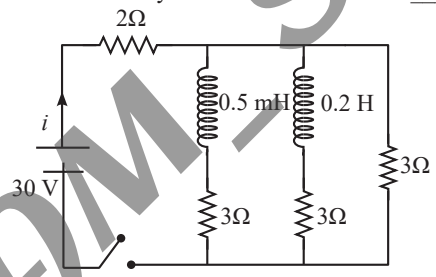
(*a*) 2 mA (*b*) 0.2 A (*c*) 2 A (*d*) 4A

133. Figure shows an L-R circuit. When the switch S is closed, the current through resistor R_1, R_2 and r_3 are I_1, I_2 and I_3 respectively. The value of I_1, I_2 and I_3 at $t = 0$ s is.



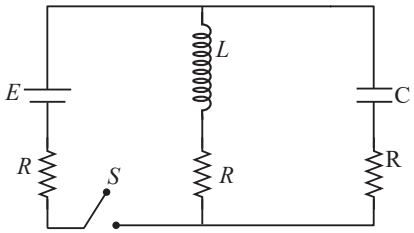
(*a*) $I_1 = I_2 = I_3 = 0$
(*b*) $I_1 = E/R_1$, $I_2 = I_3 = 0$
(*c*) $I_1 = 0$, I_2E/R_2, $I_3 = E/R_3$
(*d*) $I_1 \equiv E/R_1$, $I_2 = E/R_2 + L_1$, $I_3 = E/R_3 + L_3$

134. For the given circuit the current i through the battery when the key in closed and the steady state has been reached is_____.



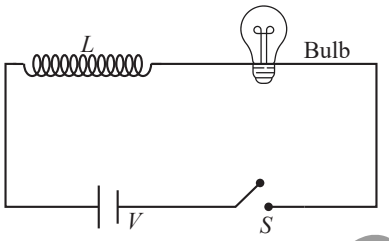
(*a*) 25 A (*b*) 0 A (*c*) 6 A (*d*) 10 A

135. The switch shown in the circuit is closed at $t = 0$ The current drawn from the battery by the circuit at t = 0 and t = ∞ in the ratio



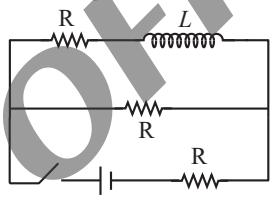
(*a*) 2 : 1 (*b*) 1 : 2 (*c*) 1 : 1 (*d*) 1 : 4

136. The given circuit, bulb will become suddenly bright, if



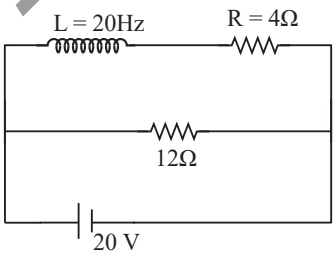
(*a*) Switch is closed or opened
(*b*) Switch is closed
(*c*) Switch is opened
(*d*) None of these

137. The ratio of initial to final current through the battery when the switch is closed in the figure is

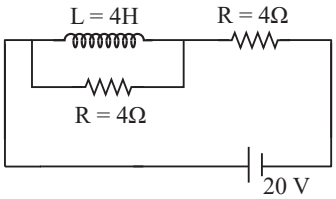


(*a*) Zero (*b*) ∞ (*c*) 4/3 (*d*) 3/4

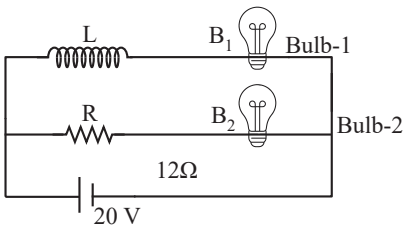
138. Find current at $t = 0$ and t = ∝.



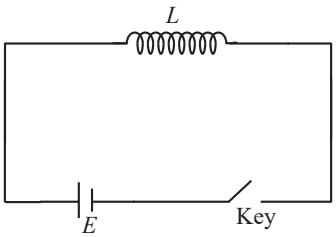
139. Find current at $t = 0$ and t = ∝.



140. Compare Brightness of Bulb at $t = 0$ and t = ∝ (steady state)



141. If only inductor is connected with battery of emf E and switch is closed then find equation of current.



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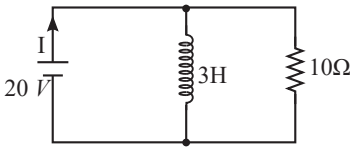
142. Find current through battery at t = 6 sec.

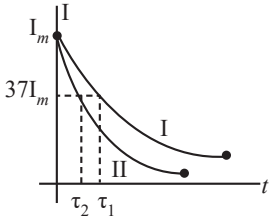


143. At steady state in a given circuit, a iron rod is placed inside inductor then find brightness of bulb after large time.

(*a*) Increase (*b*) Decrease
(*c*) Remains same (*d*) May increase or decrease

Discharging of Inductor

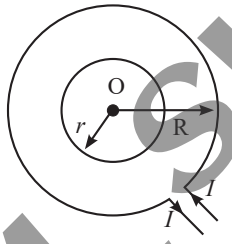
144. Current time graph for discharging of Two Inductor is given then find which option is correct for time constant.



(*a*) $\tau_1 = \tau_2$ (*b*) $\tau_1 > \tau_2$
(*c*) $\tau_1 < \tau_2$ (*d*) can't say

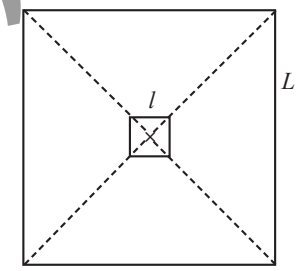
Mutual Inductance

145. Figure shows two concentric loops of radii R and r (R >> *r*). A current *i* is passed through the outer loop. Find the flux linked with inner loop and the mutual inductance of the arrangement.



(*a*) $\frac{\pi\mu_0 r^2}{4R}$ (*b*) $\frac{\pi\mu_0 r^2}{R}$ (*c*) $\frac{\pi\mu_0 R^2}{2r}$ (*d*) $\frac{\pi\mu_0 r^2}{2R}$

146. A small square loop of wire of side *I* is placed inside a large square loop of wire of side L (>>*I*) The loops are coplanar and their centres coincide. The mutual inductance of the system is



(*a*) $\frac{2\sqrt{2}\mu_0 L}{\pi I}$ (*b*) $\frac{2\sqrt{2}\mu_0 L^2}{\pi I}Y$ (*c*) $\frac{2\sqrt{2}\mu_0 I}{\pi L}$ (*d*) $\frac{2\sqrt{2}\mu_0 I^2}{\pi L}$

147. With the decrease of current in the primary coil from 2 A to zero in 0.01 s , the e.m.f. generated in the secondary coil is 1000 V . The mutual inductance of the two coil is

(*a*) 1.25 H (*b*) 2.50 H (*c*) 5.00 H (*d*) 10.00 H

148. Two coaxial coils are very close to each other and their mutual inductance is 5 mH . If a current 50 sin 500*t* is passed in one of the coils then the peak value of induced e.m.f. in the secondary coil will be

(*a*) 5000 V (*b*) 500 V (*c*) 150 V (*d*) 125 V

149. Two coils of self - inductance 2 mH and 8 mH are placed so close together that the effective flux in one coil is completely linked with the other. The mutual inductance between these coils is

(*a*) 10 mH (*b*) 6 mH (*c*) 4 mH (*d*) 16 mH

150. The coefficient of self inductor coils are 20 mH and 40 mH respectively. If the coils are connected in series so as to support each other and the resultant inductance is 80 mH then the value of mutual inductance between the coils will be

(*a*) 5 mH (*b*) 10 mH
(*c*) 20 mH (*d*) 40 mH

151. There are two long co-axial solenoids of same length *l*. The inner and outer coils have radii r_1 and r_2 and number of turns per unit length n_1 and n_2 respectively. The ratio of mutual inductance to the self-inductance of the inner-coil is.

(*a*) $\frac{n_1}{n_2}$ (*b*) $\frac{n_2}{n_1}\frac{r_1}{r_2}$ (*c*) $\frac{n_2}{n_1}\frac{r_2^2}{r_1^2}$ (*d*) $\frac{n_2}{n_1}$

152. The mutual inductance of the two coils is 1.25 henry. In the first coil, the current changes at 80 amp/s, the value of induced emf in volts in the secondary coil will be:

(*a*) 12.5 (*b*) 64
(*c*) 0.016 (*d*) 100

153. Two coils have mutual inductance 0.002 H . The current changes in the first coil according to the relation $i = i_0 \sin \omega t$, where $i_0 = 5$A and $\omega = 50\pi$ rad/s. The maximum value of emf in the second coil is $\frac{\pi}{\alpha}$V . The value of α is.....

154. Two coils having self inductance 2 H and 8 H have a mutual inductance of 3 H . Find the coefficient of coupling.

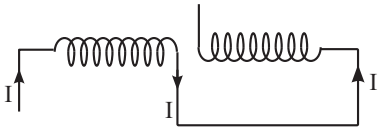
(*a*) 3 /4 (*b*) 1/2 (*c*) 8/3 (*d*) 4/3

Series & Parallel Combination of Inductor

155. The equivalent inductance of two inductor is 2.4 H when connected in parallel and 10 H when connected in series. The difference between two inductance is (Neglecting mutual induction between coils)

(*a*) 2H (*b*) 3 H (*c*) 4 H (*d*) 5 H

156. Two coils of self inductance L_1 and L_2 are connected in series combination having mutual inductance of coil as M . The equivalent self-inductance of the combination will be :



(*a*) $\frac{1}{L_1}+\frac{1}{L_2}+\frac{1}{M}$ (*b*) $L_1 + L_2 + 2M$
(*c*) $L_1 + L_2 + M$ (*d*) $L_1 + L_2 - 2M$

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157. Two coils have self inductance L_1= 4 mH and L_2 = 1 mH respectively. The currents in the two coils are increased at the same rate. At a certain instant of time both coils are given the same power. If I_1 and I_2 are the currents in the two coils, at that instant of time respectively, then the value of I_1 / I_2 is

(*a*) 1/8 (*b*) 1/4 (*c*) 1/2 (*d*) 1

158. A coil is placed in a time varying magnetic field. If the number of turns in the coil were to be halved and the radius of wire doubled, the electrical power dissipated due to the current induced in the coil would be :

(Assume the coil to be short circuited.)

(*a*) Halved (*b*) Quadrupled

(*c*) The same (*d*) Doubled

Transformer

159. In a transformer ratio of secondary turns (N_S) and primary turn (N_P) i.e. $\frac{N_S}{N_P} = 4$.

If the voltage applied on primary side is 200 V, 50 Hz and current is 1 A then which of the following statements are correct :-

A. Voltage induced in secondary coil of transformer is 800 V.

B. If transformer is ideal then current in secondary coil will be 0.25 A .

C. If efficiency of transformer is 80% then current in secondary coil will be 0.15 A .

D. Given transformer is step up transformer

(*a*) A, C, D (*b*) A, B, D

(*c*) A, B, C (*d*) A, B, C, D

160. A transformer is used to light a 200 W and 110 V lamp from a 220 V mains. If the main current is 1 amp , the efficiency of the transformer is approximately :-

(*a*) 10% (*b*) 30%

(*c*) 50% (*d*) 90%

161. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).

Assertion (A) : Transformer cant be used to step up or step down the steady dc voltage

Reason (R) : Transformers are based upon the principle of mutual induction for which a time varying voltage is necessary.

In the light of the above statements, choose the most appropriate answer from the options given below:

(*a*) Both (A) and (R) are true and (R) is the correct explanation of (A).

(*b*) Both (A) and (R) are true and (R) is NOT the correct explanation of (A).

(*c*) (A) is true but (R) is false.

(*d*) (A) is false but (R) is true.

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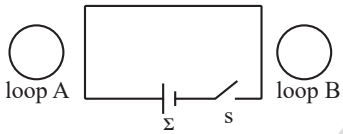
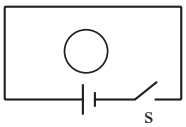
1. **Statement I:** A rod of length l rotates with angular velocity ω about it's perpendicular bisector. A uniform magnetic field B exits parallel to the axis of rotation. The potential difference between the two ends of the rod will be zero.

   Statement II: for the Same situation given above, the potential difference between the centre of the rod and an end will be $\frac{1}{2}B\omega l^2$

2. Consider the situation as shown in figure. If the switch is closed the loop_____ will show clockwise current pulse and after some time if switch is opened again, the loop_____ will show anti-clockwise current pulse.



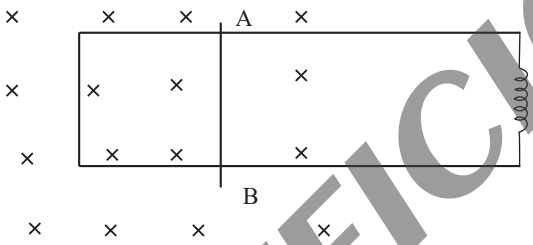
3. Consider the situation as shown in figure. If the switch is closed, _____ current pulse will be generated in loop and if the switch is opened again, the closed loop will show_____ current pulse.



4. **Statement I:** An emf can be induced by moving a conductor in a magnetic field.

   Statement II: An emf can be induced by changing the magnetic field.

5. **Statement I:** Consider the situation as shown below. The wire AB is slid on fixed rails with constant velocity. If the wire AB is replaced by a semicircular wire, the magnitude of induced current will increase due to increase in length.



   Statement II: Two circular loops of equal radii are placed coaxially at some separation. The first is cut & Battery is inserted in between to drive a current in it. The current changes slightly because of variation in resistance with temperature. During this period the Two loops will attract each other.

6. **Statement I:** A small conducting circular loop is placed inside a long solenoid carrying a current. The plane of the loop contains the axis of the solenoid. If the current in the solenoid is varied the current induced in the loop will be zero.

   Statement II: A conducting rod is moved with a constant velocity v in a magnetic field. A potential difference appears across the Two ends only if $\vec{v} \parallel \vec{B}$.

7. A Bar magnet is moved along the axis of a copper ring placed far away from the magnet. Looking from the side of magnet, an anti-clockwise current is found to be induced in the ring. This situation may be true if _____ pole faces the ring & the magnet moves towards it OR The _____ pole faces the ring and the magnet moves away from it.

8. **Statement I:** A conducting loop is placed in a uniform magnetic field with its plane perpendicular to the field. An emf will be induced in the loop if it is translated.

   Statement II: A conducting loop is placed in a uniform magnetic field with its plane perpendicular to the field. An emf will be induced in the loop if it is rotated about its axis.

   Statement III: A conducting loop is placed in a uniform magnetic field with its plane perpendicular to the field. An emf will be induced in the loop if it is Rotated about a diameter.

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Answer Key

1. $\frac{BA}{2}$ **2.** (*i*) $-B_3S$, (*ii*) B_1S, (*iii*), B_2S **3.** $\phi = 0$ **4.** $\phi = 0$ **5.** (*b*) **6.** (*a*) **7.** (c)

8. A: anticlockwise, B: Clockwise **9.** C.W **10.** (*a*) **11.** (*b*) **12.** (i) ACW, (ii) CW **13.** (*a*)

14. B → A & C → D **15.** (*c*) **16.** (*d*) **17.** (*c*) **18.** (0) **19.** (*b*) **20.** (*a*) **21.** (c)

22. ACW then CW **23.** (*a*) **24.** (*a*) **25.** (*d*) **26.** (*c*) **27.** (*b*) **28.** (*a*) **29.** (*b*) **30.** (b)

31. ACW & Upwards **32.** (*b*) **33.** (*d*) **34.** (*a*) **35.** (*b*) **36.** (*b*) **37.** (*a*) **38.** (3) **39.** (*a*)

40. (*a*) **41.** (*b*) **42.** (*d*) **43.** (*a*) **44.** (*d*) **45.** (*b*) **46.** (*a*) **47.** (*a*) **48.** (*b*) **49.** (*d*)

50. $\frac{\mu_0 I_0 l}{\pi}\log\left(\frac{a+l}{a}\right)t$ **51.** 75mV **52.** Sol. $e.m.f = Blv, I = \frac{Blv}{R}$ **53.** 0.1 **54.** (*a*) **55.** (*b*)

56. Place your fore finger of right hand along velocity and slap magnetic field, thumb will represent higher potential **57.** (*d*)

58. (*b*) **59.** (*c*) **60.** (*a*) **61.** (*c*) **62.** (*d*) **63.** (*a*) **64.** (*d*) **65.** (*i*) 0, (*ii*), B*vl*, (*iii*), 0 (*iv*), B*vl*

66. (*i*) B*vl*, (*ii*) 0, (*iii*) B*vl*, (*iv*) 0, **67.** (*b*) **68.** (*c*) **69.** (0) **70.** BVL **71.** 0 **72.** $\frac{\mu IV}{2\pi}\log\left(\frac{a+l}{a}\right)$

73. (*a*) **74.** (*c*) **75.** (*d*) **76.** 18 **77.** (*b*) **78.** (*a*) **79.** (*b*) **80.** (*d*) **81.** (*d*) **82.** (c)

83. (*d*) **84.** (*d*) **85.** (*b*) **86.** (*b*) **87.** (*c*) **88.** $\frac{1}{2}B\omega l^2$ **89.** 0 **90.** (*b*) **91.** (*a*) **92.** (*a*)

93. (*d*) **94.** (*a*) **95.** 5 **96.** $\frac{R^2}{2r}\frac{dB}{dt}$ **97.** (1) $E = \frac{-B_0 r}{2}$, (2) $E = \frac{-B_0 R^2}{2r}$ **98.** (*d*) **99.** (*c*) **100.** (*a*)

101. (*d*) **102.** (*a*) **103.** (*d*) **104.** (*b*) **105.** (*c*) **106.** (*a*) **107.** Increase

108. Because in a DC circuit there is no change in current **109.** I/n **110.** (*a*) **111.** (*c*) **112.** (*a*) **113.** (*d*)

114. (*b*) **115.** (2) **116.** (*a*) **117.** (*c*) **118.** (*b*) **119.** 28V **120.** 6 V **121.** (*a*) **122.** –24V **123.** –23 V

124. (*c*) **125.** 0.2 A/S **126.** (*d*) **127.** (6) **128.** (*d*) **129.** (*b*) **130.** (*b*) **131.** (*i*) $\frac{E}{2R}$, (*ii*) $\frac{2E}{3R}$ **132.** (*d*)

133.(*b*) **134.** (*d*) **135.** (*c*) **136.** (*c*) **137.** (*d*)

138. $t = 0, I = 1.67$ A, $t = \infty, I = 6.67$ A **139.** *At*, $t = 0$, I = 2.5 A, At, t = ∞, I = 5A **140.** $B_1 > B_2$ **141.** $I = \frac{E}{L}t$ **142.** 42A

143. (*c*) **144.** (*b*) **145.** (*d*) **146.** (*d*) **147.** (*c*) **148.** (*d*) **149.** (*c*) **150.** (*b*) **151.** (*d*) **152.** (*d*)

153. (2) **154.** (*a*) **155.** (*a*) **156.** (*d*) **157.** (*b*) **158.** (*c*) **159.** (*b*) **160.** (*d*) **161.** (*d*)

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1. I. True, II. False **2.** (A and B) in both blanks **3.** First Blank → Anticlockwise, Second Blank → Clockwise
4. Both are True **5.** I. False, II. True **6.** I. True, II. False **7.** North, South
8. I. False, II. True, III. True

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Work, Energy & Power

(Practice Questions)

Work

1. **Assertion (A):** Work can't be negative.

   Reason (R): Work is scalar quantity

   (*a*) If both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.
   (*b*) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.
   (*c*) If the Assertion is correct but Reason is incorrect.
   (*d*) If the Assertion is incorrect but the Reason is correct.
   (e) If both the Assertion and Reason are incorrect.

2. **Assertion (A):** Work is a scalar quantity.

   Reason (R): Work is dot product of force & displacement vector and resultant of dot product of two vector is always scalar.

   (*a*) both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.
   (*b*) both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.
   (*c*) the Assertion is correct but Reason is incorrect.
   (*d*) the Assertion is incorrect but the Reason is correct.
   (e) both the Assertion and Reason are incorrect.

3. A force $\vec{F} = \left(2\hat{i} - \hat{j} - 4\hat{k}\right)N$ displaces a particle upto

   $\vec{d} = \left(3\hat{i} + 2\hat{j} - \hat{k}\right)m$. Calculate work done.

   (*a*) Zero (*b*) 8J
   (*c*) 4J (*d*) 12J

4. A 2 kg mass lying on a table is displaced in the horizontal direction through 50 cm. The work done by the normal reaction will be:-

   (*a*) 0 (*b*) 100 joule
   (*c*) 100 erg (*d*) 10 joule

5. A force of 10 N displaces an object by 10 m. If work done is 50 J then direction of force make an angle with direction of displacement:-

   (*a*) 120° (*b*) 90°
   (*c*) 60° (*d*) None of these

6. A stone of mass *m* is tied to a string of length *l* at one end and by holding second end it is whirled into a horizontal circle, then work done will be:-

   (*a*) 0 (*b*) $\left(\frac{mv^2}{\ell}\right)2\pi\ell$
   (*c*) $(\text{mg})\cdot 2\pi\ell$ (*d*) $\left(\frac{mv^2}{\ell}\right)\ell$

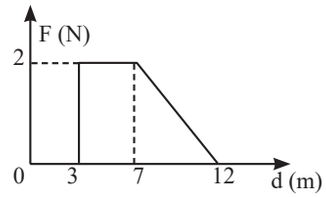
7. A rope is used to lower vertically a block of mass M by a distance *x* with a constant downward acceleration g/2. The work done by the rope on the block is:-

   (*a*) Mg*x* (*b*) $\frac{1}{2}Mgx^2$
   (*c*) $-\frac{1}{2}Mgx$ (*d*) Mgx^2

8. A force $F = Kx^2$ acts on a particle at an angle of 60° with the *x*-axis. The work done in displacing the particle from x_1 to x_2 will be:

   (*a*) $\frac{kx^2}{2}$ (*b*) $\frac{k}{2}\left(x_2^2 - x_1^2\right)$
   (*c*) $\frac{k}{6}\left(x_2^3 - x_1^3\right)$ (*d*) $\frac{k}{3}\left(x_2^3 - x_1^3\right)$

9. Force *F* on a particle moving in a straight line varies with distance *d* as shown in the figure. The work done on the particle during its displacement of 12 m is:



   (*a*) 18 J (*b*) 21 J
   (*c*) 26 J (*d*) 13 J

10. A particle moves from a point $\left(-2\hat{i} + 5\hat{j}\right)$ to $\left(4\hat{j} + 3\hat{k}\right)$ when a force of $\left(4\hat{i} + 3\hat{j}\right)$N is applied. How much work has been done by the force?

    (*a*) 5 J (*b*) 2 J
    (*c*) 8 J (*d*) 11 J

11. A uniform force of $\left(3\hat{i} + \hat{j}\right)$ newton acts on a particle of mass 2 kg . Hence the particle is displaced from position $\left(2\hat{i} + \hat{k}\right)$ meter to position $(4\hat{i} + 3\hat{j} - \hat{k})$ meter. The work done by the force on the particle is:

    (*a*) 15 J (*b*) 9 J
    (*c*) 6 J (*d*) 13 J

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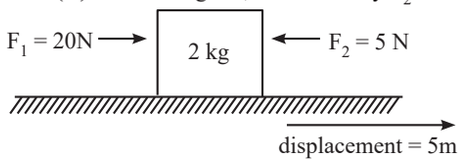
12. A particle moves from point P(1, 2) to Q (2, 1, 4) under the action of a constant force $\vec{F} = \left(2\hat{i} + \hat{j} + \hat{k}\right) N$. Work done by the force is

(*a*) 2 J (*b*) 4 J
(*c*) 16 J (*d*) 8 J
(*e*) 5 J

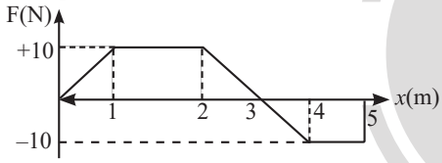
13. **Assertion (A):** In this diagram, work done by F_2 will be - 25N.



Reason (R): Work done by one force doesn't depend on other force acting on object.

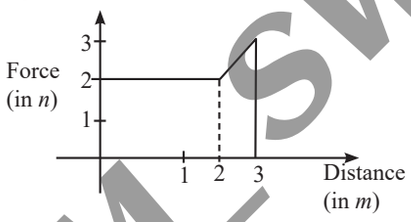
(*a*) If both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.
(*b*) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.
(*c*) If the Assertion is correct but Reason is incorrect.
(*d*) If the Assertion is incorrect but the Reason is correct.
(e) If both the Assertion and Reason are incorrect.

14. A position dependent force F acting on a particle and its force-position curve is shown in the figure. Work done on the particle, when its displacement 0 to 5 m is



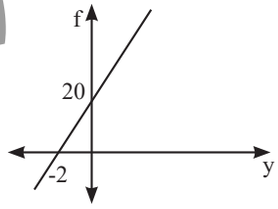
(*a*) 35 J (*b*) 25 J
(*c*) 15 J (*d*) 5 J

15. A particle moves in one dimension from rest under the influence of a force that varies with the distance travelled by the particle as shown in figure. The kinetic energy of particle after it has travelled 3m is:



(*a*) 6.5 Joule (*b*) 2.5 Joule
(*c*) 5 Joule (*d*) 4 Joule

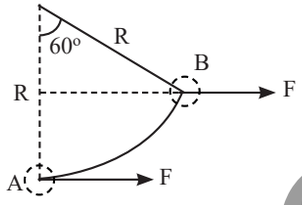
16. Calculate the work done by the force to move the particle from y = 0 to y = 1m from the given graph of F v/s y.



17. A string is used to pull a block of mass m vertically up by a distance h at a constant acceleration g/3. The work done by the tension in the string is

(*a*) 2/3 *mgh* (*b*) (–*mgh*)/3
(*c*) *Mgh* (*d*) 4/3 *mgh*

18. Block of mass *m* is pulled along a circular arc by means of a constant horizontal force *F* as shown. Work done by this force in pulling the block from *A* to *B* is



(*a*) *FR*/2 (*b*) *FR*
(*c*) $\frac{\sqrt{3}}{2}FR$ (*d*) *mgR*

19. Work done by frictional force

(*a*) In always negative
(*b*) Is always positive
(*c*) Is zero
(*d*) May be positive, negative or zero

20. A particle moves along X-axis from $x = 0$ to $x = 1$ m under the influence of a force given by $F = 3x^2 + 2x - 10$ Work done in the process is

(*a*) + 4 J (*b*) – 4 J
(*e*) + 8 J (*d*) – 8 J

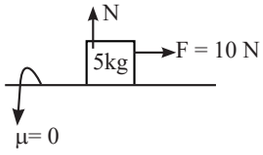
21. A particle moves along *x*-axis from $x = 0$ to $x = 5$ metre under the influence of a force $F = 7 - 2x + 3x^2$ The work done in the process is

(*a*) 70 (*b*) 135
(*c*) 270 (*d*) 35

22. A body of mass 2 kg travels in straight line with velocity $v = x^3$. Work done by net force during its displacement from $x = 1$ m to $x = 2$ m will be:

(*a*) 64 J (*b*) 63 J
(*c*) 32 J (*d*) None of these

23. Find work done by this force in 4-sec



24. Identify the correct statements from following:

A. Work done by a man in lifting a bucket out of a well by means of rope tied to the bucket is negative.
B. Work done by gravitational force in lifting a bucket out of well by rope tied to the bucket is negative,
C. Work done by friction on body sliding down an inclined plane is positive.
D. Work done by an applied force on a body moving on rough horizontal plane with uniform velocity is zero.
E. Work done by air resistance on an oscillating pendulum. is negative.

(*a*) A and C only (*b*) and D only
(*c*) B, D and E only (*d*) B and E only

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25. **Assertion:** While climbing the stairs, work done by normal reaction on the climbing man is zero.

Reason: When normal reaction is acting, there is no displacement of point where normal force is acting and when there is displacement normal stops acting as foot loses its contact with stair during displacement.

(*a*) If both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.

(*b*) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.

(*c*) If the Assertion is correct but Reason is incorrect.

(*d*) If the Assertion is incorrect but the Reason is correct.

(e) If both the Assertion and Reason are incorrect.

26. **Assertion (A):** If a man is walking on a rough road, the work done by the frictional force is positive.

Reason (R): Frictional force acts in the direction of motion of man

(*a*) If both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.

(*b*) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.

(*c*) If the Assertion is correct but Reason is incorrect.

(*d*) If the Assertion is incorrect but the Reason is correct.

(e) If both the Assertion and Reason are incorrect.

27. **Statement-I:** A truck and a car moving with same kinetic energy are brought to rest by applying breaks which provide equal retarding forces both come to rest in equal distance

Statement-II: A car moving towards east takes a town and moves towards north, the speed remains unchanged. The acceleration of car is zero.

In the light of given statements, choose the most appropriate answer from the options given below.

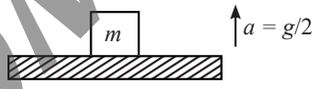
(*a*) Statement I is correct but Statement II is incorrect

(*b*) Statement I is incorrect but Statement II is correct

(*c*) Both Statement I and Statement II are correct

(*d*) Both Statement I and Statement II are incorrect

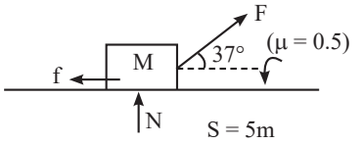
28. A block of mass *m* is kept on a platform which starts from rest with constant acceleration $\frac{g}{2}$ upward, as shown in figure. Work done by normal reaction on block in time *t* is-



(*a*) $\frac{mg^2t^2}{8}$ (*b*) $\frac{3mg^2t^2}{8}$

(*c*) $\frac{-mg^2t^2}{8}$ (*d*) 0

29. A block of mass M = 20 kg is dragged 5 m by force F = 100 N on rough horizontal surface (μ = 0.5). Match the column



Force on block		Work done by force on block	
A.	Applied (F)	R	400 J
B.	Normal (N)	P	Zero
C.	Friction (F)	S	-350 J
D.	Net resultant (F_{res})	Q	50 J

(*a*) A-Q; B-P; C-S; D-R (*b*) A-R; B-P; C-S; D-Q

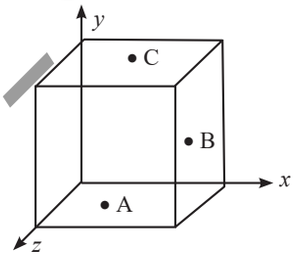
(*c*) A-P; B-Q; C-R; D-S (*d*) A-S; B-R; C-Q; D-P

30. A man pulls a bucket full of water from *h* metre deep well. If the mass of rope is *m* and mass of bucket full of water is *M*, then work done by the man is

(*a*) $\left(\frac{M}{2}+m\right)gh$ (*b*) $\left(\frac{M+m}{2}\right)gh$

(*c*) $\left(M+\frac{M}{2}\right)gh$ (*d*) $(M+m)gh$

31. A particle is shifted from A to B and then from B to C where A, B and C are the midpoints of the corresponding faces of a cube of side 4m. If a force $\vec{F}=(3\hat{i}-4\hat{j}+5\hat{k})$ is continuously acting on the particle, then select incorrect alternative



(*a*) Work done from A to B is -2J

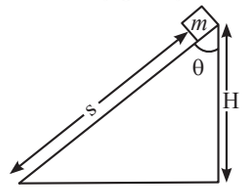
(*b*) Work done from B to C is -14J

(*c*) Work done from A to Cis-16J

(*d*) Force $\vec{F}$, is nonconservative force

Work done by Gravity & Friction

32. In the diagram, a mass *m* is placed on an inclined plane. The mass is moved along the plane a distance *s*, with the vertical height *H*. The work done by gravity is:



(*a*) *mgs* (*b*) *mgs*cosθ

(*c*) *mgh* (*d*) Both *B & C*

33. The upper half of an inclined plane of inclination θ is perfectly smooth while lower half is rough. A block starting from rest at the top of the plane will again come to rest at the bottom, if the coefficient of friction between the block and lower half of the plane is given by

(*a*) $\mu=\frac{2}{\tan\theta}$ (*b*) μ = 2tanθ

(*c*) μ = tanθ (*d*) $\mu=\frac{1}{\tan\theta}$

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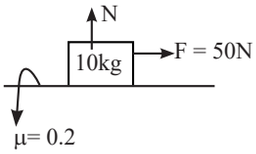
34. A horizontal force F = 50 N is applied to a block of mass 10 kg resting on a horizontal surface with a coefficient of friction μ=0.2. The block moves under the influence of this force. Calculate the work done by the frictional force on the block over a time period of 3 seconds.



35. A block of mass *M* is being acted upon by a horizontal force *F*, causing it to move a distance *s* along the positive *x*-axis. The surface has a coefficient of friction μ and the force *F* makes an angle β as shown in figure. Find the work done by friction on block

36. The work done by the frictional force on a surface in drawing a circle of radius *r* on the surface by a pencil of negligible mass with a normal pressing force N(coefficient of friction μk) is:

(*a*) 0 (*b*) $-2\pi r^2 \mu kN$

(*c*) $-3\pi r^2 \mu kN$ (*d*) $-2\pi r \mu kN$

37. **Assertion (A):** Work done by friction may be positive.

Reason (R): Friction always opposes the motion.

(*a*) If both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.

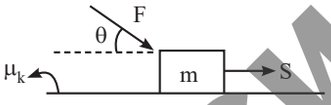
(*b*) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.

(*c*) If the Assertion is correct but Reason is incorrect.

(*d*) If the Assertion is incorrect but the Reason is correct.

(e) If both the Assertion and Reason are incorrect.

38. Find work done by friction for displacement 'S'?



(*a*) μ_k (mg + F sinθ). S (*b*) $-\mu_k$ (mg + F cosθ). S

(*c*) μ_k (mg – F sinθ). S (*d*) $-\mu_k$ (mg – F sinθ). S

39. Mtch the following columns.

Column-I		Column-II	
A	Work done in pulling out a bucket from well by person and by gravitational force	1.	Positive
B	Work done by friction on a body sliding down an inclined plane	2.	Negative
C	Work done by a person in pulling a luggage on a rough surface	3.	Positive
D	Work done by air in bringing a vibrating pendulum to rest	4.	Negative

(*a*) 4 1 2 3 (*b*) 3 2 1 4

(*c*) 4 2 1 3 (*d*) None of the above

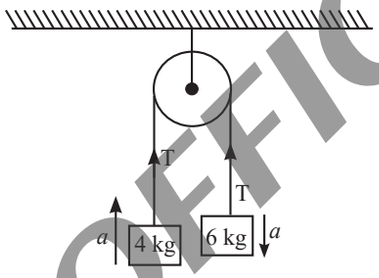
40. A small block of mass *m* is kept on a rough inclined surface with inclination angle θ, fixed in an elevator. The elevator goes down with a uniform velocity *v* and the block does not slide on the wedge. The work done by the force of friction on the block in time *t* will be

(*a*) $-mgvt$ (*b*) $mgvt$

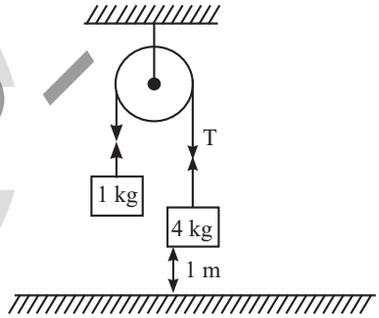
(*c*) $-mgvt \sin^2\theta$ (*d*) $-mgvt \cos^2\theta$

Work done by Tension Force and Spring Force

41. Two blocks of masses 4 kg and 6 kg are connected by a light inextensible string over a frictionless pulley as shown in the figure. The system is released from rest at $t = 0$. Find the work done by the tension and the gravitational force on both blocks in 2 seconds. Assume the acceleration due to gravity $g = 10 m/s^2$.



42. The net work done by the tension in the figure when the bigger block of mass 4 kg touches the ground is :



(*a*) 40 J (*b*) +30 J

(*c*) -30 J (*d*) Zero

43. If work done by spring is *w* in elongation of 2m then find work done in further elongation of 2m

(*a*) w (*b*) 3 w

(*c*) 2 w (*d*) 4 w

Kinetic Energy-Momentum Relation

44. Two identical particle having same *k-E* must have same momentum

(*a*) True (*b*) False

45. Two identical particle having same momentum must have same

(*a*) True (*b*) False

46. **Statement-I:** Work done by one force doesn't depend on other forces acting on a body.

Statement-II: Two objects having some kinetic energy and some mass must passes same momentum

In the light of given statements, choose the most appropriate answer from the

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Options given below.

(*a*) Statement I is correct but Statement II is incorrect

(*b*) Statement I is incorrect but Statement II is correct

(*c*) Both Statement I and Statement II are correct

(*d*) Both Statement I and Statement II are incorrect

47. **Assertion (A):** Two object of same mass having same kinetic energy will must have same momentum.

Reason (R): Those two object have same speed.

(*a*) If both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.

(*b*) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.

(*c*) If the Assertion is correct but Reason is incorrect.

(*d*) If the Assertion is incorrect but the Reason is correct.

(*e*) If both the Assertion and Reason are incorrect

48. **Assertion (A):** The object having lower mass will always have lower kinetic energy as compared to kinetic energy of object having higher mass.

Reason (R): Kinetic energy is always directly proportional to mass by formula K.E. $\frac{1}{2}mv^2$

(*a*) If both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.

(*b*) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.

(*c*) If the Assertion is correct but Reason is incorrect.

(*d*) If the Assertion is incorrect but the Reason is correct.

(e) If both the Assertion and Reason are incorrect

49. Two bodies of masses m_1 and m_2 have same momentum. The ratio of their kinetic energy is

(*a*) $\sqrt{\frac{m_2}{m1}}$ (*b*) $\sqrt{\frac{m_1}{m_2}}$

(*c*) $\frac{m_1}{m_2}$ (*d*) $\frac{m_2}{m_1}$

50. Two bodies with kinetic energies in the ratio of 4: 1 are moving with equal linear momentum. The ratio their masses is

(*a*) 4 :1 (*b*) 1 : 1

(*c*) 1 : 2 (*d*) 1 : 4

51. A stationary particle explodes into two particles of masses m_1 and m_2 which move in opposite directions with velocities v_1 and v_2

The ratio of their kinetic energies $\frac{E_1}{E_2}$ is

(*a*) $\frac{m_2}{m_1}$ (*b*) $\frac{m_1}{m_2}$

(*c*) 1 (*d*) $\frac{m_1v_2}{m_2v_1}$

52. Two bodies of masses m_1 and m_2 are moving with same kinetic energy. If P_1 and P_2 are their respective momentum, the $\frac{P_1}{P_2}$ ratio is equal to

(*a*) $\frac{m_1}{m_2}$ (*b*) $\sqrt{\frac{m_2}{m_1}}$

(*c*) $\sqrt{\frac{m_1}{m_2}}$ (*d*) $\frac{m_1^2}{m_2^2}$

53. A body moving with velocity *v* has momentum and kinetic energy numerically equal. What is the value of *v*?

(*a*) 2 m/s (*b*) √2 m/s

(*c*) 1 m/s (*d*) 0.2 m/s

54. If man increase his speed by 2 m/s, his K.E. is doubled, the original speed of the man is:

(*a*) (1 + 2√2) m/s (*b*) 4 m/s

(*c*) (2 + 2√2) m/s (*d*) (2 + √2) m/s

55. If % change in kinetics energy is 3% then find % change in momentum.

56. Kinetic energy of a body is increased by 44% what is the percentage increases in the momentum?

(*a*) 10 % (*b*) 20 %

(*c*) 30 % (*d*) 44 %

57. Fill in the blank. If the kinetic energy (K.E) is increased by 44%, then the final kinetic energy ($K.E_F$)———

58. If the kinetic energy (K.E) decreases by 44%, then the final kinetic energy ($K.E_F$)———

59. If the kinetic energy (K.E) decreases by 17%, then the final kinetic energy ($K.E_F$)———

60. If the kinetic energy (K.E) is changed to 30%, of initial K.E. Then the final kinetic energy ($K.E_F$)———

61. When momentum of a body increases by 200%, its kinetic energy increases by

(*a*) 200 % (*b*) 300 %

(*c*) 400 % (*d*) 800 %

62. If kinetic energy is decrease by 19% then % change in momentum

63. Match the column I with column II

	Column-I		Column-II
(1)	If kinetic energy is increased by 300%, then percentage change in momentum	(A)	30%
(2)	When a momentum of body increases by 200%, It's kinetic energy increases by	(B)	100%
(3)	If kinetic energy is decreased by 19% then % changes in momentum	(C)	800%
(4)	If K.E. increases by 69%, then find % change in momentum	(D)	10%

Work-Energy Theorem

64. Kinetic energy acquired by a mass *m* in travelling a certain distance *d*, starting from rest, under the action of a constant force F is

(*a*) Directly proportional to $\sqrt{m}$

(*b*) Directly proportional to *m*

(*c*) Directly proportional to $\frac{1}{m}$

(*d*) None of these

65. Under the action of a force 2 kg body moves such that its position *x* as α function of time t is given by $x = t^2/3$ where *x* is in metres and *t* in seconds. The work done by the force in first two seconds is

(*a*) 1600 J (*b*) 160 J

(*c*) 16 J (*d*) 16/9 J

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66. A particle of mass 3 kg is moving along x-axis and its position at time t is given by equation $x = (2t^2 + 5)$ m. Work done by all the forces acting on it in time interval $t = 0$ to $t = 3$ is

(*a*) 144 J (*b*) 72 J
(*c*) 108 J (*d*) 216 J

67. A particle of mass 2 kg travels along a straight line with velocity $v = a\sqrt{x}$,where a is a constant. The work done by net force during the displacement of particle from x, = 0 to x = 4 m is

(*a*) a^2 (*b*) $2a^2$
(*c*) $4a^2$ (*d*) $\sqrt{2}a^2$

68. A particle of mass m starts moving from origin along x-axis and its velocity varies with position (x) as $v = k\sqrt{x}$. The work done by force acting on it during first "t" seconds is

(*a*) $\frac{mk^4t^2}{4}$ (*b*) $\frac{mk^2t}{2}$
(*c*) $\frac{mk^4t^2}{8}$ (*d*) $\frac{mk^2t^2}{4}$

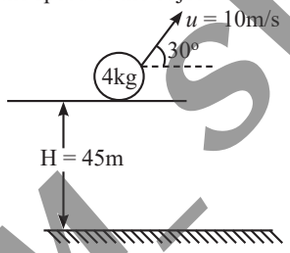
69. A rifle bullets loses $\left(\frac{1}{20}\right)^{th}$ of its velocity in passing through a plank. Assuming that the plank exerts a constant retarding force, the least number of such planks required just to stop the bullet is

(*a*) 11 (*b*) 20
(*c*) 21 (*d*) Infinite

70. A particle of mass m is projected at an angle a to the horizontal with an initial velocity u. The work done by gravity during it reaches its highest point is

(*a*) $u^2\sin^2\alpha$ (*b*) $-\frac{mu^2\cos^2\alpha}{2}$
(*c*) $\frac{mu^2\sin^2\alpha}{2}$ (*d*) $-\frac{mu^2\sin^2\alpha}{2}$

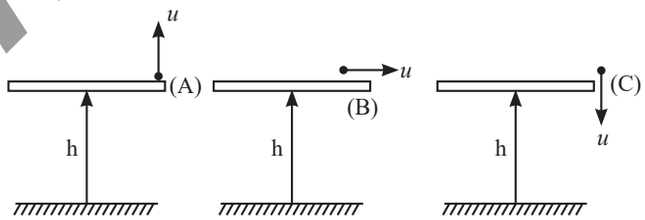
71. A 4 kg object is projected with an initial velocity of u = 10 m/s at an angle of 30° with the horizontal from a platform of height H = 45. Calculate the speed of the object when it reaches the ground.



72. Object 5 Kg dropped from a height 20 m then its velocity at ground is 5 m/s, then find work done by friction

73. Object of mass 2 kg is projected up with velocity 20 m/s and its vertical height attained by it is 10 m. Then find work done by friction will be

74. **Statement-I:** If A, B and C all are projected with same speed in different directions as shown. Their velocity while striking the ground will be same.



Statement-II: In all the given scenarios, work done by gravity is same

n the light of given statements, choose the most appropriate answer from the

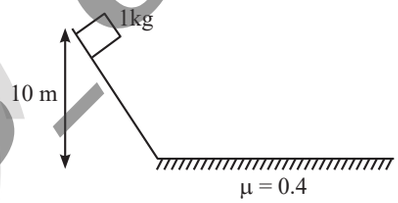
options given below.

(*a*) Statement I is correct but Statement II is incorrect
(*b*) Statement I is incorrect but Statement II is correct
(*c*) Both Statement I and Statement II are correct
(*d*) Both Statement I and Statement II are incorrect

75. A body of mass 'm' dropped from a height 'h' reaches the ground with a speed of 0.8 $\sqrt{gh}$ The value of work done by the air-friction is

(*a*) –0.68 mgh (*b*) 0.64 mgh
(*c*) mgh (*d*) 1.64 mgh

76. A block of mass 1 kg is released, then distance travelled by the block before it stop on rough track will be:

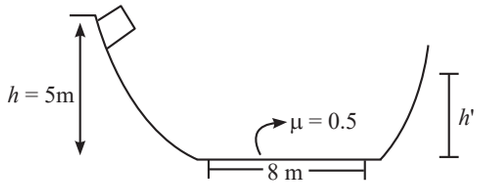


(*a*) 100 m (*b*) 25 m
(*c*) 50 m (*d*) None of these

77. Consider a drop of rain water having mass 1 g falling from a height of 1 km. It hits the ground with a speed of 50 ms^{-1}. Take 'g' constant with a value 10 ms^{-2}. The work done by the (i) gravitational force and the (ii) resistive force of air is

(*a*) (i) 1.25 J (ii) –8.25 J (*b*) (i) 100 J (ii) 8.75 J
(*c*) (i) 10 J (ii) –8.75 J (*d*) (i) –10 J (ii) –8.25 J

78. A block is released from rest from a height h = 5 m. after travelling through the smooth curved surface it moves on rough horizontal surface through a length l = 8m and climbs onto the other smooth curved surface through a height h. If m = 0.5kg find h'.



79. A simple pendulum with bob of mass m and length x is held in position at an angle θ_1 and then angle θ_2 with the vertical. When released from these positions, speeds with which it passes the lowest positions are v_1 and v_2 respectively. Then, v_1/v_2 is

(*a*) $\frac{1-\cos\theta_1}{1-\cos\theta_2}$ (*b*) $\sqrt{\frac{1-\cos\theta_1}{1-\cos\theta_2}}$
(*c*) $\sqrt{\frac{2gx(1-\cos\theta_1)}{1-\cos\theta_2}}$ (*d*) $\sqrt{\frac{1-\cos\theta_1}{2gx(1-\cos\theta_2)}}$

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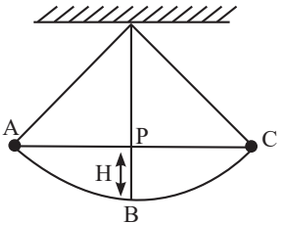
80. A simple pendulum with a bob of mass m oscillates from A to C and back to A such that PB is H. If the acceleration due to gravity is g, then the velocity of the bob as it passes through B is



(*a*) 2gH (*b*) $\sqrt{2gH}$
(*c*) Zero (*d*) 1gH

81. To maintain a speed of 80 km/h by a bus of mass 500 kg on a plane rough road for 4 km distance, the work done by the engine of the bus will be_____KJ the coefficient of friction between tyre of bus and road is 0.04

82. An object of mass m slides down a hill of orbit ray shape and after travelling a certain horizontal path stops because of friction. The total vertical height descended is h. The friction coefficient is different for different segments for entire path but it is independent of velocity and direction of motion. The work that a tangential force must perform to return the object to tis initial position along same path is

(*a*) mgh (*b*) –2 mgh
(*c*) –mgh (*d*) 2 mgh

83. A block of mass m is released on the top of a smooth inclined plane of length x and inclination as shown in figure. Horizontal surface is rough. If block comes to rest after moving a distance d on the horizontal surface, then coefficient of friction between block and surface is

(*a*) $\frac{x\sin\theta}{2d}$ (*b*) $\frac{x\cos\theta}{2d}$
(*c*) $\frac{x\sin\theta}{d}$ (*d*) $\frac{x\cos\theta}{d}$

84. A stone with weight w is thrown vertically upward into the air from ground level with initial speed v_0. If a constant force f due to air drag acts on the stone throughout its flight. The maximum height attained by the stone is

(*a*) $h=\frac{v_0^2}{2g\left(1+\frac{f}{w}\right)}$ (*b*) $h=\frac{v_0^2}{2g\left(1-\frac{f}{w}\right)}$
(*c*) $h=\frac{v_0^2}{2g\left(1+\frac{w}{f}\right)}$ (*d*) $h=\frac{v_0^2}{2g\left(1-\frac{w}{f}\right)}$

85. If constant force acting on object find kinetic energy as a function of time?

86. If position of object is proportional to time ($x \propto t$) then find work as a function of time

87. If acceleration of object is proportional to time ($a = kt$) them find K.E as a function of time.

88. A particle experiences a variable force $\vec{F}=(4x\hat{i}+3y^2\hat{j})$ in a horizontal x-y plane. Assume distance in meters and force is Newton. If the particle moves from point (1, 2) to point (2, 3) in the x-y plane, then kinetic energy changes by:

(*a*) 50.0 J (*b*) 12.5 J
(*c*) 25.0 J (*d*) 0 J

Potential Energy

89. Potential energy is defined

(*a*) Only in conservative fields
(*b*) As the negative of work done by conservative forces
(*c*) As the negative of work done by external forces when $\Delta K = 0$
(*d*) All of these

90. **Assertion (A):** Potential energy is defined as negative of work done by external forces when change in kinetic energy = 0.

Reason (R): Potential energy doesn't depend on frame of reference

(*a*) If both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.
(*b*) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.
(*c*) If the Assertion is correct but Reason is incorrect.
(*d*) If the Assertion is incorrect but the Reason is correct.
(*e*) If both the Assertion and Reason are incorrect.

91. A air bubble in water raising up then potential energy of air bubble will

(*a*) increase (*b*) decrease
(*c*) constant (*d*) can't say

92. **Assertion (A):** In every nature process, potential energy always decreases.

Reason (R): Lesser the potential energy processes goes towards stability. higher will be stability and nature processes goes towards stability

(*a*) If both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.
(*b*) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.
(*c*) If the Assertion is correct but Reason is incorrect.
(*d*) If the Assertion is incorrect but the Reason is correct.
(e) If both the Assertion and Reason are incorrect.

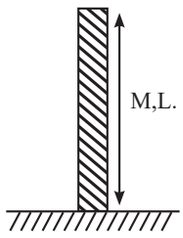
93. When a conservative force does positive work on a body then the

(*a*) Potential energy of body increases
(*b*) Potential energy of body decreases
(*c*) Total mechanical energy of body increases
(*d*) Total mechanical energy of body decreases

94. The potential energy of a system increases if work is done

(*a*) upon the system by a non-conservative force
(*b*) by the system against a conservative force
(*c*) the system against a non-conservative force
(*d*) upon the system by a conservative force

95. A rod of mass M and length L is placed vertical as shown Then its potential energy will be: (Reference line is ground)



(*a*) MgL (*b*) MgL/2
(*c*) MgL/4 (*d*) MgL/3

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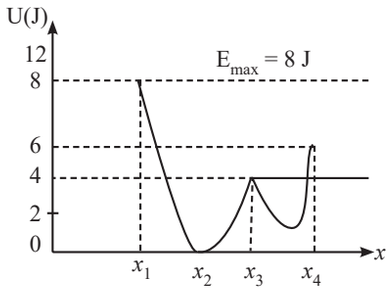
96. A rod of mass M and length L is released from vertically upward position, then its total kinetic energy in its vertically downward position will be:

(*a*) 2 MgL (*b*) MgL

(*c*) Mgl/2 (*d*) 4MgL

97. Given below is the plot of a potential energy function $U(x)$ for a system, in which a particle is in one dimensional motion, while a conservation force $F(x)$ acts on it. Suppose that E_{max} = 8J, the incorrect statement for this system is:



(*a*) at $x = x_3$, *K. E.* = 4 J.

(*b*) at $x > x_4$, *K.E.* is constant throughout the region.

(*c*) at $x < x_1$, *K.E.* is smallest and the particle is moving at alowest speed.

(*d*) at $x = x_2$, *K.E.* is greatest and the particle is moving at the fastest speed.

98. Assume that in space potential energy U-depends on x-coordinate only by $U = \frac{x^3}{3} - 6x^2 + 32x$ A mass m can be kept on x-axis. In each position indicated in column-1, comment situation from column-II.

Column-I		Column-II	
A	$x = 8$	P	Stable equilibrium
B	$x = 2$	Q	Unstable equilibrium
C	$x = 4$	R	Neutral equilibrium
		S	Not a equilibrium

(*a*) A → P, B → S, C → R (*b*) A → S, B → P, C → Q

(*c*) A → P, B → S, C → Q (*d*) A → Q, B → S, C → P

99. Select the correct statements

(*a*) Potential energy is defined only for gravitational force.

(*b*) Potential energy can be associated with frictional force

(*c*) Work done by spring force is equal to change in potential energy of the spring.

(*d*) Potential energy defined as negative work done by conservative force

(*e*) Total work done by all external force is equal to change in KE.

(*a*) a and b (*b*) a and c

(*c*) d, e (*d*) None of these

Potential Energy-Conservative Force Relation

100. The potential energy $U(x)$ of a particle moving long x-axis is given by $U(x) = ax - bx^2$ Find the equilibrium position of particle

101. $U = 2x^3 - 15x^2 + 36x$ then stable equilibrium position will be:

(*a*) $x = 2$ (*b*) $x = 3$

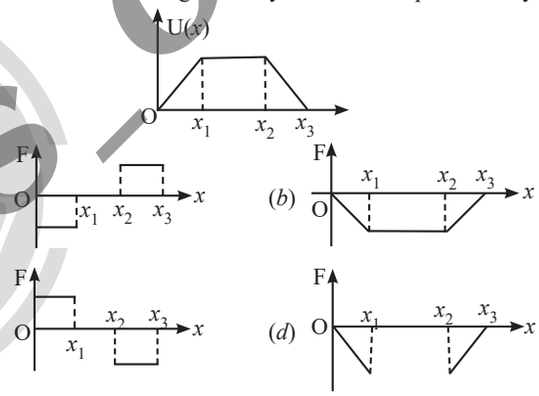
(*c*) both (1) and (2) (*d*) None of these

102. The potential energy of an object of mass m moving in xy - plane in a conservative field is given by $U = ax + by$, where x and y are position coordinates of the object. Find magnitude of its acceleration.

103. If Potential enemy $U = \left(\frac{a}{x^4} - \frac{b}{x^5}\right)$ find x for which object will be in equilibrium)

104. If potential energy ($U = xy + yz + zx$), find force at (1,1,1)

105. The variation of potential energy U of a system is Shown in figure. The force acting on the system is best represented by



106. **Assertion (A):** Slope of work v/s displacement group gives force.

Reason (R): Area of force v/s displacement graph gives work.

(*a*) If both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.

(*b*) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.

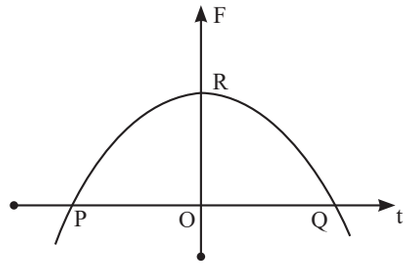
(*c*) If the Assertion is correct but Reason is incorrect.

(*d*) If the Assertion is incorrect but the Reason is correct.

(e) If both the Assertion and Reason are incorrect.

Potential Energy-Distance Graph

107. At which point particle is at equilibrium.



(*a*) P (*b*) R

(*c*) Q (*d*) Both P & Q

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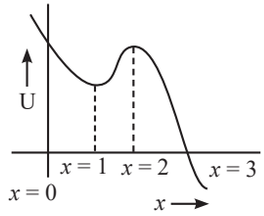
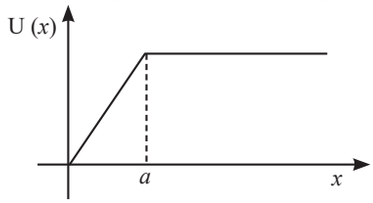
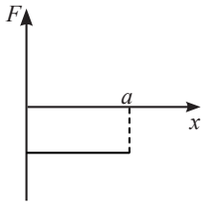
108. The equilibrium positions of a particle moving in the potential field as shown in the figure will be at:

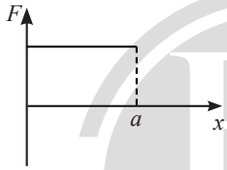


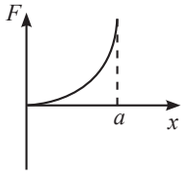
(*a*) $x = 0$ and 3 (*b*) $x = 0$ and 2
(*c*) $x = 1$ and 2 (*d*) x = 0, 1, 2 and 3

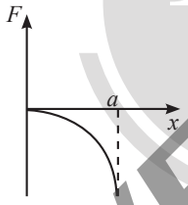
109. Convert the given graph U(*x*)/*x* into *F*/*x* graph



(*a*)


(*b*)


(*c*)


(*d*)


Work done by Conservative Force - Potential Energy Difference Relation

110. One of the some forces acting on a particle is conservative then :-

(*a*) Its work done is non zero when the particle moves exactly once around any closed path.
(*b*) Its work equals the change in the kinetic energy of the particle
(*c*) It does not obey Newton's second law.
(*d*) Its work done depends on the terminal points of the motion, not on the path in between

111. A particle in a certain conservative force field has a potential energy given by $U = \frac{20xy}{z}$ The force exerted on it is

(*a*) $\left(\frac{20y}{z}\right)\hat{i} + \left(\frac{20x}{z}\right)\hat{j} + \left(\frac{20xy}{z^2}\right)\hat{k}$

(*b*) $-\left(\frac{20y}{z}\right)\hat{i} - \left(\frac{20x}{z}\right)\hat{j} + \left(\frac{20xy}{z^2}\right)\hat{k}$

(*c*) $-\left(\frac{20y}{z}\right)\hat{i} - \left(\frac{20x}{z}\right)\hat{j} - \left(\frac{20xy}{z^2}\right)\hat{k}$

(*d*) $-\left(\frac{20y}{z}\right)\hat{i} + \left(\frac{20x}{z}\right)\hat{j} - \left(\frac{20xy}{z^2}\right)\hat{k}$

112. **Statement-I:** Friction is a non-conservative force.

Statement-II: This is because work done against friction, in moving a body over a closed path, is never zero.

(*a*) Statement - 1 is true , statement -2 is true, and statement-2 is correct explanation of statement -1.
(*b*) Statement-1 if true, statement-2 is true, but statement -2 is not a correct explanation of statement-1.
(*c*) Statement-1 is true, but statement -2 is false.
(*d*) Statement-1 is false, but statement-2 is true.

113. If work done by Conservative force to move the object for A to B is 50 J then find potential energy at A if $U_\beta = -20$J

(*a*) 30 J (*b*) –30 J
(*c*) 70 J (*d*) –70 J

114. If work done by Conservative force is -30J in moving form A to B if potential energy at A is 30 J then find potential energy at (B)

(*a*) 60 J (*b*) –60J
(*c*) 0 (*d*) 30 J

115. **Assertion (A):** Work done in close path for conservative forces is always zero.

Reason (R): Work depends only initial and final position for conservative forces.

(*a*) If both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.
(*b*) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.
(*c*) If the Assertion is correct but Reason is incorrect.
(*d*) If the Assertion is incorrect but the Reason is correct.
(e) If both the Assertion and Reason are incorrect.

116. **Assertion (A):** We can find potential energy of object if we know work done by conservative force.

Reason (R): Charge in potential energy doesn't depend on frame of reference,

(*a*) If both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.
(*b*) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.
(*c*) If the Assertion is correct but Reason is incorrect.
(*d*) If the Assertion is incorrect but the Reason is correct.
(e) If both the Assertion and Reason are incorrect.

Work Done by Non-Conservative Force and Potential Energy Difference relation

117. Work done in bringing object from A to B is 40 J then find potential energy at B if $U_A = -30$J

(*a*) 70 J (*b*) –10 J
(*c*) +10J (*d*) + 70J

118. A chain of length L and mass *m* (uniformly distributed) is hanging with one-third of its length over the edge of a table. Calculate the work required to slowly pull the hanging part of the chain back onto the table.

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119. A chain is on a frictionless table with one fifth of its length hanging over the edge. If the chain has length L and mass M, the work required to be done to pull the hanging part back onto the table is (vary slowly)

(*a*) $\frac{MgL}{30}$ (*b*) $\frac{-MgL}{30}$

(*c*) MgL/50 (*d*) $\frac{-MgL}{50}$

Work Done by Spring Force and Potential Energy

120. Force constants K_1 and K_2 of two springs are in the ratio 5: 4. They are stretched by same length. If potential energy stored in one spring is 25 J then potential energy stored in second spring is

(*a*) 25 J (*b*) 16 J
(*c*) 100 J (*d*) 20 J

121. Two springs have their force constants in the ratio of 3: 4. Both the springs are stretched by applying equal force F If elongation in first spring is *x* then elongation in second spring is

(*a*) 3*x* (*b*) 4*x*
(*c*) $\frac{4}{3}x$ (*d*) $\frac{3}{4}x$

122. Two springs A and B having spring constant K_A and K_B ($K_A = 2 K_B$) are stretched by applying force of equal magnitude. If energy stored in spring A is E_A then energy stored in B will be

(*a*) $2E_A$ (*b*) $E_A/4$
(*c*) $E_A/2$ (*d*) $4 E_A$

123. A spring with spring constants k when compressed by 1 cm, the potential energy stored is U. If it is further compressed by 3 cm, then change in its potential energy is

(*a*) 3 U (*b*) 9 U
(*c*) 8 U (*d*) 15 U

124. Two similar springs P and Q have spring constants K_P and K_Q such that $K_P > K_Q$ They stretched first by the same amount (case a), then by the same force (case b). The work done by the springs W_P and W_Q are related as in case (*a*) and case (*b*), respectively

(*a*) $W_P < W_Q$; $W_Q < W_P$ (*b*) $W_P = W_Q$; $W_P = W_Q$
(*c*) $W_P = W_Q$; $W_P > W_Q$ (*d*) $W_P > W_Q$; $W_Q > W_P$

125. **Assertion (A):** Two similar springs P and Q having spring constants K_P and K_Q [$K_P > K_Q$] are stretched by same force. So work done by P will be more than Q.

Reason (R): Work done in stretching the spring is given by $W = -\frac{1}{2}Kx^2$. So, K↑→ W↑ for same explain compression.

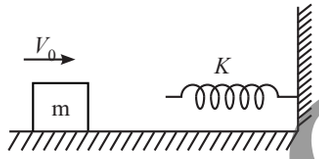
(*a*) If both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.
(*b*) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.
(*c*) If the Assertion is correct but Reason is incorrect.
(*d*) If the Assertion is incorrect but the Reason is correct.
(e) If both the Assertion and Reason are incorrect

126. The potential energy of long spring when stretched by 2 cm is U. In order to gain 16 U of potential energy, By how much cm sparing should be stretched further ?

(*a*) 8 cm (*b*) 6 cm
(*c*) 16 cm (*d*) 12 cm

Conservation of Mechanical Energy

127. A block of mass *m* moving with velocity V_0 on a smooth horizontal surface hits the spring of constant *k* as shown. The maximum compression in spring is



128. As per the given figure, two blocks each of mass 250 g are connected to a spring of spring constant 2 Nm^{-1}. If both are given velocity *v* in opposite direction, then maximum elongation of the spring is:

(*a*) $\frac{v}{2\sqrt{2}}$ (*b*) $\frac{v}{2}$

(*c*) $\frac{v}{4}$ (*d*) $\frac{v}{\sqrt{2}}$

129. A uniform cable of mass *M* and length *L* is placed on a horizontal surface 1 such that its $(1/n)^{th}$ part is hanging below the edge of the surface. To lift the hanging part of the cable upto the surface, the work done should be:

(*a*) $\frac{MgL}{n^2}$ (*b*) $\frac{MgL}{2n^2}$

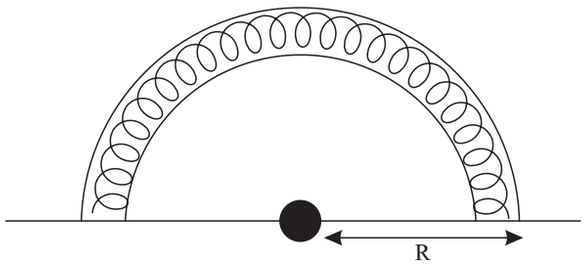
(*c*) $\frac{2MgL}{n^2}$ (*d*) nMgL

130. A uniform chain of length 3 m and mass 3 kg overhangs a smooth table with 2 m laying on the table, If *k* is the kinetic energy of the chain in joule as it completely slips off the table, then the value of *k* is___ (Take g = 10m /s^2)

(*a*) 30 (*b*) 10
(*c*) 40 (*d*) None of these

131. Initially half length of chain of mass *M* and length *L* hanged vertically from table and released from smooth table find, speed of chain when it becomes vertical.

132. Find potential energy of chain of mass M placed on hemispherical surface. of radius R



(*a*) MgR (*b*) $\frac{MgR}{2}$

(*c*) Zero (*d*) $\frac{2MgR}{\pi}$

133. Two protons moving towards each other then P.E will

(*a*) Increase (*b*) Decrease
(*c*) Constant (*d*) can't say

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134. An electron and a positron are moving towards each other. What happens to the kinetic energy and potential energy as they approach?

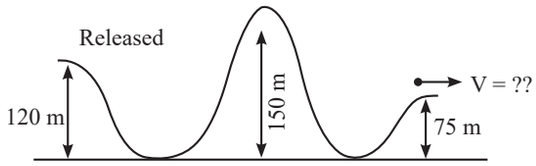
(*a*) Kinetic energy increases and potential energy decreases.

(*b*) Kinetic energy decreases and potential energy increases.

(*c*) Both kinetic and potential energy increase.

(*d*) Both kinetic and potential energy decrease.

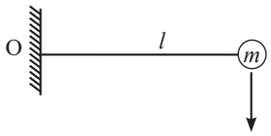
135. A body is released from rest at a height of 120 m above the ground and moves along a frictionless track. It reaches a maximum height of 150 m before descending to a height of 75 m. Assuming all potential energy is converted to kinetic energy during motion, calculate the speed of the body at the lowest point (75 m above the ground).



(*a*) $v = 30$ m/s (*b*) $v > 30$ m/s

(*c*) $v < 30$ m/s (*d*) Not possible

136. Ball is released from horizontal position then find its speed when it rotated by 60º



137. Calculate K.E. and potential energy when ball of mass 3 kg is projected up with speed 20 m/s after 1 sec.

138. The potential energy of a system increases if work is done:

(*a*) Upon the system by a non conservative force

(*b*) By the system against a conservative force

(*c*) By the system against a non conservative force

(*d*) Upon the system by a conservative force

139. When a conservative force does positive work on a body,

(*a*) The potential energy increases

(*b*) The potential energy decreases

(*c*) Total energy increases

(*d*) Total energy decreases

140. An open knife edge of mass *M* is dropped from a height *h* on a wooden floor. If the blade penetrates distance in to the wood, the average resistance offered by the wood to the blade is

(*a*) Mg (*b*) $Mg\left(1+\frac{h}{s}\right)$

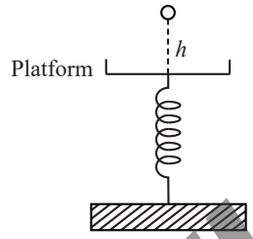
(*c*) $Mg\left(\frac{1-h}{s}\right)$ (*d*) $Mg\left(\frac{1+h}{s}\right)z$

141. A vertical spring with force constant *k* is fixed on a table. A ball of mass *m* at a height *h* above the free upper end of the spring falls vertically on the spring so that the spring is compressed by a distance *d*. The net work done in the process is

(*a*) $mg\,(h+d)-\frac{1}{2}kd^2$ (*b*) $mg\,(h-d)-\frac{1}{2}kd^2$

(*c*) $mg\,(h-d)+\frac{1}{2}kd^2$ (*d*) $mg\,(h+d)+\frac{1}{2}kd^2$

142. A ball of mass 100 g is dropped from a height h = 10 cm on a platform fixed at the top of a vertical spring (as shown in figure). The ball stays on the platform and the platform is depressed by a distance h/2. The spring constant is_____Nm^{-1} (Use $g = 10ms^{-2}$)



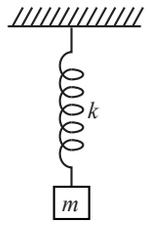
143. A mass of 0.5kg moving with a speed of 1.5m/s on a horizontal smooth surface, collides with a nearly weightless spring of force constant k = 50N / m The maximum compression of the spring would be

(*a*) 0.15 m (*b*) 0.12 m

(*c*) 0.5 m (*d*) 0.25 m

144. Ball is dropped from height H from ground then find maximum compression in spring. length of spring is negligible in compare to H.

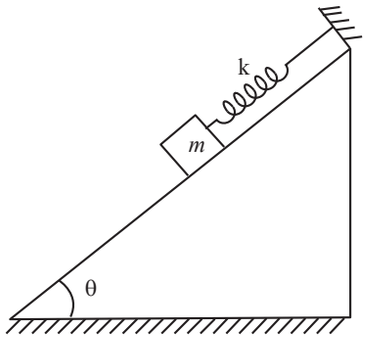
145. Initially mass m is held such that spring is in relaxed condition. If mass m is slowly released, maximum elongation in spring will be



(*a*) $\frac{m}{k}g$ (*b*) $\frac{2mg}{k}$

(*c*) $\frac{m}{2kg}$ (*d*) $\frac{m}{4kg}$

146. A block of mass *m* is placed on a smooth inclined plane at an angle θ and is connected to a spring of spring constant *k*. The block is released from rest. Find the maximum extension *x*_max in the spring.



(*a*) $\frac{mg}{k}$ (*b*) $\frac{2mg}{k}$

(*c*) $\frac{mg\sin\theta}{k}$ (*d*) $\frac{2mg\sin\theta}{k}$

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147. A ball of mass m is attached to the lower end of light vertical spring of force constant K. The upper end of spring is fixed. The ball is released from rest with the spring at its normal [Unstretched] length and comes too rest again after descending through a distance x. identify the correct statements

(i) $x = mg/K$

(ii) $x = 2mg/K$

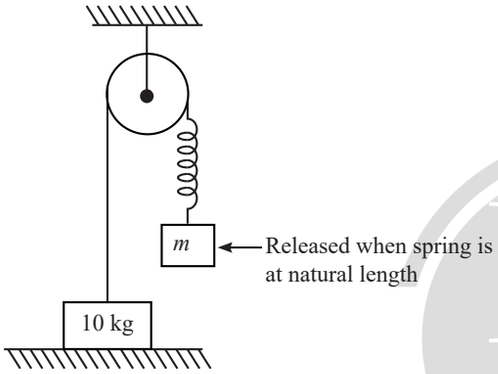
(iii) The ball will have no acceleration a the position where it has descended though

(iv) The ball will have an upward acceleration equal to g at it's lowermost position

(*a*) Only *i* (*b*) Only ii

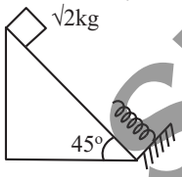
(*c*) ii, iii, iv (*d*) Only i and iv

148. Find minimum value of m so that block leave contact from ground.



149. A particle of mass m is moving in horizontal circle of radius r under centripetal force equal to $-K/r^2$; where K is constant then find total mechanical energy.

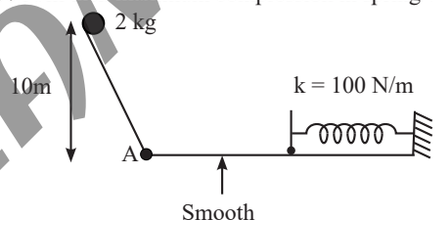
150. A block of mass $\sqrt{2}$ kg is released from the top of an inclined smooth surface as shown in figure. If spring constant of spring is 100 N/m and block comes to rest after compressing the spring by 1 m, then the distance travelled by block before it comes to rest is



(*a*) 1 m (*b*) 1.25 m

(*c*) 2.5 m (*d*) 5 m

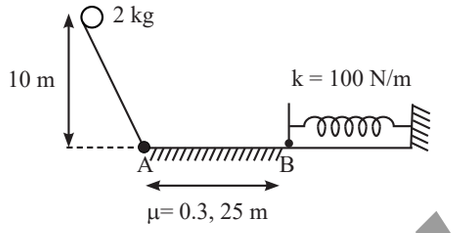
151. A ball of mass 2 kg is released from height 10 m as shown. It moves on smooth horizontal track and compress spring of spring constant k = 100 N/m then maximum compression in spring will be :



(*a*) 1 m (*b*) $\sqrt{2}$ m

(*c*) 2 m (*d*) $2\sqrt{2}$m

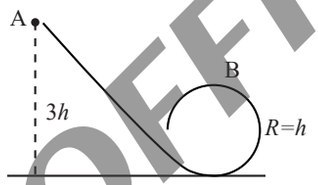
152. A ball of mass 2 kg is released from height 10 m as shown. It moves on smooth horizontal track and compress spring of spring constant k = 100 N/m, if horizontal track AB is rough with $\mu = 0.3$ and length of track AB is 25 m. Then maximum compression in spring will be :



(*a*) 1 m (*b*) 2 m

(*c*) $\sqrt{2}$ m (*d*) 3 m

153. In the figure shown, a particle is released from the position A on a smooth track. When the particle reaches at B, then normal reaction on it by the track is

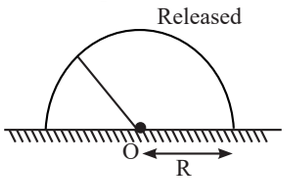


(*a*) mg (*b*) $2\ mg$

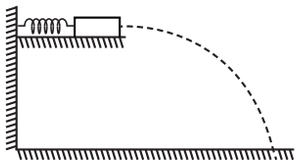
(*c*) $2/3\ mg$ (*d*) m^2g

154. Given expression as $u(x) = \left(\frac{x^3}{3} - \frac{x^2}{2}\right)$, if mechanical Energy is 4J then find maximum speed (Given mass, M =2kg)

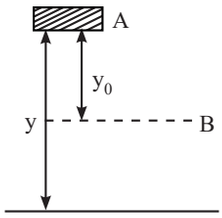
155. A ball of mass(m) released then find angle from vertical where, it will loose contact, hemispherical surface is smooth.



156. As shown in figure there is a spring block system. Block of mass 500 g is pressed against a horizontal spring fixed at one end to compress the spring through 5.0 cm. The spring constant is 500 N/m. When released, the block moves horizontally till it leaves the spring. Calculate the distance where it will hit the ground 4 m below the spring?



157. In the given figure, the block of mass m is dropped from point 'A'. The expression for kinetic energy of block when it reaches point 'B' is



(*a*) $\frac{1}{2}mg\ y_0^2$ (*b*) $\frac{1}{2}mg\ y^2$

(*c*) $mg\ (y - y_0)$ (*d*) mgy_0

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158. **Assertion (A):** Law of conservation of mechanical energy is always valid.

Reason (R): As it is derived from work energy theorem which is always valid

(*a*) If both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.

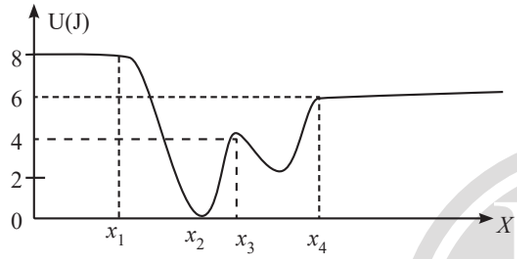
(*b*) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.

(*c*) If the Assertion is correct but Reason is incorrect.

(*d*) If the Assertion is incorrect but the Reason is correct.

(e) If both the Assertion and Reason are incorrect

159. Given below is the plot of a potential energy function $U(x)$ for a system, in which particle is in one dimensional motion, while a conservative force $f(x)$ acts on it. Suppose that E (mechanical) = 8 Joule, the incorrect statement for this system is



(*a*) At $x > x_4$, K.E. is constant throughout the region

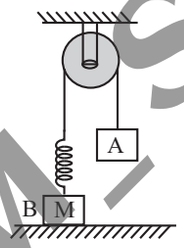
(*b*) At $x < x_1$, K.E. is smallest and particle is moving at slowest speed. At $x > x_4$, K.E. is constant throughout the region

(*c*) At $x = x_2$, K.E. is greatest and the particle is moving at fastest speed

(*d*) At $x = x_3$, K.E.= 4J

160. A body is dropped on ground from a height 'h_1' and after hitting the ground, it rebounds to a height 'h_2'. If the ratio of velocities of the body just before and after hitting ground is 4, then percentage loss in kinetic energy of the body is $x/4$. The value of x is

161. In the given figure, ball A is released from rest when the spring is at its natural (unstretched) length. For the block B of mass M to leave contact with the ground at some stage, the minimum mass of A must be



(*a*) $2M$

(*b*) M

(*c*) $M/2$

(*d*) A function of M and the force constant of the spring.

162. **Statement-I:** Two particles moving in the same direction do not lose all their energy in a completely inelastic collision.

Statement-II: Principle of conservation of momentum holds true for all kinds of collision

(*a*) Statement - 1 is true , statement -2 is true, and statement-2 is correct explanation of statement -1.

(*b*) Statement-1 if true, statement-2 is true, but statement -2 is not a correct explanation of statement-1.

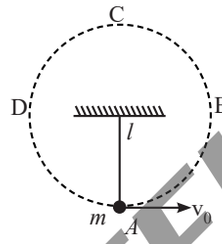
(*c*) Statement-1 is true, but statement -2 is false.

(*d*) Statement-1 is false, but statement-2 is true.

Vertical Circular Motion

163. A ball of mass m is attached to a string of length l and is given an initial velocity V_0. Find the velocity of the ball when the string makes an angle θ with the vertical.

164. Find tension at A, B, C and D.

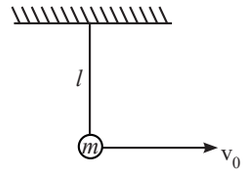


165. *If* $\frac{T_{max}}{T_{min}} = 3$ then find T_{max} if object of mass m. Moving in vertical circular motion.

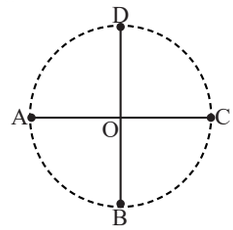
166. A small bob tied at one end of a thin string of length 1 m is describing a vertical circle so that the maximum and minimum tension in the string are in the ratio 5: 1. The velocity of the bob at the highest position is

m/s. (Take g = 10m/s^2)

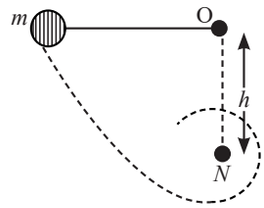
167. Find minimum given velocity at mean position so that it complete vertical circular motion.



168. As shown in figure, a particle of mass m a performing vertical circular motion. The velocity of the particle is increased, then at which point string break?



169. A particle of mass m attached to the end of string of length 1 is released from the horizontal position. The particle rotates in a circle about O as shown. When it is vertically below O, the string makes contact with a nail N placed directly below O at a distance h and rotates around it. For the particle to swing completely around the nail in a circle find h



170. A stone of mass 1 kg is tied with a string and it is whirled in a vertical circle of radius 1 m. If tension at the highest point is 14 N, then velocity at lowest point will be :

(*a*) 3 m/s (*b*) 4 m/s

(*c*) 6 m/s (*d*) 8 m/s

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171. A stone is tied to one end of a light inextensible string of length l and made to rotate on a vertical circle keeping other end of the string at the centre. If speed of the highest point is $v(v > \sqrt{gl})$ then its speed at the lowest point is

(*a*) $\sqrt{4gl}$ (*b*) $\sqrt{v^2 + 2gl}$

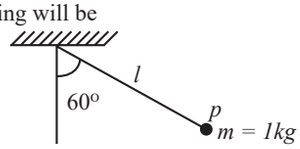
(*c*) $\sqrt{v^2 + gl}$ (*d*) $\sqrt{v^2 + 4gl}$

172. A particle of mass 200 g, is whirled into a vertical circle of radius 80 cm using a massless string. The speed of the particle when the string makes an angle of 60° with the vertical line is 1.5 ms^{-1} The tension in the string at this position is:

(*a*) 1 N (*b*) 1.56 N

(*c*) 2 N (*d*) 3 N

173. A ball of mass l kg is released as shown then Maximum Possible tension in string will be



(*a*) 10 N (*b*) 5 N

(*c*) 20 N (*d*) 30 N

174. A 1 kg stone at the end of 1 m long string is whirled in a vertical circle at constant speed of 4 m/sec. The tension in the string is 6 N, when the stone is at : (g = 10 m/sec²)

(*a*) Top of the circle (*b*) bottom of the circle

(*c*) half way down (*d*) None of these

175. A body of mass m hangs at one end of a string of length I, the other end of which is fixed. It is given a horizontal velocity so that the string would just reach where it makes an angle of 60° with the vertical. The tension in the string at mean position is :

(*a*) 2 mg (*b*) mg

(*c*) 3 mg (*d*) √3 mg

176. A particle of mass 200 g is moving in a circle of radius 2m. The particle is just "looping the loop". The speed of the particle and the tension in the string at highest point of the circular path are (g = 10m / s^2)

(*a*) 4ms^{-1},5N (*b*) 4.47 ms^{-1},0

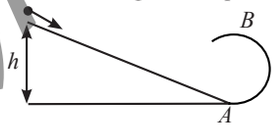
(*c*) 2.47 ms^{-1},0 (*d*) 1ms^{-1},0

177. What is the minimum velocity with which a body of mass m must enter a vertical loop of radius R so that it can complete the loop?

(*a*) $\sqrt{3gR}$ (*b*) $\sqrt{5gR}$

(*c*) $\sqrt{gR}$ (*d*) $\sqrt{2gR}$

178. A body initially at rest and sliding along a frictionless track from a height h (as shown in the figure) Just completes a vertical circle of diameter AB = D. The height h is equal to



(*a*) $\frac{3}{2}D$ (*b*) D

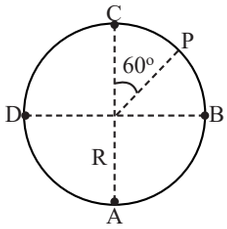
(*c*) $\frac{7}{5}D$ (*d*) $\frac{5}{4}D$

179. A stone is rotated in a vertical circle. Speed at bottom most point is $\sqrt{8gR}$, where R is the radius of circle. The ratio of tension at the top and the bottom is:

(*a*) 1 : 2 (*b*) 1 : 3

(*c*) 2 : 3 (*d*) 1 : 4

180. A particle is moving along a vertical circle of radius R. The velocity of particle at P will be: (assume critical condition at C)

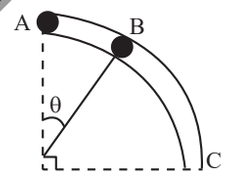


181. A pendulum of length 2 m consists of a wooden bob of mass 5g. A bullet of mass 75 g is fired towards the stationary bob with a speed v. The bullet emerges out of the bob with a speed v/3 and the bob just completes the vertical circle. The value of v is ____ ms^{-1} (g = 10 m/s²)

182. If velocity $V = \sqrt{3gR}$ is given at the mean position then find angle where bob will leave circular path

183. If given velocity at mean is $V = \sqrt{gR}$ then angle where it will leave circular path.

184. The tube AC forms a quarter circle in a vertical plane. The ball B has an area of cross-section slightly smaller than of the tube and can move without friction through it. B is placed at A and displaced slightly. It will



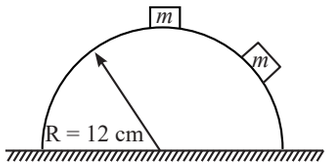
(*a*) Always be in contact with the outer wall of the tube

(*b*) Always be in contact with the inner wall

(*c*) Initially be in contact with the inner wall and later with the outer wall

(*d*) Initially be in contact with the outer wall and later with the inner wall

185. An object of mass m is displaced on a smooth bowl of radius R = 12 cm & released then height from the ground at which block will leave the bowl?



(*a*) 4 cm (*b*) 8 cm

(*c*) 6 cm (*d*) 10 cm

186. A child is sitting on a swing. Its minimum and maximum heights from the ground 0.75 m and 2 m respectively, its maximum speed will be

(*a*) 10 m/s (*b*) 5 m/s

(*c*) 8 m/s (*d*) 15 m/s

187. A stone of mass m, tied to a string is being whirled in a vertical circle with a uniform speed. The tension in the string is

(*a*) The same throughout the motion

(*b*) Minimum at the highest position of the Circular path

(*c*) Minimum at the lowest position of the circular path

(*d*) Minimum when the rope is the horizontal position

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Power

188. Which of the following statement is NOT correct about power?

(*a*) It is the rate at which work is done or energy is consumed

(*b*) It is a scalar quantity

(*c*) 1 horsepower is equal to 746 kW

(*d*) When work is done, an equal amount of energy is consumed

189. One coolie takes 1 minute to raise a suitcase through a height of 2 m but the second coolie takes 30 s to raise the same suitcase to the same height. The powers of two coolies are in the ratio,

(*a*) 1 : 2 (*b*) 1 : 3

(*c*) 2 : 1 (*d*) 3 : 1

190. If a force of 9 N is acting on a body, then find instantaneous power supplied to the body when its velocity is 5 m/s in the direction of force

(*a*) 195 watt (*b*) 45 watt

(*c*) 75 watt (*d*) 100 watt

191. A particle moves with the velocity $\vec{v} = (5\hat{i} - 2\hat{j} - \hat{k})$ ms-¹ under the influence of a constant force, $\vec{F} = (2\hat{i} + 5\hat{j} - 10\hat{k})$ N. The instantaneous power applied is

(*a*) 5 W (*b*) 10 W

(*c*) 20 W (*d*) 30 W

192. A Body of mass 2 kg begins to move under the action of a time dependent force given by $\vec{F} = (6t\hat{i} + 6t^2\hat{j})$ N. The power developed by force at time t is given by:

(*a*) $(3t^3 + 6t^5)$ W (*b*) $(3t^4 + 9t^5)$ W

(*c*) $(9t^3 + 6t^3)$ W (*d*) $(9t^3 + 6t^5)$ W

193. Ball is projected with u at angle θ then find Power delivered by gravitational force at maximum height.

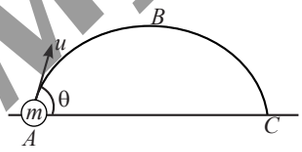
194. Ball is projected with u at angle θ then Find Power delivered by gravitational Force at time 't'

195. A body of mass *m* is projected from ground with speed u at an angle θ with horizontal. The power delivered by gravity to it at half of maximum height from ground is

(*a*) $\frac{mgu\cos\theta}{\sqrt{2}}$ (*b*) $\frac{mgu\sin\theta}{\sqrt{2}}$

(*c*) $\frac{mgu\cos(90+\theta)}{\sqrt{2}}$ (*d*) Both (b) and (c)

Direction for the question's from 196-198



196. Power delivered by gravitational force from. A to B is negative

(*a*) True (*b*) False

197. Power delivered by gravitational force from *B to C is positive*

(*a*) True (*b*) False

198. Magnitude of Power delivered is decrease as object more from A to B

(*a*) True (*b*) False

199. **Assertion (A):** Power developed by tension in wire during vertical circular motion is always zero.

Reason (R): Tension in wire is equal to centripetal force acting on body under vertical circular motion.

(*a*) If both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.

(*b*) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.

(*c*) If the Assertion is correct but Reason is incorrect.

(*d*) If the Assertion is incorrect but the Reason is correct.

(e) If both the Assertion and Reason are incorrect

200. A body projected vertically form the earth reaches a height equal to earth's radius before returning to the earth. The power exerted by the gravitational force is greatest

(*a*) At the instant just after the body is projected

(*b*) At the highest position of the body

(*c*) At the instant just before the body hits the earth

(*d*) it remains constant all through

201. A body is being moved from rest along a straight line by a machine delivering constant power. The distance covered by body in time t is proportional to

(*a*) $\sqrt{t}$ (*b*) $t^{3/2}$

(*c*) $t^{3/4}$ (*d*) t^2

202. A body of mass 2 kg is initially at rest. It starts moving unidirectionally under the influence of a source of constant power *P*. Its displacement in 4s is $\frac{1}{3}\alpha^2\sqrt{P}$ m. The value of α will be

203. It Position of object $x \propto t$ then find Power delivered as a function of time

204. The position (*x*) of a body moving along *x*-axis at time (*t*) is given by $x = 3t^2$ where *x* is in metre and *t* is in second. If mass of body is 2 kg, then find the Instantaneous power delivered to body by force acting on it at $t = 4$ s

205. An elevator that can carry a maximum load of 1500 kg (elevator + passengers) is moving up with a constant speed of 2 ms^{-1}. The frictional force opposing the motion is 3000 N. Find the minimum power delivered by the motor of the elevator in watts as well as in horse power ($g = 10ms^{-2}$)

206. The power of water pump is 4 kW. If $g = 10ms^{-2}$ the amount of water it can raise in 1 minute to a height of 20 m is

(*a*) 100 litre (*b*) 1000 litre

(*c*) 1200 litre (*d*) 2000 litre

207. The power of a pump, which can pump 500 kg of water to height 100 m in 10 s is

(*a*) 75 kW (*b*) 25 kW

(*c*) 50 kW (*d*) 500 kW

208. An engine pumps 800 kg of water through height of 10 m in 80 s. Find the power of the engine if its efficiency is 75%.

209. Water falls from a height of 60 *m* at the rate of 15 kg/s to operate a turbine. The losses due to frictional forces are 10% of energy. How much power is generated by the turbine? (Take, $g = 10ms^{-2}$)

(*a*) 12.3 kw (*b*) 7.0 kw

(*c*) 8.1 kw (*d*) 10.2 kw

210. A body of mass *m* accelerates uniformly from rest to velocity v_1 in time interval T_1. The instantaneous power delivered to the body as a function of time *t* is

211. A pump is used to pump a liquid of density ρ continuously through a pipe of cross section area A. If liquid is flowing with speed V, then power of pump is

(*a*) $\frac{1}{3}\rho AV^2$ (*b*) $\frac{1}{2}\rho AV^2$

(*c*) $2\rho AV^2$ (*d*) $\frac{1}{2}\rho AV^3$

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212. An engine pumps water continuously through a hose. Water leaves the hose with a velocity v and m is the mass per unit length of the water jet. What is the rate at which kinetic energy is imparted water?

(*a*) mv^2 (*b*) $\frac{1}{2}mv^2$

(*c*) $\frac{1}{2}m^2v^2$ (*d*) $\frac{1}{2}mv^3$

213. An engine pumps water continuously through a hose. Water leaves the hose with a velocity v and λ is the mass per unit length of the water jet. What is the rate at which kinetic energy is imparted water?

(*a*) λV^2 (*b*) $\frac{1}{2}\lambda v^2$

(*c*) $\frac{1}{2}\lambda^2 v^2$ (*d*) $\frac{1}{2}\lambda v^3$

214. An engine pumps water through a hose pipe. Water passes through the pipe and leaves it with a velocity of 2 m/s. The mass per unit length of water in the pipe is 100 kg/m/

What is the power of the engine?

(*a*) 800 W (*b*) 400 W

(*c*) 200 W (*d*) 100 W

215. The force required to row a boat at constant velocity is proportional to square of its speed. If a speed of v km/h requires 4 kW, how much power does a speed of $2v$ km/h require?

(*a*) 8 kW (*b*) 16 kW

(*c*) 24 kW (*d*) 32 kW

216. A particle of mass m is driven by a machine that delivers a constant power k watts. If the particle starts from rest then the force on the particle at time t is

(*a*) $\frac{1}{2}\sqrt{mk}t^{-1/2}$ (*b*) $\sqrt{\frac{mk}{2}}t^{-1/2}$

(*c*) $\sqrt{mk}t^{-1/2}$ (*d*) $\sqrt{2mk}t^{-1/2}$

217. A car of mass m starts from rest and accelerates so that the instantaneous power delivered to the car has a constant magnitude P_0. The instantaneous velocity of this car is proportional to

(*a*) t^2P_0 (*b*) $t^{1/2}$

(*c*) $t^{-1/2}$ (*d*) $\frac{1}{\sqrt{m}}$

218. Water falls from a height of 60 m at the rate of 15 kg/s to operate a turbine. The losses due to frictional forces are 10% of energy. How much power is generated by the turbine? (g = 10 m/s²)

(*a*) 7.0 kW (*b*) 8.1 kW

(*c*) 10.2 kW (*d*) 12.3 kW

219. The machine gun fires 300 bullets per minute. If the mass of each bullet is 10 g and the velocity of the bullets is 600 ms^{-1}, the power (in kW) imparted to the bullets:

220. A truck of mass 10,000 kg moves up an inclined plane rising 1 in 50 with a speed of 36 km/h. The power of the engine will be: ($g = 10 m/s^2$)

(*a*) 10 kW (*b*) 40 kW

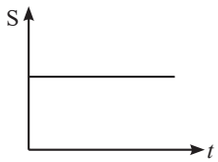
(*c*) 20 kW (*d*) 5 kW

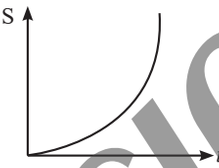
221. A particle of mass M starting from rest undergoes uniform acceleration. If the speed acquired in time T is V, the power delivered to the particle is

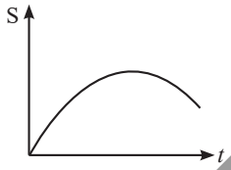
(*a*) $\frac{MV^2}{T}$ (*b*) $\frac{1}{2}\frac{MV^2}{T^2}$

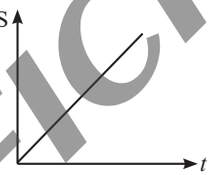
(*c*) $\frac{MV^2}{T^2}$ (*d*) $\frac{1}{2}\frac{MV^2}{T}$

222. A particle is moving unidirectionally on a horizontal plane under the action of a constant power supplying energy source. The displacement(S) time-(t) graph that describes the motion of particle is

(*a*)


(*b*)


(*c*)


(*d*)


223. Match the following columns.

	Column-I		Column-II
A	Erg	1.	1.6×10^{-19} J
B	Electron vole (eV)	2.	3.6×10^{6} J
C	Calorie (cal)	3.	10^{-7} J
D	Kilowatt hour (kWh)	4.	4.186 J

	A	B	C	D
(*a*)	3	1	4	2
(*b*)	1	3	2	4
(*c*)	1	2	3	4
(*d*)	4	3	2	1

224. A body is moving along straight line by a machine delivering a power proportional to time

	Column-I		Column-II
A	Velocity is proportional to	i	t (time)
B	Displacement is proportional to	ii	t^2
C	Work done is proportional to	iii	t^3
		iv	t^{-1}

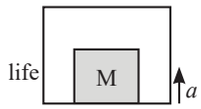
(*a*) (*a*) – (ii); (b) – (iv); (c) –(iii)

(*b*) (*a*) – (iii); (b) – (iv); (c) –(i)

(*c*) (*a*) – (ii); (b) – (iii); (c) –(i)

(*d*) (*a*) – (i); (b) – (ii); (c) –(ii)

225. Block of mass M = 5 kg is kept inside a lift, which starts motion from rest in vertical upward direction with uniform acceleration [a = 4m /sec²)



	Power delivered to block by force		Power (in watt)
A	By normal at 5 sec	P	-500
B	By normal in 5 sec	Q	700
C	By Mg (gravity) at 5 sec	R	-1000
D	By Mg (gravity) in 5 sec	S	1400

(*a*) A-P; B-Q; C-R; D-S (*b*) A-Q; B-S; C-R; D-P

(*c*) A-S; B-Q; C-P; D-R (*d*) A-S; B-Q; C-R; D-P

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1. A heavy Stone is thrown from a cliff of height h with a speed v. If it is thrown_____, the stone will hit the ground with Maximum speed.
   (*a*) Vertically upwards
   (*b*) vertically downwards
   (*c*) Horizontally
   (*d*) Speed at Bottom will same any initial Direction.

2. **Statement I:** Two springs A and B are stretched by applying forces of equal magnitudes. Spring Constant of A being doubled as that of B, potential Energy in B will be double the potential energy stored in A.

   Statement II: Two equal masses are attached to the two ends of spring of constant K The masses are pulled out symmetrically to stretch the spring by length x over it's Natural length. The work done by spring on each mass is $\frac{1}{4}kx^2$.

3. **Statement I:** The Work done by conservative internal forces on system equals change in potential energy.

   Statement II: The Work done. by all the forces on a system equals change in kinetic energy.

   Statement III: The work done by external forces on system equals change in total energy.

4. **Statement I:** A small Block of mass m is kept on a rough inclined surface of inclination θ fixed in an elevator The elevator goes up with uniform velocity v and block doesn't Slide on wedge. The Work done by force of friction on block in time t will be Zero.

   Statement II: A Heavy stone is thrown from a cliff of height h in given direction. The speed with which it hits ground may be smaller than the speed of projection.

5. **Statement I:** The Total Work done on particle is equal to change in it's Kinetic energy Only if forces acting on it are Conservative.

   Statement II: You lift a suitcase from the floor and keep it on a Table The Work done by you on suitcase does not depend on path taken by suitcase, time taken by you in doing so and your weight.

6. **Statement I:** No Work is done by a force on an object if the force is always perpendicular to it's acceleration.

   Statement II: No work is done by a force on an object if it moves in such a way that the point of application of force remains fixed.

7. **Statement I:** In a vertical circular Motion, initially the string is kept Horizontal and particle is given an upward velocity v so that it is Just able to Complete a circle The string Become Slack when the particle reaches its highest point.

   Statement II: for above given case in statement I, Velocity of particle becomes zero at highest point.

   Statement III: The Kinetic energy of Ball in initial position will be equal to mgl.

8. **Statement I:** The Resultant force on the particle must be parallel to the velocity at all instants so that the Kinetic energy of a particle continuously increases with time.

   Statement II: If K.E. of particle continuously increases with time, then its height above the ground level must continuously decrease.

9. **Statement I:** One end of light spring is fixed to wall and other end is tied to Block placed on a Smooth Horizontal surface. In a displacement, it is possible that the work done by the Spring is $\frac{1}{2}kx^2$ (Positive work by spring).

   Statement II: The spring was initially compressed by distance x and was finally in its natural length.

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MR PHYSICS for questions practice

Answer Key

1. (*d*) **2.** (*a*) **3.** (*b*) **4.** (*a*) **5.** (*c*) **6.** (*a*) **7.** (*c*) **8.** (*c*) **9.** (*d*) **10.** (a)

11. (*b*) **12.** (*e*) **13.** (*a*) **14.** (*d*) **15.** (*a*) **16.** 25 **17.** (*d*) **18.** (*c*) **19.** (*d*) **20.** (*d*)

21. (*b*) **22.** (*d*) **23.** 160 J **24.** (*d*) **25.** (*a*) **26.** (*d*) **27.** (*a*) **28.** (*b*) **29.** (*b*) **30.** (c)

31. (*d*) **32.** (*d*) **33.** (*b*) **34.** – 270 J **35.** W = –μ (mg + Fcos β)S **36.** (*d*) **37.** (*c*) **38.** (*b*)

39. (*d*) **40.** (*c*) **41.** $(W_T)_{4kg}$ = 192 N,$(W_T)_{6kg}$ = –192 N, $(W_g)_{4kg}$ = *–160* N,$(W_g)_{6kg}$ = +240 N **42.** (*d*) **43.** (*b*)

44. (*b*) **45.** (*a*) **46.** (*a*) **47.** (*d*) **48.** (*e*) **49.** (*d*) **50.** (*d*) **51.** (*a*) **52.** (*c*) **53.** (*a*)

54. (*c*) **55.** 1.5% **56.** (*b*) **57.** 144% K.E **58.** 56% K.E **59.** 83% K.E. **60.** 30% K,E

61. (*d*) **62.** Decreases by 10% **63.** (1 – B) (2 – C) (3 – D) (4 – A) **64.** (*d*) **65.** (*d*) **66.** (*d*) **67.** (*c*)

68. (*c*) **69.** (*a*) **70.** (*d*) **71.** $10\sqrt{10}$ **72.** – 937.5 J **73.** –200 J **74.** (*c*) **75.** (*a*) **76.** (*b*)

77. (*c*) **78.** 1 metre **79.** (*b*) **80.** (*b*) **81.** 784 kJ **82.** (*d*) **83.** (*d*) **84.** (*a*) **85.** $\frac{k^2t^2}{2m}$

86. Zero **87.** K.E ∝ t^4 **88.** (*c*) **89.** (*a*) **90.** (*e*) **91.** (*b*) **92.** (*a*) **93.** (*b*) **94.** (*b*) **95.** (b)

96. (*b*) **97.** (*c*) **98.** (*a*) **99.** (*d*) **100.** $x = \frac{a}{2b}$ **101.** (*b*) **102.** $\frac{\sqrt{a^2+b^2}}{m}$ **103.** 5*b*/4*a*

104. $2\sqrt{3}N$ **105.** (*a*) **106.** (*b*) **107.** (*d*) **108.** (*c*) **109.** (*a*) **110.** (*d*) **111.** (*b*) **112.** (*a*) **113.** (*a*)

114. (*a*) **115.** (*a*) **116.** (*d*) **117.** (*c*) **118.** MgL/18 **119.** (*c*) **120.** (*d*) **121.** (*d*) **122.** (*a*)

123. (*d*) **124.** (*d*) **125.** (*d*) **126.** (*b*) **127.** $\sqrt{\frac{mV_0^2}{k}}$ **128.** (*b*) **129.** (*b*) **130.** (*c*) **131.** $\sqrt{\frac{3gL}{2}}$

132. (*d*) **133.** (*a*) **134.** (*a*) **135.** (*d*) **136.** $u = \sqrt{2\sqrt{3}gl}$ **137.** 150 J, 450 J **138.** (*b*) **139.** (*b*)

140. (*b*) **141.** (*a*) **142.** 120 N/*m* **143.** (*a*) **144.** $\sqrt{\frac{2mgH}{k}}$ **145.** (*a*) **146.** (*d*) **147.** (*c*)

148. $\frac{m}{2}$ **149.** $U = -\frac{k}{2r}$ **150.** (*d*) **151.** (*c*) **152.** (*a*) **153.** (*a*) **154.** 4.16 m/s **155.** $\cos^{-1}\left(\frac{2}{3}\right)$

156. 1.4 m **157.** (*d*) **158.** (*d*) **159.** (*b*) **160.** 375 **161.** (*c*) **162.** (*a*) **163.** $V = \sqrt{V_0^2 - 2gl(1-\cos\theta)}$

164. $T_A = \frac{mv_0^2}{l} + mg$, $T_B = \frac{mv_0^2}{l} - 2mg$, $T_C = \frac{mv_0^2}{l} - 5mg$, $T_D = \frac{mv_0^2}{l} - 2mg$ **165.** 9mg **166.** 5 m/s **167.** $\sqrt{5gl}$ **168.** (B)

169. $h = \frac{3}{5}m$ **170.** (*d*) **171.** (*d*) **172.** (*b*) **173.** (*c*) **174.** (*a*) **175.** (*a*) **176.** (*b*) **177.** (b)

178. (*d*) **179.** (*b*) **180.** $V = \sqrt{2g}R$ **181.** 1 m/s **182.** $\cos^{-1}\left(-\frac{1}{3}\right)$ **183.** 60° **184.** (*c*) **185.** (*b*)

186. (*b*) **187.** (*b*) **188.** (*c*) **189.** (*a*) **190.** (*b*) **191.** (*b*) **192.** (*d*) **193.** Zero **194.** P = – mg (using θ – gt)

195. (*b*) **196.** (*a*) **197.** (a) **198.** (*a*) **199.** (*c*) **200.** (*c*) **201.** (*b*) **202.** 4 **203.** Zero **204.** 288 W

205. 36 kW, **48.**28 HP **206.** (*c*) **207.** (*c*) **208.** $\frac{4}{3}kW$ **209.** (*c*) **210.** $m\left(\frac{V_1}{T_1}\right)^2 t$ **211.** (*d*) **212.** (*d*)

213. (*d*) **214.** (*a*) **215.** (*d*) **216.** (*b*) **217.** (*b*) **218.** (*b*) **219.** 9 **220.** (*c*) **221.** (*d*) **222.** (*b*)

223. (*a*) **224.** (*d*) **225.** (*d*)

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MR PHYSICS for questions practice

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1. (*d*) **2.** I. = True, II. = False **3.** I. = False, II. = True, III. = True **4.** Both are False **5.** I. - False, II. - True
6. I. - False, II. - True **7.** I. - True, II. - False, III. - False **8.** Both are False
9. Both Correct and R is correct explanation of A.

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MR PHYSICS for questions practice

Moving charges and magnetism

(Practice Questions)

Biot-Savart Law

1. **Statement I:** Electrostatic field and magnetic field both are produced by vector source Hence both are vector quantities.

   Statement II: Magnetic field is perpendicular to the plane containing displacement vector and current element whereas electrostatic field i along the displacement vector joining source and field point.

   (*a*) Statement-I is true, statement-I is true; statement-II is a correct explanation for statement-I.

   (*b*) Statement-I is true, statement-II is true and statement-II is not a correct explanation for statement-I.

   (*c*) Statement-I is true, statement-II is false.

   (*d*) Statement-I is false, statement-II is true.

2. Magnetic field and electric field both following inverse square law.

Magnetic Field

3. Magnetic field due to straight wire is rectangular close loop.

   (*a*) True (*b*) False

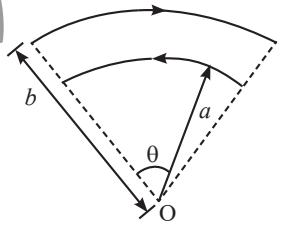
4. Magnetic field at the centre of circular loop is directly proportional to number of loop.

   (*a*) True (*b*) False

5. A long wire carrying a steady current is bent into a circular loop of one turn. The magnetic field at the centre of the loop is B. It is then bent into a circular coil of *n* turns. The magnetic field at the centre of this coil of *n* turns will be

   (*a*) nB (*b*) n^2B (*c*) $2n$B (*d*) $2n^2$B

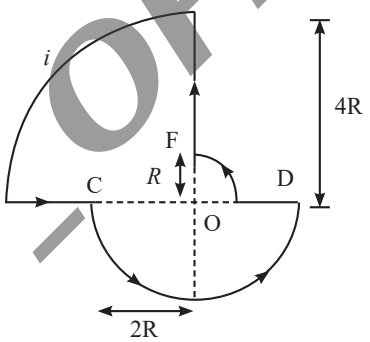
6. The figure below shows a current loop having two circular arcs joined by two radial lines. The magnetic field at O is



   (*a*) $\frac{\mu_0 i\theta}{2\pi ab}(b-a)$ (*b*) $\frac{\mu_0 i\theta}{4\pi ab}(b-a)$

   (*c*) Zero (*d*) $\frac{\mu_0 i\theta}{3\pi ab}(b+a)$

7. Find the magnetic field at the centre O of the loop shown in the figure.



8. A straight wire of diameter 0.5 mm carrying a current of 1 A is replaced by the another wire of 1 mm diameter carrying the same current. The strength of the magnetic field far away is

   (*a*) One-quarter of the earlier value

   (*b*) One-half of the earlier value

   (*c*) Twice the earlier value

   (*d*) Same as the earlier value.

9. The magnetic field at a distance *r* from a long wire carrying current *i* is 0.4 T tesla. The magnetic field at a distance 2*r* is.

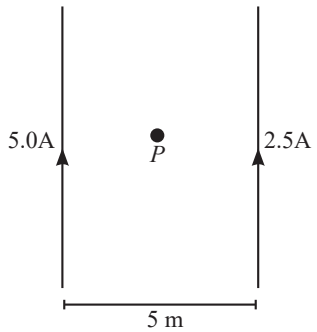
   (*a*) 0.2 tesla (*b*) 0.8 tesla (*c*) 0.1 tesla (*d*) 1.6 tesla

10. The magnetic induction at a point *P* which is at the distance of 4 cm from a long current carrying wire is 10^{-3} T. The field of induction at a distance 12 cm from the current will be

    (*a*) 3.33×10^{-4}T (*b*) 1.11×10^{-4}T

    (*c*) 33×10^{-4}T (*d*) 9×10^{-4}T

11. The magnetic field at centre, *P* will be



    (*a*) $\frac{\mu_0}{4\pi}$ (*b*) $\frac{\mu_0}{\pi}$ (*c*) $\frac{\mu_0}{2\pi}$ (*d*) $4\mu_0\pi$

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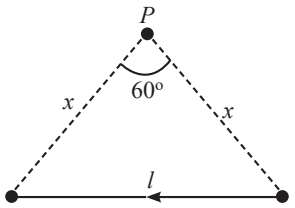
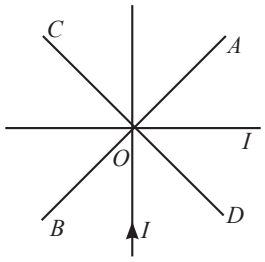
12. A straight wire of finite length carrying current I subtends an angle of 60° at point P as shown. The magnetic field at P is



(*a*) $\frac{\mu_0 I}{2\sqrt{3}\pi x}$ (*b*) $\frac{\mu_0 I}{2\pi x}$ (*c*) $\frac{\sqrt{3}\mu_0 I}{2\pi x}$ (*d*) $\frac{\mu_0 I}{3\sqrt{3}\pi x}$

13. Two equal electric currents are flowing perpendicular to each other as shown in the figure. AB and CD are perpendicular to each other and symmetrically placed with respect to the currents. Where do we expect the resultant magnetic field to by zero?



(*a*) On CD (*b*) On AB
(*c*) On both OD and BO (*d*) On both AB and CD

14. Two identical long conducting wires AOB and COD are placed at right angle to each other, with one above other such that O is their common point for the two. The wires carry I_1 and I_2 currents, respectively. Point 'P' is lying at distance d from O along a direction perpendicular to the plane containing the wires. The magnetic field at the point P will be

(*a*) $\frac{\mu_0}{2\pi d}\left(\frac{i_1}{i_2}\right)$ (*b*) $\frac{\mu_0}{2\pi d}(i_1+i_2)$

(*c*) $\frac{\mu_0}{2\pi d}(i_1^2-i_2^2)$ (*d*) $\frac{\mu_0}{2\pi d}(i_1^2+i_2^2)^{1/2}$

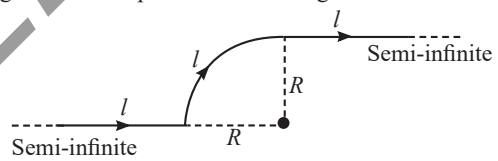
15. Two long straight wires are placed along x-axis and y-axis. They carry current I_1 and I_2 respectively. The equation of locus of zero magnetic induction in the magnetic field produced by them is.

(*a*) $y = x$ (*b*) $y=\left(\frac{l_2}{l_1}\right)x$

(*c*) $y=\left(\frac{l_1}{l_2}\right)x$ (*d*) $y=(l_1\, l_2)x$

16. A current carrying conductor of length l is bent into two loops one by one. First loop has one turn of wire and the second loop has two turns of wire. Compare the magnetic fields at the centre of the loops.

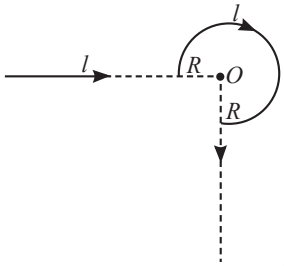
17. Magnetic field at point O due to the given structure is



(*a*) $\frac{\mu_0 I}{4\pi a}\left(\frac{\pi}{2}+1\right)\otimes$ (*b*) $\frac{\mu_0 I}{4\pi a}\left(\frac{\pi}{2}+1\right)\odot$

(*c*) $\frac{\mu_0 I}{2\pi a}(\pi+1)\otimes$ (*d*) $\frac{\mu_0 I}{2\pi a}(\pi+1)\odot$

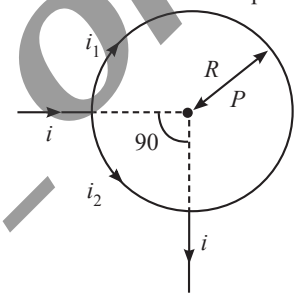
18. Magnetic field at the point O due to the given structure is



(*a*) $\frac{\mu_0 I}{4R}\left[\frac{3}{2}\right]\odot$ (*b*) $\frac{\mu_0 I}{2R}[3]\otimes$

(*c*) $\frac{\mu_0 I}{4R}\left[\frac{3}{2}\right]\otimes$ (*d*) $\frac{\mu_0 I}{4R}[3]\odot$

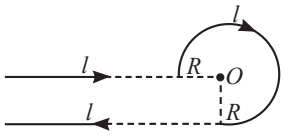
19. A straight conductor carrying current i splits into two parts as shown in the figure. The radius of the circular loop is R. The total magnetic field at the centre P at the loop is



(*a*) Zero (*b*) $3\mu_0 i/32R$, Outward

(*c*) $3\mu_0 i/32R$, Outward (*d*) $\frac{\mu_0 i}{2R}$ inward

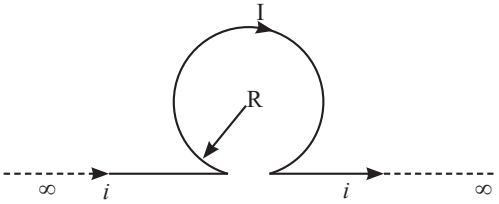
20. Magnetic field at the centre O due to the given structure is



(*a*) $\frac{\mu_0 I}{4R}\left[\frac{3}{2}+\frac{1}{\pi}\right]\odot$ (*b*) $\frac{\mu_0 I}{2R}\left[3+\frac{1}{\pi}\right]\otimes$

(*c*) $\frac{\pi_0 I}{4R}\left[\frac{3}{2}+\frac{1}{\pi}\right]$ (*d*) $\frac{\mu_0 I}{4R}\left[3+\frac{2}{\pi}\right]\odot$

21. Find the magnetic field at the centre of the circular loop shown in figure.



22. An arrangement of three parallel straight wires placed perpendicular to plane of paper carrying same current 'I' along the same direction is shown in figure. Magnitude of force per unit length on the middle wire 'B' is given by

(*a*) $\frac{\mu_0 I^2}{2\pi d}$ (*b*) $\frac{2\mu_0 I^2}{\pi d}$

(*c*) $\frac{\sqrt{2}\mu_0 I^2}{\pi d}$ (*d*) $\frac{\mu_0 I^2}{\sqrt{2}\pi d}$

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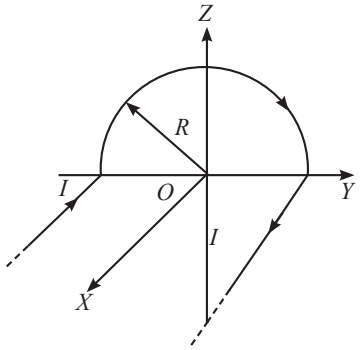
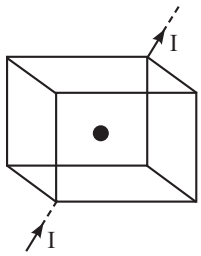
23. A wire carrying current I has the shapes as shown in adjoining figure. Linear parts of the wire are very long and parallel to X -axis while semicircular portion of radius R is lying in $Y-Z$ plane. Magnetic field at point O is

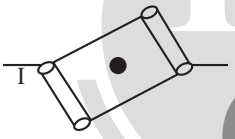


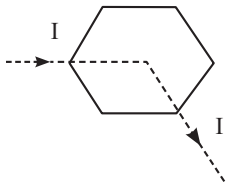
(*a*) $\vec{B}=\frac{\mu_0}{4\pi}\frac{I}{R}\left(\pi i-2\hat{k}\right)$ (*b*) $2\vec{B}=\frac{\mu_0}{4\pi}\frac{I}{R}\left(\pi\hat{i}+2\hat{k}\right)$

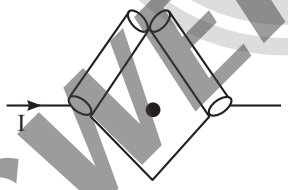
(*c*) $\vec{B}=-\frac{\mu_0}{4\pi}\frac{I}{R}(\pi\hat{i}+2\hat{k})$ (*d*) $\vec{B}=-\frac{\mu_0}{4\pi}\frac{I}{R}(\pi\hat{i}+2\hat{k})$

24. In which of the following cases, magnetic field at centre will have non zero value ?

(*a*)


(*b*)


(*c*)


(*d*)


25. A thin ring of radius R metre has charge q coulomb uniformly spread on it. The ring rotates about its axis with a constant frequency f revolution/s. The value of magnetic field in tesla at the centre of the ring is

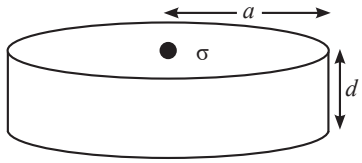
(*a*) $\frac{\mu_0 qf}{2\pi R}$ (*b*) $\frac{\mu_0 q}{2\pi fR}$ (*c*) $\frac{\mu_0 q}{2fR}$ (*d*) $\frac{\mu_0 qf}{2R}$

26. Two similar circular loops of radius R, are lying concentrically with their planes at right angles to each other. The currents flowing in them are I and $I\sqrt{3}$ respectively. The magnetic field at the centre of the coil is

(*a*) $\frac{\mu_0 I}{2R}$ (*b*) $\frac{\mu_0 I}{R}$ (*c*) $\frac{4\mu_0 I}{R}$ (*d*) $\frac{\sqrt{3}\mu_0 I}{R}$

27. Three circular wire of same radius R having current I then find magnetic field at centre if they are placed concentric and plane perpendicular to each other.

28. Surface charge density on a ring of radius a and width d is σ as shown in figure. Assume that the charge is only on outer surface. If it is rotating, then magnetic field induced at centre is $\mu_0\sigma\pi dx$. . In this given equation, x is

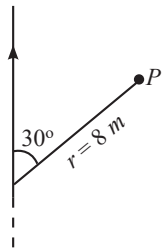


(*a*) Time period of rotation.
(*b*) Frequency with which ring rotates
(*c*) Angular frequency of rotation.
(*d*) Angular velocity of rotation.

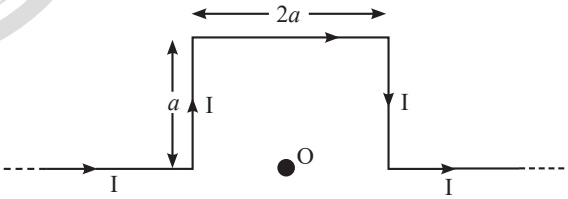
29. There are two infinitely long straight wires separated by distance of 5 cm. Which of the following statement is correct?

(*a*) If they carry unequal current in opposite direction, magnetic field will be zero close to the wire carrying smaller current. Between the wire
(*b*) If they carry unequal currents in same direction, Magnetic field will be zero close to the wire carrying smaller current.
(*c*) If they carry equal current in opposite direction, Magnetic field will be zero midway.
(*d*) If they carry unequal current in same direction, Magnetic field will be zero close to wire carrying larger currents.

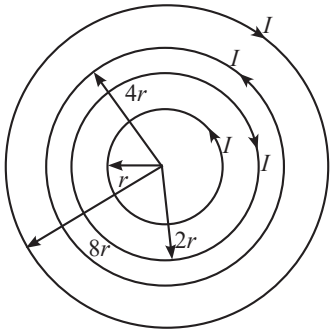
30. Infinite wire as shown in figure. Find magnetic field at P.



31.

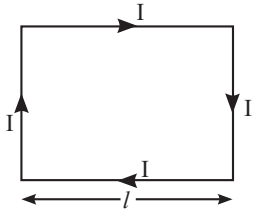


32.



(*a*) Zero (*b*) $\frac{\mu_0 I}{3r}$ (*c*) $\frac{\mu_0 I}{2r}$ (*d*) $\frac{\mu_0 I}{r}$

33. Magnetic field at the centre of square loop.



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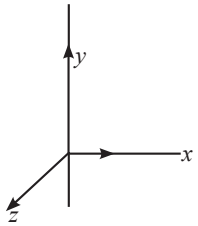
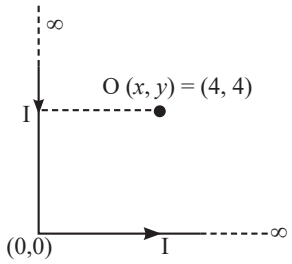
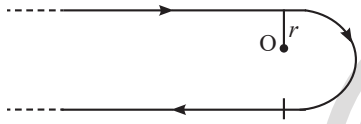
34. Infinite wire is placed along y-axis and current flowing in it is 10 A. Find magnetic field at A (4,5) and B (3,4)



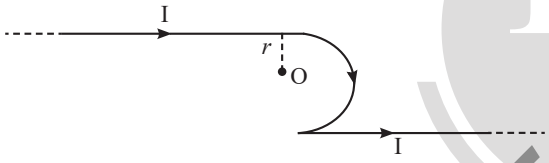
35. Find magnetic field at point O (4, 4)



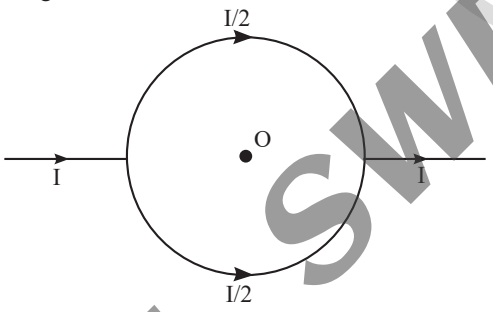
36. Find magnetic field at O



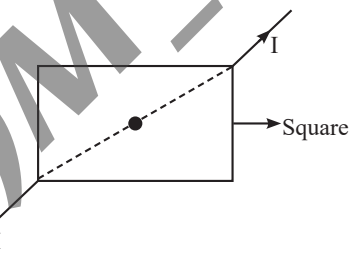
37. Find magnetic field at O



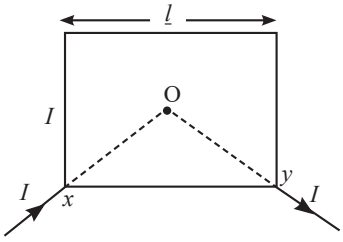
38. Find magnetic field at O



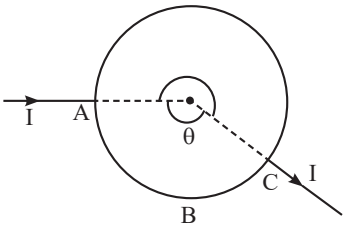
39. Find magnetic field at O



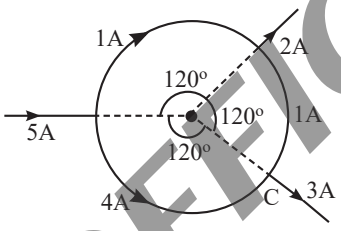
40. Find magnetic field at O



41. Find magnetic field due to arc ABC .



42. Find magnetic field at O



43. The magnetic field at the centre of a current carrying circular coil of radius 10 cm is $5\sqrt{5}$ times the magnetic field at a point on its axis. The distance of the point from the centre of the coil (in cm) is

(*a*) 5 (*b*) 10 (*c*) 20 (*d*) 25

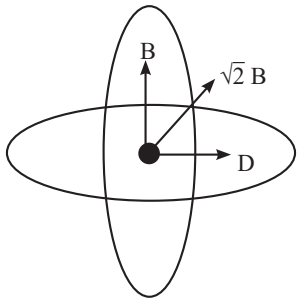
44. A circular coil carrying a certain current produces a magnetic field B_0 at its centre. The coil is now rewound so as to have 3 turns and the same current is passed through it. The new magnetic field at the centre is

(*a*) $\frac{B_0}{9}$ (*b*) $9B_0$ (*c*) $\frac{B_0}{3}$ (*d*) $3B_0$

45. At what distance on the axis, from the centre of a circular current carrying coil of radius r, the magnetic field becomes $1/8^{th}$ of the magnetic field at centre?

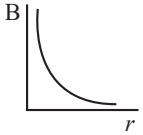
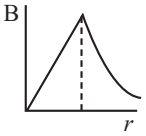
(*a*) $\sqrt{2}r$ (*b*) $2^{3/2}r$ (*c*) $\sqrt{3}r$ (*d*) $3\sqrt{2}r$

46. Two identical circular wires of radius 20 cm and carrying current $\sqrt{2}A$ are placed in perpendicular planes as shown in figure. The net magnetic field at the centre of circular wires is_____$\times 10^{-8}$T.



(*a*) 3.14 (*b*) 31.4 (*c*) 628 (*d*) 62.8

47. Match the following

Magnetic Field	Graph
(i) Infinite line charge	(A) 
(ii) Solenoid	(B) 

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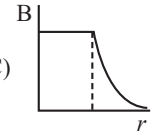
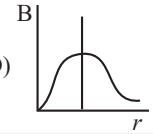
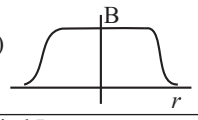
(iii) Hollow cylinder	(C) 
(iv) Solid cylinder	(D) 
(v) Ring	(E) 

Ampere's Circuital Law

48. $\oint \vec{B}\cdot d\vec{l} = \mu_0 I$ magnetic field due to inside current and I is due to all the current inside or outside.

(*a*) True (*b*) False

49. Amperes circuital law is only valid for symmetric current distribution.

(*a*) True (*b*) False

50. **Assertion:** Ampere's circuital law can not define magnetic flux

Reason: $\oint \vec{B}\cdot d\vec{l} = \mu_0 I$ in this expression there is line integral not areal integral.

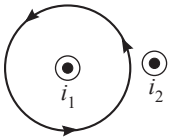
(*a*) Both assertion and reason are true and reason is the correct explanation of assertion

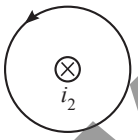
(*b*) Both assertion and reason are true, but reason is not the correct explanation of assertion

(*c*) Assertion is true, but reason is false

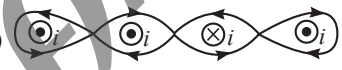
(*d*) Both assertion and reason are false

51. Find $\oint \vec{B}\cdot\overrightarrow{dl}$ over following loops (direction in which integration has to be performed is indicated by arrows)

(i) 

(ii) 

(iii)

(iv) 

Magnetic Field due to Solenoid

52. A long solenoid of 50 cm length having 100 turns carries a current of 2.5 A . The magnetic field at the centre of the solenoid is $(\mu_0 = 4\pi\times10^{-7}\ \text{T m A}^{-1})$

(*a*) 6.28×10^{-4} T (*b*) 3.14×10^{-4} T

(*c*) 6.28×10^{-4} T (*d*) 3.14×10^{-4} T

53. A long solenoid carrying a current produces a magnetic field *B* along its axis. If the current is doubled and the number of turns per cm is halved, the new value of the magnetic field is

(*a*) B/2 (*b*) B

(c) 2B (*d*) 4B

54. If length of solenoid doubled then magnetic field Inside Solenoid will be ?

(*a*) Same (*b*) Half

(*c*) Doubled (*d*) Cant say

55. Two toroids 1 and 2 have total number of turns 200 and 100 respectively with average radii 40 cm and 20 cm respectively. If they carry same current *i*, the ratio of the magnetic fields along the two loops is.

(*a*) 1 : 1 (*b*) 4 : 1

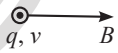
(*c*) 2 : 1 (*d*) 1 : 2

Magnetic Force on Charge

56. Find instantaneous direction of force in following cases (magnetic field and velocity are indicated)

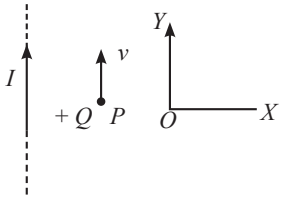
(*i*)

(*ii*)

(*iii*) 

(*iv*)

57. A charge Q moves parallel to a very long straight wire carrying a current I as shown. The force on the charge is



(*a*) Opposite to OX (*b*) Along OX

(*c*) Opposite to OY (*d*) Along 0Y

58. The magnetic force acting on a charged particle of charge –2 μC in a magnetic field of 2T acting in *y* direction, when the particle velocity is $(2\hat{i}+3\hat{j})\times10^6\ \text{ms}^{-1}$ is

(*a*) 4 N in z direction (*b*) 8 N in y direction

(*c*) 8 N in z direction (*d*) 8 N in –z direction

59. Velocity of charge particle $(2\hat{i}+3\hat{j})$ and acceleration $(3\hat{i}-\beta\hat{j})$ in magnetic field then find value of β?

60. When a charged particle moving with velocity $\vec{v}$ is subjected to a magnetic field of induction $\vec{B}$, the force on it is non-zero. This implies that

(*a*) Angle between is either zero or 180°

(*b*) Angle between is necessarily 90°

(*c*) Angle between can have any value other than 90°

(*d*) Angle between can have any value other than zero and 180°

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Lorentz Force

61. A charge q moves in a region where electric field and magnetic field both exist, then force on it is

(*a*) $q\left(\vec{v}\times\vec{B}\right)$ (*b*) $\left(q\vec{E}\right)+q\left(\vec{v}\times\vec{B}\right)$

(*c*) $q\vec{E}+\vec{q}\left(\vec{B}+\vec{v}\right)$ (*d*) $q\vec{B}+q\left(\vec{E}+\vec{v}\right)$

62. Charge q is moving with $v=(3\hat{i}-2\hat{j})$ and $B=4\hat{j}$ and $\vec{E}=2\hat{i}$ then find net force??

63. Ratio of magnetic force to electric force is $\left(\frac{c^2}{V^2}\right)$

(*a*) True (*b*) False

Motion of charge particle in magnetic field

64. A charge moving with velocity v in X-direction is subjected to a field of magnetic induction in negative X -direction. As a result, the charge will

(*a*) Remain unaffected
(*b*) Start moving in a circular path Y-Z plane
(*c*) Retard along *X*-axis
(*d*) Moving along a helical path around *X*-axis.

65. A positively charged particle moving due East enters a region of uniform magnetic field directed vertically upwards. This particle will

(*a*) Move in a circular path with a decreased speed
(*b*) Move in a circular path with a uniform speed
(*c*) Get deflected in vertically upward direction
(*d*) Move in circular path with an increased speed.

66. A charged particle moves through a magnetic field in a direction perpendicular to it. Then the

(*a*) Speed of the particle remains unchanged
(*b*) Direction of the particle remains unchanged
(*c*) Acceleration remains unchanged
(*d*) Velocity remains unchanged.

67. Under the influence of a uniform magnetic field, a charged particle moves with a constant speed v in a circle of radius R. The time period of rotation of the particle

(*a*) Depends on R and Motion
(*b*) Is independent of both v and R
(*c*) Depends on both v and R
(*d*) Depends on v and not on R.

68. Ionized hydrogen atoms and a-particles with same momenta enters perpendicular to a constant magnetic field, B. The ratio of their radii of their paths $r_H : r_\alpha$ will be

(*a*) 1 : 4 (*b*) 2 : 1 (*c*) 1 : 2 (*d*) 4 :1

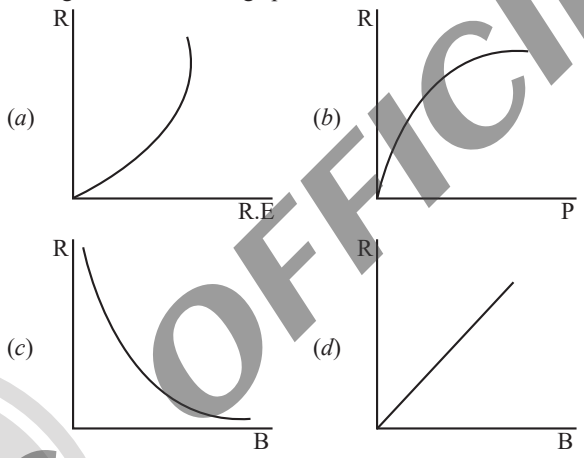
69. A proton (m,e), deuteron ($2m,e$), and α–particle ($4m$, $2e$) are projected with same Velocity in Magnetic field then find Ratio of their radius of circular Path.

70. A Proton (m,e), deuteron ($2m,e$), and α–particle ($4m$, $2e$) are Projected with same momentum in magnetic field then Find Ratio of their radius of circular path.

71. A Proton (m,e), deuteron ($2m,e$), and α–particle ($4m$, $2e$) are Projected with same (K.E.) in magnetic field then Find Ratio of their radius of circular path.

72. A proton (m,e), deuteron ($2m,e$), and α–particle ($4m$, $2e$) are accelerated with same potential and then Projected in magnetic field. Then find Ratio of their radius of circular putt.

73. Which of the following graphs is correct for radius of circular path in magnetic field of charge particle.



74. A particle of mass m carrying charge q is accelerated by a potential difference V. It enters perpendicularly in a region of uniform magnetic field B and executes circular arc of radius R, then $\left(\frac{q}{m}\right)$ equals

(*a*) $\frac{2V}{B^2R^2}$ (*b*) $\frac{V}{2BR}$

(*c*) $\frac{VB}{2R}$ (*d*) $\frac{mV}{BR}$

75. A proton and an alpha particle both enter a region of uniform magnetic field B, moving at right angles to the field B. If the radius of circular orbits for both the particles is equal and the kinetic energy acquired by proton is 1 MeV, the energy acquired by the alpha particle will be

(*a*) 1.5 MeV (*b*) 1 MeV (*c*) H MeV (*d*) 0.5 MeV

76. A proton carrying 1 MeV kinetic energy is moving in a circular path of radius R in uniform magnetic field. What should be the energy of an α particle to describe a circle of same radius in the same field?

(*a*) 2 MeV (*b*) 1 MeV (*c*) 0.5 MeV (*d*) 4 MeV

77. An electron having mass m and kinetic energy E enter in uniform magnetic field B perpendicularly, then its frequency will be

(*a*) $\frac{eE}{qvB}$ (*b*) $\frac{2\pi m}{eB}$

(*c*) $\frac{eB}{2\pi m}$ (*d*) $\frac{2m}{eBE}$

78. A proton and an α-particle enter a uniform magnetic field perpendicular with the same speed. If proton takes 20μs to make 5 revolutions, then the periodic time for the α-particle would be.

(*a*) 5 μs (*b*) 8 μs (*c*) 10 μs (*d*) 16 μs

79. A 10 eV electron is circulating in a plane at right angles to a uniform field at magnetic induction 10^{-4} Wb/m^2 (=1.0 gauss), the orbital radius of electron is

(*a*) 11 cm (*b*) 218 cm
(*c*) 12 cm (*d*) 16 cm

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80. A uniform magnetic field acts right angles to the direction of motion of electrons. As a result, the electron moves in a circular path of radius 2 cm. If the speed of electrons is doubled, then the radius of the circular path will be

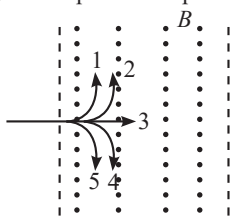
(*a*) 2.0 cm (*b*) 0.5 cm (*c*) 4.0 cm (*d*) 1.0 cm

81. A charged particle is whirled in a horizontal circle by attaching it to a string fixed at one point. If a magnetic field is switched on the vertical direction, the tension in the string.

(*a*) Will increase (*b*) Will decrease

(*c*) Will remain the same (*d*) May increase or decrease

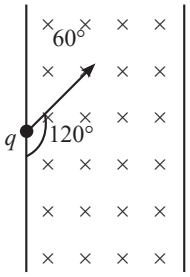
82. A proton, an electron, a neutron, an α-particle and an unknown particle enter in a region of uniform magnetic field with equal momenta. Figure shows path (Marked 1 to 5) followed by these particles. Identify which path corresponds to which particle.



83. A charged particle enters a uniform magnetic field at some angle. The particle will be deviated from its path by angle 180º. Value of θ will be

(*a*) 90º (*b*) 60º (*c*) 120º (*d*) 180º

84. Find times spent in magnetic field.



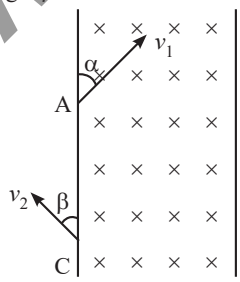
(*a*) 120° (*b*) 60°

(*c*) 240° (*d*) None of these

85. A charged particle enters a magnetic field at right angles to the magnetic field. The field exists for a length equal to 1.5 times the radius of circular path of the particle. The particle will be deviated from its path by

(*a*) 90° (*b*) $\sin^{-1}\left(\frac{2}{3}\right)$ (*c*) 30° (*d*) 180°

86. A particle of charge $-q$ and mass m enters a uniform magnetic field $\vec{B}$ at A with speed v_1 at an angle α and leaves the field at C with speed V_2 at an angle β as shown. Then



(*a*) $\alpha - \beta$

(*b*) $v_1 = v_2$

(*c*) Particle remains in the field for time $= \frac{2m(\pi - \alpha)}{qB}$

(*d*) All of these

87. The time period of a charge particle which is projected in a magnetic field B with velocity $\vec{v}$ at an angle θ with the direction of magnetic field is

(*a*) $\frac{2\pi m}{qB}$ (*b*) $\frac{2\pi m}{qB}\sin\theta$

(*c*) $\frac{2\pi m}{qB}\cos\theta$ (*d*) $\frac{2\pi m}{qB}\tan\theta$

88. An electron is moving on a circular orbit of radius r with speed v. It produces a magnetic field B at its centre, then radius of circle is proportional to

(*a*) $\frac{v}{B}$ (*b*) $\frac{v}{B^2}$ (*c*) $\left(\frac{v}{B}\right)^2$ (*d*) $\left(\frac{v}{B}\right)^{1/2}$

89. A particle of charge per unit mass α is released from origin with a velocity $\vec{v} = v_0 i$ in a uniform magnetic field $\vec{B} = -B_0\hat{k}$. If the particle passes through (0,y,0) then y is equal to

(*a*) $-\frac{2v_0}{B_0 a}$ (*b*) $\frac{v_0}{B_0 a}$ (*c*) $\frac{2v_0}{B_0 a}$ (*d*) $-\frac{v_0}{B_0 a}$

90. A charge having e/m equal to 10^8C/kg and with velocity 3×10^5 m/s enters into a uniform magnetic field B = 0.3 tesla at an angle 30º with direction of field. The radius of curvature will be

(*a*) 0.01 cm (*b*) 0.5 cm (*c*) 1 cm (*d*) 2 cm

91. A proton of mass m, charge q enters a magnetic field B with a velocity v at an angle θ with the direction of B. The radius of the resulting path is

(*a*) $\frac{mv}{qB}$ (*b*) $\frac{mv\sin\theta}{qB}$

(*c*) $\frac{mv\cos\theta}{qB}$ (*d*) $\frac{mv}{qB\sin\theta}$

92. A particle with a specific charges (s) is fired with a speed v towards a wall at a distance d, perpendicular to the wall. What minimum magnetic field must exist in this region for the particle doesn't hit the wall?

(*a*) $\frac{v}{sd}$ (*b*) $\frac{2v}{sd}$ (*c*) $\frac{v}{2sd}$ (*d*) $\frac{v}{4sd}$

93. A charge particle moving in magnetic field B, has the components of velocity along B as well as perpendicular to B. The path of the charge particle will be :

(*a*) Helical path with axis along magnetic field.

(*b*) Straight along direction of magnetic field.

(*c*) Circular path

(*d*) Helical path with axis perpendicular to direction of magnetic field B.

94. A charged particle is whirled in horizontal circle by attaching it to a string fixed at one point. If a magnetic field is switched on directed vertically upwards. Then answer the following in true / false.

(i) If a particle is negative changed, Tension in string will decrease.

(ii) If a particle is positively charged, tension in string will increase.

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Motion of Charge Particle in Electric Field and Magnetic Field

95. A particle having a charge of 10μC and mass 1μg moves in a horizontal circle of radius 10 cm under the influence of a magnetic field of 0.1 T . When the particle is at a point P , a uniform electric field is switched on so that the particle starts moving along the tangent with uniform velocity. The electric field is

(*a*) 0.1 V/m (*b*) 1.0 V/m
(*c*) 10.0 V/m (*d*) 100 V/m

96. When a proton is released from rest in a room, it starts with an initial acceleration a_0 towards west. When it is projected towards north with a speed v_0 it moves with an initial acceleration $3a_0$ towards west. The electric and magnetic fields in the room are:

(*a*) $\frac{ma_0}{e}$ west, $\frac{2ma_0}{ev_0}$ down (*b*) $\frac{ma_0}{e}$ *east*, $\frac{2ma_0}{ev_0}$ *up*
(*d*) $\frac{ma_0}{e}$ east, $\frac{2ma_0}{ev_0}$ down (*d*) $\frac{ma_0}{e}$ west, $\frac{2ma_0}{ev_0}$ up

97. Charge particle at rest experience zero electromagnetic force then electric field may be zero.

(*a*) True (*d*) False

98. Charge Particle is at rest, experience zero electromagnetic force then magnetic field may te zero.

(*a*) True (*d*) False

99. Charge particle is at rest, experience electromagnetic force then electric field must be non-zero

(*a*) True (*d*) False

100. Charge particle is ad rest, experience electromagnetic force then magnetic field must be non-zero

(*a*) True (*d*) False

101. Charge is moving in $E - M$ field without deviation then electric field and magnetic field both may be non-zero or both may be zero

(*a*) True (*d*) False

102. Charge Particle Passes EM Field without acceleration then three conditions are possible: (E = 0, B = 0); (E = 0, B ≠ 0) (E ≠ 0, B ≠ 0)

(*a*) True (*d*) False

103. Charge is moving on circular Path in EM field then only one condition (E = 0, B ≠ 0)

(*a*) True (*d*) False

104. A charged particle moves in a gravity free space without change in velocity. Which of the following is not possible in the space?

(*a*) E = 0, B = 0 (*b*) E ≠ 0, B = 0
(*c*) E = 0, B ≠ 0 (*d*) E ≠ 0, B ≠ 0

105. An electron moving with constant velocity passes through a region of space without change in its velocity. If E and *B* represent electric and magnetic field respectively, the region of space may have

(*a*) E = 0, B = 0 (*b*) E = 0, B ≠ 0
(*c*) E ≠ 0, B ≠ 0 (*d*) All of these

106. If an electron is not deflected in passing through a certain region of space, can we be sure that there is no magnetic field in that region?

(*a*) True (*d*) False

107. If a moving electron is deflected sideways on passing through a certain region of space, can we be sure that a magnetic field exists in that region?

108. A beam of protons is deflected sideways. Could this deflection be caused

(*i*) By an electric field?
(*ii*) By a magnetic field,?
(*iii*) If either could be responsible how would you be able to tell which was present

109. A charged particle moves along a circle under the action of possible constant electric and magnetic fields. Possible case is.

110. Magnetic force can not accelerate charge particle.

(*a*) True (*b*) False

111. Magnetic field can change momentum of charge particle.

(*a*) True (*b*) False

112. A uniform, electric field and a uniform magnetic field are acting along the same direction in a certain region. If an electron is projected in region such that its velocity is projected along direction of fields, then choose the correct statement from following. Projected

(*a*) Speed of electron decreases as both fields are producing Retardation.
(*b*) Electron will turn towards right of direction of motion.
(*c*) Electron will turn towards left of direction of motion.
(*d*) Speed of electron will decrease as electrostatic force is producing retardation.

Cyclotron

113. If frequency of cyclotron is *n* then find B magnetic field ues in cyclotron)?

114. Potential difference of oscillator is 100 *kV* , find total no. of oscillation for 20 MeV kinetic energy of proton.

115. A cyclotron is used to accelerated protons. If the operating magnetic field is 1.0 T and the radius of the cyclotron 'dees' is 60 cm , the kinetic energy of the accelerated protons in MeV will be : [use $m_p = 1.6 \times 10^{-27}$ kg, $e = 1.6 \times 10^{-19}$ C]

(*a*) 12 (*b*) 18 (*c*) 16 (*d*) 32

116. **Statement I :** Dimension of ratio of magnetic field to electric field is same as that of dimension of velocity.

Statement II : Any charged particle can be accelerated by a machine known as "cyclotron".

(*a*) Statement-I is true, statement-I is true; statement-II is a correct explanation for statement-I.
(*b*) Statement-I is true, statement-II is true and statement-II is not a correct explanation for statement-I.
(*c*) Statement-I is true, statement-II is false.
(*d*) Both Statement-I and statement-II are false.

Magnetic Force on a Current Carrying Conductor

117. A straight wire of length 0.5 metre and carrying a current of 1.2 ampere is placed in uniform magnetic field of induction 2 tesla. The magnetic field is perpendicular to the length of the wire. The force on the wire is

(*a*) 12.4 N (*b*) 1.2 N (*c*) 3.0 N (*d*) 2.0 N

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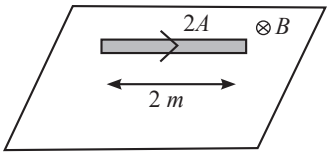
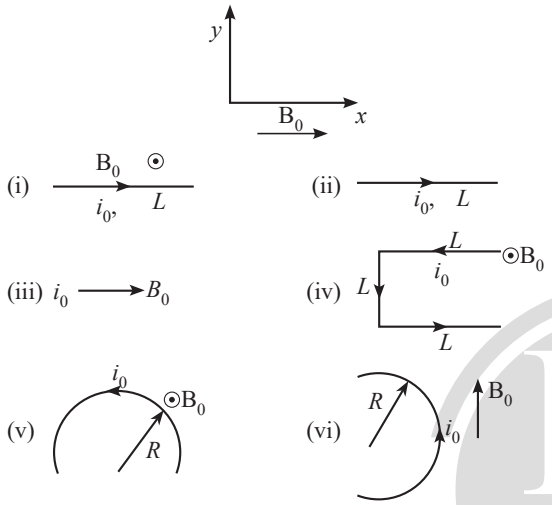
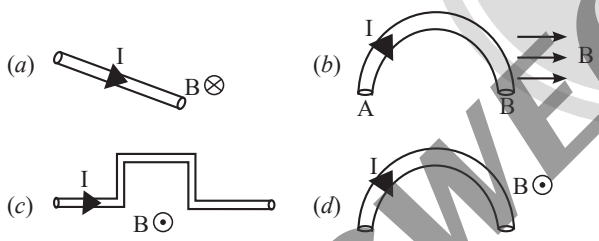
118. A straight wire of mass 400g and length 2 m carries a current of 2A. If is suspended in mid air by a uniform horizontal field B. What is the magnitude of the magnetic field?



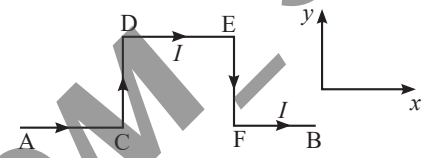
119. Find the direction of magnetic force on following current carrying wires. Direction of magnetic field is indicated in each case.



120. In which of the following system, the force on current carrying wire will be zero?

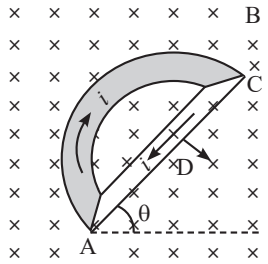


121. A uniform magnetic field $\vec{B} = B_0\hat{k}$ exists in a region. A current carrying wire is placed in $x - y$ plane as shown. Find the force acting on the wire AB, if each section of the wire is of length 'a'



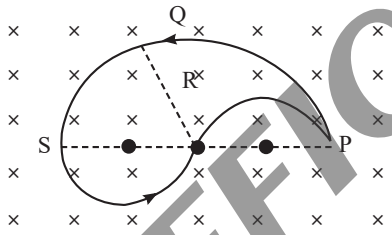
122. A wire having current 3 Amp and coordinate of its two end is (3,6,7) & (6,10,12) then find force if magnetise field $4T\hat{k}$.

123. A circular wire ABC and a straight conductor ADC are carrying current i and are kept in the magnetic field B then considering points A and C.



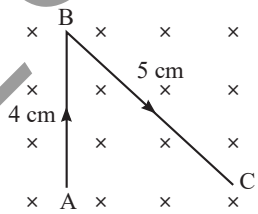
(*a*) Magnitude of force on ABC is more than ADC
(*b*) Magnitude of force on ABC is less than ADC
(*c*) Magnitude of force on ABC is equal to that on ADC
(*d*) All of these

124. A semicircular wire PQS of radius R is connected to a wire bent in the form of a sine curve to form a closed loop as shown in the figure. If the loop carries a current i and is placed in a uniform magnetic field B, then the total force acting on the sine curve is



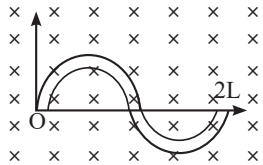
(*a*) 2BiR(downward) (*b*) 2BiR(upward)
(*c*) BiR(upward) (*d*) Zero

125. A uniform conducting wire ABC has a mass of 10 g . A current of 2 A flows through it. The wire is kept in a uniform magnetic field B = 2T. The acceleration of the wire will be



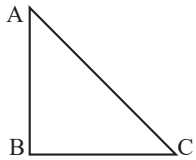
(*a*) Zero (*b*) 12 ms^{-2}
(*c*) 1.2×10^{-3} ms^{-2} (*d*) 0.6×10^{-3} ms^{-2}

126. A wire carrying a current i is placed in a magnetic field in the form of the curve $y = a\sin\left(\frac{\pi x}{L}\right) 0 \le x \le 2L$. Force acting on the wire is



(*a*) $\frac{iBL}{\pi}$ (*b*) iBLπ (*c*) 2iBL (*d*) Zero

127. A current carrying closed loop in the form of a right angle isosceles triangle ABC is placed in a uniform magnetic field acting along AB. If the magnetic force on the arm BC is $\vec{F}$ the force on the arm AC is



(*a*) $-\sqrt{2}\vec{F}$ (*b*) $-\vec{F}$ (*c*) $\vec{F}$ (*d*) $\sqrt{2}\vec{F}$

128. A small circular flexible loop of wire of radius R carries a current I. It is placed in a uniform magnetic field B. The tension in the loop will be doubled, if

(*a*) I is doubled (*b*) B is doubled
(*c*) is doubled (*d*) All of these

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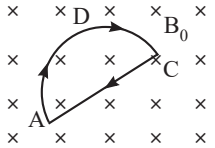
129. Figure shows a conducting loop ADCA carrying current i and placed in a region of uniform magnetic field B_0 . The apart ADC forms a semicircle of radius R. The magnitude of force on the semicircle part of the loop is equal to



(*a*) πRiB_0 (*b*) Zero (*c*) $2\pi RiB_0$ (*d*) $2iRB_0$

130. Magnetic force on a close loop always zero

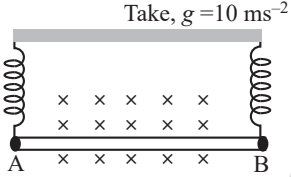
(*a*) True (*b*) False

131. Magnetic force on a close loop always zero in uniform magnetic

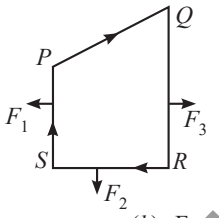
(*a*) True (*b*) False

132. A straight wire *AB* of mass 40 g and length 50 cm is suspended by a pair of flexible leads in uniform magnetic field of magnitude 0.40 T as shown in the figure. The magnitude of the current required in the wire to remove the tension in the supporting leads is....A

Take, $g = 10\ ms^{-2}$



133. A closed loop PQRS carrying a current is placed in a uniform magnetic field. If the magnetic forces on segments PS, SR and RQ are F_1, F_2 and F_3 respectively and are in the plane of the paper and along the directions shown, the force on the segment QP is

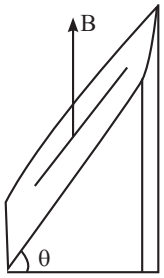


(*a*) $F_3 - F_1 + F_2$ (*b*) $F_3 - F_1 - F_2$

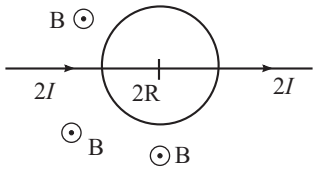
(*c*) $\sqrt{(F_3 - F_1)^2 + F_2^2}$ (*d*) $\sqrt{(F_3 - F_1)^2 - F_2^2}$

134. A straight conducting wire of length L and mass *m* carries a current I and is placed on a smooth inclined plane that makes an angle θ with the horizontal. The plane is inclined in a uniform magnetic field B, which is oriented perpendicular to the plane. Find the value of the magnetic field strength B such that the wire remains at rest on the inclined plane. Neglect frictional forces.

135. A conducting wire of length L and mass m carries a current I and lies on a smooth inclined plane at an angle θ. A uniform magnetic field B is oriented vertically upward, and the plane is inclined with respect to the horizontal. The wire is at rest on the plane due to the balance between gravitational forces and magnetic forces acting on the current-carrying wire. Determine the magnitude of the magnetic field B such that the wire remains in static equilibrium on the plane.



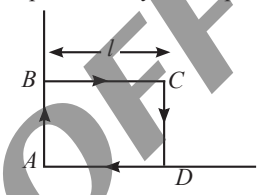
136. Find net force on circular wire.



(*a*) Zero (*b*) BIR (*c*) 4BIR (*d*) 2BIL

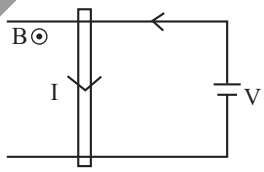
137. The magnetic field existing in a region is given by $\vec{B} = B_0\left(1 + \frac{x}{l}\right)\hat{k}$

A square loop of edge l and carrying a current i, is placed with its edge parallel to the $x - y$ axes. Find the magnitude of the net magnetic force experienced by the loop



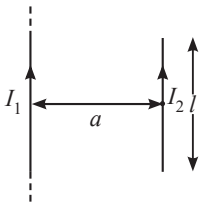
(*a*) $\frac{1}{2}iB_0l$ (*b*) Zero (*c*) iB_0l (*d*) $2iB_0l$

138. Find coefficient of friction between frame & wire so, that wire will not move.



Force Between Two Current Carrying Conductor

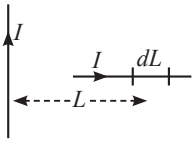
139. Find magnetic force on Infinite wire due to small wire at distance '*a*'.



(*a*) Negligible (*b*) Infinite

(*c*) $\frac{\mu_0 I_1 I_2 l}{2\pi a}$ (*d*) Cant be calculate

140. Two long wires carrying same currents are placed perpendicular to each other. The magnetic force on a small length *dL* of second wire is



(*a*) $\frac{\mu_0 I}{2\pi L}(dL)$ (*b*) $\frac{\mu_0 I^2}{2\pi L}(dL)$

(*c*) $\frac{\mu_0 I}{2\pi}(dL)X$ (*d*) $\frac{\mu_0 I}{2\pi L}$

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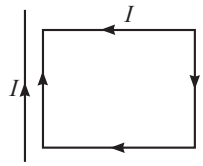
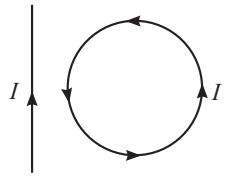
141. A rectangular loop carrying a current i is situated near a long straight wire such that the wire is parallel to one of the sides of the loop and is in the plane of the loop. If a steady current i is established in the wire, the loop will



(*a*) Rotate about an axis parallel to the wire
(*b*) Move away from the wire
(*c*) Move towards the wire
(*d*) Remain stationary

142. Circular wires will attract or repel.



143. Two parallel wires in free space are 10 cm apart and each carries a current of 10 A in the same direction. The force exerted by one wire on the other, per metre length is

(*a*) 2×10^{-4} N, repulsive (*b*) 2×10^{-7} N, repulsive
(*c*) 2×10^{-4} N, attractive (*d*) 2×10^{-7} N, attractive

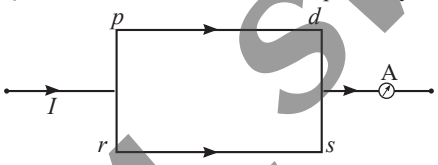
144. Three infinite wire as shown in figure, find net force per unit length on middle wire.

I⊙ ⊗I ⊙I

145. A circular coil ABCD carrying a current 'i' is placed in a uniform magnetic field. If the magnetic force on the segment AB is $\vec{F}$, the force on the remaining segment BCDA is

(*a*) $-\vec{F}$ (*b*) $3\vec{F}$ (*c*) $-3\vec{F}$ (*d*) $\vec{F}$

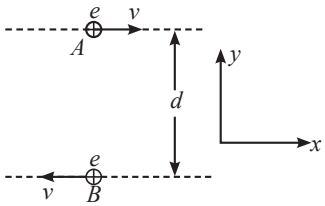
146. A current carrying rectangular loop PQRS is made of uniform wire so that resistance in PQ is same as that of RS. If ammeter reading changes from I to 2I , ratio of magnetic forces per unit length on wire PQ due to wire RS in two cases respectively is :



(*a*) 1 : 3 (*b*) 1 : 2 (*c*) 1 : 4 (*d*) 1 : 5

Force Between Two Moving Charges

147. Two protons A and B move parallel to the x-axis in opposite directions with equal speeds v. At the instant shown, the ratio of magnetic force and electric force acting on the proton A is (C = speed of light in vacuum)



(*a*) $\frac{v}{c}$ (*b*) $\frac{v^2}{c^2}$ (*c*) $\frac{vd^2}{c}$ (*d*) $\frac{2v}{c}$

Magnetic Moment

148. Ratio of magnetic moment and angular momentum is $\frac{e}{2m_e}$

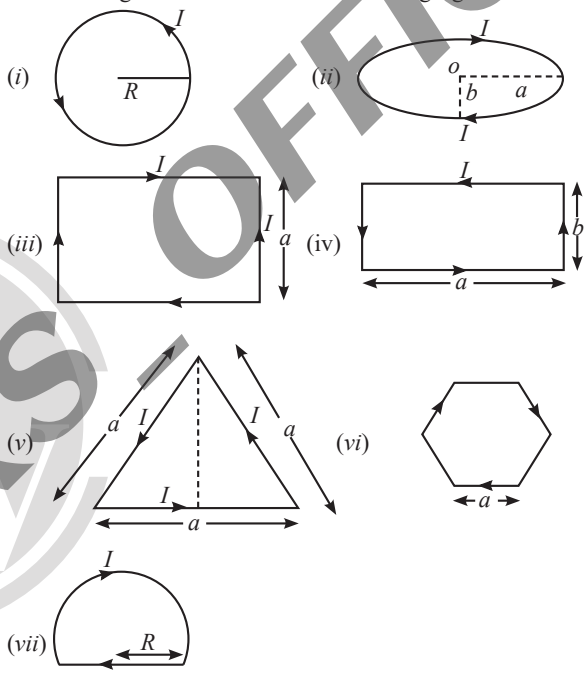
(*a*) True (*b*) False

149. Magnetic moment of revolving electron is independent of its angular speed of revolution,

(*a*) True (*b*) False

Current Carrying loop as Magnetic Dipole

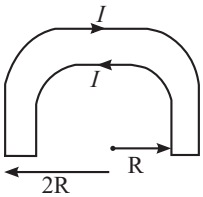
150. Find the magnetic moment for the following figure.



151. If the planes of two identical concentric coils are perpendicular and the magnetic moment of each coil is M, then the resultant magnetic moment of the two coils will be

(*a*) M (*b*) 2M (*c*) 3M (*d*) $\sqrt{2}$M

152. Find magnetic moment.



Magnetic Dipole Moment of Revolving Electron

153. If number of turns, area and current through a coil is given by n, A and i respectively then its magnetic moment will be

(*a*) niA (*b*) n^2iA (*c*) niA^2 (*d*) ni/$\sqrt{A}$

154. A charged particle (charge q) is moving in a circle of radius R with uniform speed v. The associated magnetic moment μ is given by

(*a*) qvR^2 (*b*) $qvR^{2/2}$ (*c*) pvR (*d*) qvR/2

155. A Massless disc of radius r and carrying charge q, is rotating with angular speed ω about an axis passing through its centre and perpendicular to its plane. Calculate its magnetic moment.

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Torque on Magnetic Dipole

156. Torque on magnetic dipole is always perpendicular to the magnetic field.

(*a*) True (*b*) False

157. A rectangular coil of length 0.12 m and width 0.1 m having 50 turns of wire is suspended vertically in a uniform magnetic field of strength 0.2 Weber/m^2. The coil carries a current of 2 A . If the plane of the coil is inclined at an angle of 30° with the direction of the field, the torque required to keep the coil in stable equilibrium will be

(*a*) 0.24 N m (*b*) 0.12 N m (*c*) 0.15 N m (*d*) 0.20 N m

158. A coil in the shape of an equilateral triangle of side *l* is suspended between the pole pieces of a permanent magnet such that $\vec{B}$ is in plane of the coil. If due to a current *i* in the triangle a torque τ acts on it, the side *l* of the triangle is

(*a*) $\frac{2}{\sqrt{3}}\left(\frac{\tau}{Bi}\right)$ (*b*) $2\left(\frac{\tau}{\sqrt{3}Bi}\right)^{1/2}$

(*c*) $\frac{2}{\sqrt{3}}\left(\frac{\tau}{Bi}\right)^{1/2}$ (*d*) $\frac{1}{\sqrt{3}}\frac{\tau}{Bi}$

159. A circular loop of area 0.01 m^2 carrying a current of 10 A , is held perpendicular to a magnetic field of intensity 0.1 T . The torque acting on the loop is

(*a*) 10.001 N m (*b*) 0.8 N m

(*c*) zero (*d*) 0.01 N m

160. A uniform magnetic field of 2×10^{-3} T acts in positive Y -direction. A rectangular loop of sides 20 cm and 10 cm with current of 5 A is in Y–Z plane. The current is in anticlockwise sense with reference to negative X axis. Magnitude and direction of the torque is :

(*a*) 2×10^{-4} N – m along negative Z-direction.

(*b*) 2×10^{-4} N – m along positive *X*-direction.

(*c*) 2×10^{-4} N – m along positive Y -direction.

(*c*) 2×10^{-4} N – m along positive Z-direction.

Magnetic Dipole in Uniform Magnetic Field

161. A current loop in a magnetic field

(*a*) can be in equilibrium in two orientations, both the equilibrium states are unstable.

(*b*) Can be in equilibrium in two orientations, one stable while the other is unstable.

(*c*) experiences a torque whether the field is uniform or non uniform in all orientations.

(*d*) Can be in equilibrium in one orientation.

162. A coil carrying electric current is placed in uniform magnetic field then.

(*a*) torque is formed

(*b*) e.m.f is induced

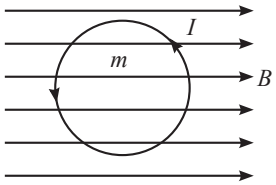
(*c*) both (1) and (2) are correct

(*d*) none of these

163. Frequency of oscillation of magnetic dipole is directly proportional to magnetic field.

(*a*) True (*b*) False

164. Ring (R, M, I) is released as shown in figure. Find Angular or speed of ring when dipole moment become parallel to magnetic field.



Moving Coil Galvanomenter

165. If current sensitivity becomes double by keeping no. of turns doubled then find change in current and voltage Sensitivity?

166. Voltage sensitivity does not depends on number of turns.

(*a*) True (*b*) False

167. The current sensitive of a galvanometer can be increased by :

(*a*) Decreasing the number of turns

(*b*) increasing the magnetic field

(*c*) Decreasing the area of the coil

(*d*) Decreasing the torsional constant of the spring

Choose the most appropriate answer from the options given below

(*a*) (B) and (C) only (*b*) (C) and (D) only

(*c*) (A) and (C) only (*d*) (B) and (D) only

168. For a moving coil galvanometer, the deflection in coil is 0.05 radian when a current of 10 mA is passing through it. If the Torsional constant of suspension wire is 4×10^{-5}c Nm rad^{-1}, then magnetic field is 0.01 T and number of turns in coil is 200 , Area of each turn (in cm^2) is :

(*a*) 1.5 (*b*) 0.5 (*c*) 2.0 (*d*) 1.0

169. Given below are two statement:

Statement-I: If the number of turns in the coil of a moving coil galvanometer is doubled then the current sensitivity becomes double.

Statement-II: Increasing current sensitivity of a moving coil galvanometer by only increasing the number of turns in the coil will also increase its voltage sensitivity in the same ratio:

In the light of the above statement, choose the correct answer from the options given below:

(*a*) Statement-I is false but Statement-II is true

(*b*) Both Statement-I and Statement-II are true

(*c*) Both Statement-I and Statement-II are false

(*d*) Statement-I is true but Statement-II is false

170. The voltage sensitivity of a moving coil galvanometer becomes *K* times when number of turns is tripled. The value of *K* is-

(*a*) 9 (*b*) 3

(*c*) 27 (*d*) 1

171. Voltage sensitivity of a moving coil galvanometer is V_s and current sensitivity is I_s. Resistance of galvanometer is '*G*'. The relation between V_s and I_s.

(*a*) $V_s = \frac{I_s}{G}$ (*b*) $V_s = I_s.G$

(*c*) $\frac{G}{V_s I_s} = Vs$ (*d*) $\frac{G}{V_s} = Vs$

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1. A negatively charged particle projected Towards east is deflected Towards North by a Magnetic field directed_____.

2. **Statement I:** A charged particle is whirled in a horizontal circle on a frictionless table by attaching it to a string fixed at one point. If a magnetic field is switched on in the vertical direction, the tension in the string May decrease.

   Statement II: Electron will describe the smallest circle among Electron, proton, He^{+}, Li^{++} when they are projected with same velocity perpendicular to a magnetic field.

3. **Statement I:** A Beam consisting of protons and electrons moving at the same speed goes through a thin region in which there is a magnetic field perpendicular to the beam. The protons and electrons will be deviated by same angle but will get separated.

   Statement II: A charged particle moves in uniform magnetic field. The velocity of the particle at some instant makes an acute angle with the magnetic field. The path of particle will be a helical with a uniform pitch.

4. **Statement I:** If a charged particle at rest experiences no Electromagnetic force, Then we can say that the Electric field Must be zero But Magnetic field may or may not be zero.

   Statement II: If a charged particle projected in a gravity-free room deflects, there must be a magnetic field.

5. **Statement I:** A charged particle goes undeflected in a region containing Electric and magnetic field It is possible that $\vec{V} \parallel \vec{B}$ But $\vec{E}$ is not parallel to $\vec{B}$.

   Statement II: A charged particle goes undeflected in a region containing electric field It is possible that $\vec{E}$ is not parallel to $\vec{B}$.

6. **Statement I:** If a charged particle goes unaccelerated in a region containing electric and Magnetic fields, E must be equal to B.

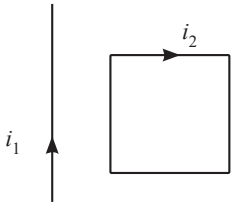
   Statement II: If a charged particle goes unaccelerated in a region containing electric and Magnetic fields, $\vec{E}$ must be perpendicular to $\vec{B}$.

7. A Vertical wire carries a current in____ direction. An electron Beam sent horizontally. Towards the wire will be deflected upwards.

8. **Statement I:** A current carrying straight wire is kept along the axis of a circular loop carrying a current The Straight wire will not exert any force on the circular loop.

   Statement II: A proton Beam is going from north to south and an electron beam is going from South to north Neglecting the earth's magnetic field, the electron Beam will be deflected towards the proton beam.

9. **Statement I:** A Square loop carrying current i_2 as shown is placed near a fixed straight wire carrying current i_1. The loop will Remain stationary as Net Magnetic force on it is zero.



   Statement II: A particle is projected in a plane perpendicular to a uniform magnetic field. The area bounded by the path described by particle will be proportional to the Velocity.

10. **Statement I:** Two parallel wires carry currents of 20A and 40 A in opposite directions. Another wire carrying a current antiparallel to 20A is placed midway between the Two wires. The Magnetic force on it will be towards 40 A.

    Statement II: The Magnetic field at origin due to a current element $i\,\vec{dl}$ placed at $\vec{r}$ position will be $\frac{\mu_o i}{4\pi}\frac{\vec{dl}\times\vec{r}}{r^3}$

11. **Statement I:** A long, straight wire of radius R carries a current distributed uniformly over its Cross section. The magnitude of the magnetic field is minimum at axis of wire and is maximum at the surface of the wire.

    Statement II: A hollow Tube is carrying an electric current along its length distributed uniformly over its surface. The magnetic field increases linearly from axis to the surface.

    Statement III: A steady electric current is flowing through a cylindrical conductor. The electric field will be zero in the vicinity of conductor but not at the axis of conductor whereas Magnetic field will be zero at the axis of conductor But not in vicinity of conductor.

12. A particle having a mass of 10^{-2} kg carries a charge of 5×10^{-8}C. The particle is given an initial horizontal velocity of 10^5 msec^{-1} in the presence of electric field $\vec{E}$ and magnetic field $\vec{B}$. To keep the particle moving in a horizontal direction, it is necessary that

    A. $\vec{B}$ should be perpendicular to the direction of velocity and $\vec{E}$ should be along the direction of velocity

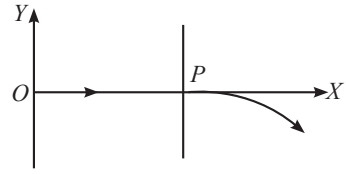
    B. Both $\vec{B}$ and $\vec{E}$ should be along the direction of velocity

    C. Both $\vec{B}$ and $\vec{E}$ are mutually perpendicular and perpendicular to the direction of velocity

    D. $\vec{B}$ should be along the direction of velocity and E should be perpendicular to the direction of velocity

    (*a*) A and C (*b*) B and C (*c*) C and D (*d*) B and D

13. For a positively charged particle moving in a $x - y$ plane initially along the x-axis, there is a sudden change in its path due to the presence of electric and/or magnetic fields beyond P. The curved path is shown in the $x - y$ plane and is found to be non-circular. Which one of the following combinations is possible



    (*a*) $\vec{E}=0;\vec{B}=b\hat{i}+c\hat{k}$ (*b*) $\vec{E}=b\hat{i};\vec{B}=c\hat{k}+a\hat{i}$

    (*c*) $\vec{E}=0;\vec{B}=c\hat{j}+b\hat{k}$ (*d*) $\vec{E}=a\hat{i};\vec{B}=c\hat{k}+b\hat{j}$

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14. Consider the motion of a positive point charge in a region where there are simultaneous uniform electric and magnetic fields $\vec{E} = E_0\hat{j}$ and $\vec{B} = B_0\hat{j}$. At time $t = 0$ this charge has velocity $\vec{v}$ in the $x - y$ plane, making an angle θ with the x-axis. Which of the following option (s) is (are) correct for time $t > 0$

(i) If θ = 0°, the charge moves in a circular path in the $x - z$ plane

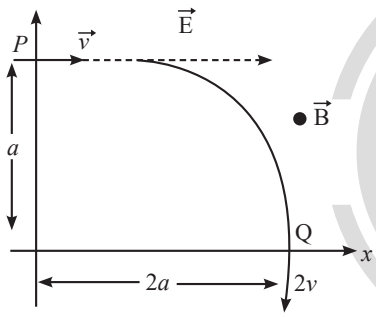
(ii) If θ = 0°, the charge undergoes helical motion with constant pitch along the y – axis

(iii) If θ = 10°, the charge undergoes helical motion with its pitch increasing with time, along the y – axis

(iv) If θ = 90°, the charge undergoes linear but accelerated motion along the y – axis

(*a*) (i), (ii) (*b*) (i), (iv) (*c*) (ii), (iii) (*d*) (iii), (iv)

15. A particle of charge $+q$ and mass m moving under the influence of a uniform electric field $E\hat{i}$ and a uniform magnetic field $B\hat{k}$ follows trajectory from P to Q as shown in figure. The velocities at P and Q are vi and $-2v\hat{j}$ respectively. Which of the following statement(s) is/are correct



(i) $E = \frac{3}{4}\frac{mv^2}{qa}$

(ii) Rate of work done by electric field at P is $\frac{3}{4}\frac{mv^2}{a}$

(iii) Rate of work done by electric field at P is zero

(iv) Rate of work done by both the fields at Q is zero

(*a*) (i), (ii) (*b*) (ii), (iv)

(*c*) (i), (ii), (iv) (*d*) (i), (iv)

16. A square coil of edge l having n turns carries a current i. It is kept on a smooth horizontal plate. A uniform magnetic field B exists in a direction parallel to an edge. The total mass of the coil is M. Minimum value of B for which the coil will start tipping over

(*a*) $\frac{Mg}{2nil}$ (*b*) $\frac{Mg}{nil}$

(*c*) $\frac{2Mg}{nil}$ (*d*) $\left(\frac{Mg}{nil}\right)^2$

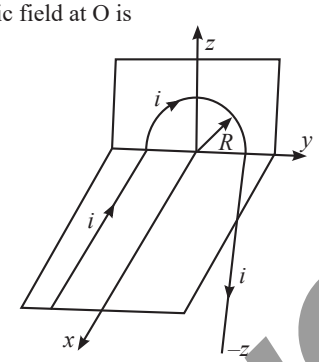
17. A long straight wire carries a current along the x-axis. Consider the points A (0, 1, 0), B (0, 1, 1), C (1, 0, 1) and D (1, 1, 1). Which of the following pairs of points will have magnetic fields of the same magnitude?

(i) A and B (ii) A and C

(iii) B and C (iv) B and D

(*a*) (i), (ii) (*b*) (ii), (iii) (*c*) (i), (ii) (*d*) (ii), (iv)

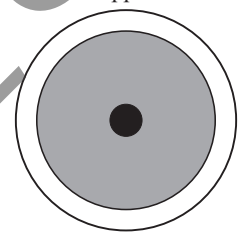
18. The magnetic field at O is



(*a*) $\left(\frac{\mu_0 I}{4R}\right)\sqrt{1+\frac{2}{\pi^2}+\frac{2}{\pi}}$ (*b*) $\left(\frac{\mu_0 I}{2R}\right)\sqrt{1+\frac{2}{\pi^2}+\frac{2}{\pi}}$

(*c*) $\left(\frac{\mu_0 I}{4R}\right)\sqrt{1+\frac{2}{\pi^2}+\frac{1}{\pi}}$ (*d*) $\left(\frac{\mu_0 I}{R}\right)\sqrt{1+\frac{2}{\pi^2}+\frac{2}{\pi}}$

19. Consider a coaxial cable which consists of an inner wire of radius a surrounded by an outer shell of inner and outer radii b and c respectively. The inner wire carries a current I and the outer shell carries an equal current in opposite direction.



(*a*) $For\ x < a, B = \frac{\mu_0 Ix}{2\pi a^2}$ (*b*) $For\ a < b, B = \frac{\mu_0 I}{2\pi x}$

(*c*) $For\ b < c, B = \frac{\mu_0 I(c^2 - x^2)}{2\pi x(c^2 - b^2)}$ (*d*) All

20. A charged particle P leaves the origin with speed $v = v_0$, at some inclination with the x – axis. There is a uniform magnetic field B along the x–axis. P strikes a fixed target T on the x – axis for a minimum value of $B = B_0$ P will also strike T if

(i) $B = 2B_0$, $v = 2v_0$ (ii) $B = 2B_0$, $v = v_0$

(iii) $B = B_0$, $v = 2v_0$ (iv) $B = B_0/2$, $v = 2v_0$

(*a*) (i), (ii) (*b*) (ii), (iii) (*c*) (i), (iii) (*d*) (ii), (iv)

21. Two parallel conductors carrying current in the same direction attract each other, while two parallel beams of electrons moving in the same direction repel each other. Which of the following statements provide part of all of the reason for this? (Choose the incorrect option)

(*a*) The conductors are electrically neutral

(*b*) The conductors produce magnetic fields on each other

(*c*) The electron beams do not produce magnetic field on each other

(*d*) The magnetic forces caused by the electron beams on each other are weaker than the electrostatic forces between them

22. An electron is moving along the positive X-axis. You want to apply a magnetic field for a short time so that the electron may reverse its direction and move parallel to the negative X-axis. This can be done by applying the magnetic field along

(i) Y-axis (ii) Z-axis one

(iii) Y-axis only (iv) -Z-axis

(*a*) (i), (ii) (*b*) (ii), (iv) (*c*) (ii), (iii) (*d*) (i), (iv)

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Answer Key

1. (*c*) **2.** (Yes) **3.** (*b*) **4.** (*b*) **5.** (*b*) **6.** (*b*) **7.** $\frac{9\mu_0 I}{32R}$ **8.** (*d*) **9.** (*a*) **10.** (*a*)
11. (*c*) **12.** (*a*) **13.** (*b*) **14.** (*d*) **15.** (*c*) **16.** ($B_2 = 4\ B_1$) **17.** (*a*) **18.** (*c*) **19.** (c)

20. (*c*) **21.** $\frac{\mu_0 I}{2R}\left[\frac{\pi-1}{\pi}\right]$ **22.** (*d*) **23.** (*d*) **24.** (*d*) **25.** (*d*) **26.** (*b*) **27.** $\sqrt{3}\left(\frac{\mu_0 I}{2R}\right)$
28. (*b*) **29.** (*b*) **30.** $\frac{\mu_0 I}{8\pi}$ **31.** $\frac{\mu_0 I}{\pi a}\left(\frac{5}{2\sqrt{2}}\right)$ **32.** (*b*) **33.** $\frac{2\sqrt{2}\mu_0 I}{\pi l}$ **34.** $B_A = \frac{5\mu_0}{4\pi}, B_B = \frac{\mu_0}{\pi}$
35. $\frac{\mu_0 I}{8\sqrt{2}\pi}(1+\sqrt{2})$ **36.** $\frac{\mu_0 I}{r}\left(\frac{1}{2\pi}+\frac{1}{4}\right)$ **37.** $\frac{\mu_0 I}{4R}$ **38.** (0) **39.** (0) **40.** (0) **41.** $\frac{\mu_0 I}{2r}\left(\frac{\theta}{2\pi}\right)$
42. $\frac{2\mu 0}{3R}$ **43.** (*c*) **44.** (*b*) **45.** (*c*) **46.** (*c*) **47.** *i* – A, *ii* – E, *iii* – C, *iv* – B, *v* – D **48.** (*b*) **49.** (*b*)
50. (*a*) **51.** (*i*) $\mu_0 i_1$,(*ii*) $-\mu_0 i_2$, (*iii*) $-2\mu_0 i$, (*iv*) $-2\mu_0 i$ **52.** (*a*) **53.** (*b*) **54.** (*d*) **55.** (*a*)
56. (*i*) Right, (*ii*) Inward, (*iii*) Upward, (*iv*) Left **57.** (*a*) **58.** (*d*) **59.** (2) **60.** (*d*) **61.** (*b*)
62. $q(2\hat{i}+12\hat{k})$ **63.** (*b*) **4.** (*a*) **65.** (*b*) **66.** (*a*) **67.** (*b*) **68.** (*b*) **69.** 1 : 2 : 2
70. 2 : 2 : 1 **71.** $1:\sqrt{2}:1$ **72.** $1:\sqrt{2}:\sqrt{2}$ **73.** (*c*) **74.** (*a*) **75.** (*b*) **76.** (*b*) **77.** (*c*)
78. (*b*) **79.** (*a*) **80.** (*c*) **81.** (*d*) **82.** 1. Unknown particle, 2. Electron, 3. Neutron, 4. Proton, 5. Alpha particle
83. (*a*) **84.** (*a*) **85.** 180° **86.** (*d*) **87.** (*a*) **88.** (*d*) **89.** (*c*) **90.** (*b*) **91.** (*b*) **92.** (*a*)
93. (*a*) **94.** (i) True (ii) False **95.** (*c*) **96.** (*a*) **97.** (*b*) **98.** (*a*) **99.** (*a*) **100.** (*b*) **101.** (*a*)
102. (*a*) **103.** (*a*) **104.** (*b*) **105.** (*c*) **106.** (*b*) **107.** No, the sideway deflection may be due to electric field as well
108. (*i*) Yes, (*ii*)Yes, (*iii*)we can find cause of deflection by throwing **109.** E = 0, B ≠ 0 **110.** (*b*) **111.** (*b*) **112.** (*d*)
113. $\frac{2\pi mn}{q}$ **114.** 100 **115.** (*b*) **116.** (*d*) **117.** (*b*) **118.** 1 T
119. (*i*) Downward, (*ii*) Force is zero, (*iii*) upward, (iv) Towards left, (v) Upward, (vi) Force is zero **120.** (*b*) **121.** $-3B_0 Ia\hat{j}$
122. 60 N **123.** (*c*) **124.** (*b*) **125.** (*b*) **126.** (*c*) **127.** (*b*) **128.** (*d*) **129.** (*d*) **130.** (*b*) **131.** (*a*)
132. $I = \frac{mg}{BL}$ **133.** (*c*) **134.** $\frac{mg\sin\theta}{IL}$ **135.** $B = \frac{mg}{IL}\tan\theta$ **136.** (*c*) **137.** (*c*)
138. $\mu = \left(\frac{BIl}{mg}\right)$ **139.** (*c*) **140.** (*b*) **141.** (*c*) **142.** Repel **143.** (*c*) **144.** $F_{net} = 0$ **145.** (*a*)
146. (*c*) **147.** (*b*) **148.** (*a*) **149.** (*b*)
150. (*i*) M = IπR²⊙, (*ii*) M = Iπab⊗, (*iii*) M = Ia²⊗, (*iv*) M = Iab⊙, (*v*) $M = \frac{I\sqrt{3}a^2}{4}\odot$, (*vi*) $M = \frac{3\sqrt{3}Ia^2}{2}\otimes$, (*vii*) $M = I\left(\frac{\pi R^2}{2}\right)\otimes$
151. (*d*) **152.** $\frac{3\pi IR^2}{2}$ **153.** (*a*) **154.** (*d*) **155.** $\frac{q\omega R^2}{4}$ **156.** (*a*) **157.** (*d*) **158.** (*d*) **159.** (*d*) **160.** (*a*)
161. (*b*) **162.** (*a*) **163.** (*b*) **164.** $\omega = \sqrt{\frac{2mB}{I}}$ **165.** σ_I = double, σ_V = remain same **166.** (*a*) **167.** (*d*)
168. (*d*) **169.** (*d*) **170.** (*d*) **171.** (*a*)

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1. Upwards. **2.** Both are True **3.** I. False, II. True **4.** I. True, II. False **5.** I. False, II. True
6. I. False, II. True **7.** Upward. **8.** Both are True **9.** Both are false. **10.** I. True, II. False
11. I. True, II. False, III. True **12.** (*b*) **13.** (*b*) **14.** (*d*) **15.** (*c*) **16.** (*a*) **17.** (*d*) **18.** (*a*)
19. (*d*) **20.** (*a*) **21.** (*c*) **22.** (*d*)

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Mechanical Properties of Fluids

(Practice Questions)

Mass

1. The term 'fluid' is used for
(*a*) Liquids only
(*b*) Gases only
(*c*) A mixture of liquid and gas only
(*d*) Both liquids and gases

2. Find mass of 1 litre of water

3. Find mass of 1 litre of milk

Density of Mixture of Two Liquids

4. Two liquids having same volume V and density ρ_1 & ρ_2 are mixed then find density of mixture

5. Two liquids having same mass M and density ρ_1 & ρ_2 are mixed then find density of mixture

Relative Density

6. If the density of gold is 19300 kg/m^3, what is the specific gravity of gold?

7. If the specific gravity of ice is 0.92, then what is the density of ice?

Pressure

8. Find the pressure exerted below a column of water, open to the atmosphere, at depth 5 m.

9. At a depth of 500 m in an ocean, what is the absolute pressure? Given that the density of sea water is 1.0×10^3 kg/m^3 and g = 10 m s^{-2}.

10. What is the pressure on a swimmer 20 m below the surface of water?
(*a*) 1 atm (*b*) 2 atm (*c*) 3 atm (*d*) 4 atm

11. If pressure at the half depth of a lake is equal to $\frac{3}{4}$ times the pressure at its bottom, then find the depth of the lake. [Take g = 10m/s^2]

12. The pressure at the bottom of a water tank is $4P$, where P is atmospheric pressure. If water is drawn out till the water level decreases by $\frac{3}{5}$th, then pressure at the bottom of the tank is
(*a*) $\frac{3P}{8}$ (*b*) $\frac{7P}{6}$ (*c*) $\frac{11P}{5}$ (*d*) $\frac{9P}{4}$

13. A air bubble rises from bottom of a lake to surface. If its radius increases by 200% and atmospheric pressure is equal to water column of height H, then depth of lake is
(*a*) 21 H (*b*) 8 H (*c*) 9 H (*d*) 26 H

14. A tank is filled by liquid of density ρ upto height H. The average pressure on the walls of container is
(*a*) $\frac{1}{2}\rho gH$ (*b*) $-\rho$gH (*c*) $\frac{1}{4}\rho$9H (*d*) $\frac{1}{8}\rho$gH

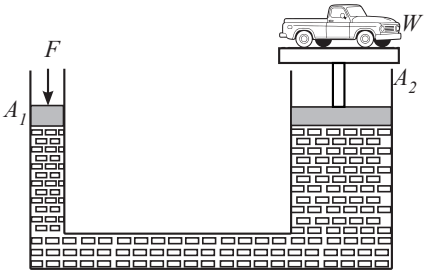
15. Select wrong statement about pressure
(*a*) Pressure is a scalar quantity
(*b*) Pressure is always compressive in nature
(*c*) Pressure at a point is same in all directions
(*d*) None of these

16. The volume of an air bubble is doubled as it rises from the bottom of lake to its surface. The atmospheric pressure is 75cm of mercury. The ratio of density of mercury to that of lake water is $\frac{40}{3}$. Find the depth of the lake.

Pascal Law

17. The neck and bottom of *a* bottle are 3cm and 15cm in radius respectively. If the cork is pressed with a force 12 N in the neck of the bottle, then force exerted on the bottom of the bottle is
(*a*) 30 N (*b*) 150 N (*c*) 300 N (*d*) 600 N

18. In a hydraulic jack as shown, mass of the car W = 800 kg, A_1 = 10 cm^2, A_2 = 10 m^2. The minimum force F required to lift the car is



(*a*) 1 N (*b*) 0.8 N (*c*) 8 N (*d*) 16 N

19. A large vessel of height H, is filled with a liquid of density ρ, upto the brim. A small hole of radius r is made at the side vertical face, close to the base. The horizontal force is required to stop the gushing of liquid is
(*a*) 2(ρgH)πr^2 (*b*) ρgH
(*c*) ρgHπr^2 (*d*) ρgπr^2

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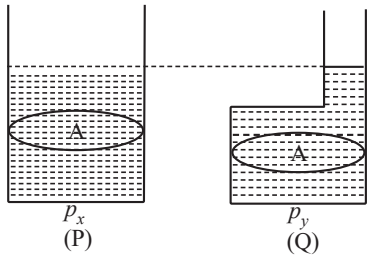
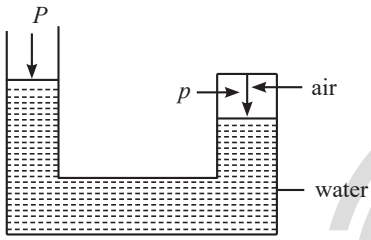
20. Figure shows two containers P and Q with same base area A and each filled upto same height with same liquid. Select the correct alternative.



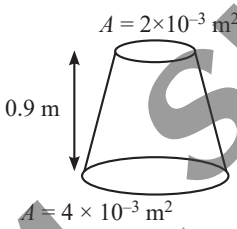
(*a*) $p_x = p_y$ (*b*) $p_x > p_y$
(*c*) $p_y > p_x$ (*d*) Cannot say

21. The pressure of confined air is p. If the atmospheric pressure is P, then



(*a*) P is equal to p
(*b*) P is less then p
(*c*) P is greater then P
(*d*) P may be less or greater than p depending on the mass of the confined air

22. A uniform tapering vessel is filled with a liquid of density of 1000 kg/m^3. What is the force acting on the base of the vessel due to the liquid?



(*a*) 15 N (*b*) 30 N
(*c*) 35N (*d*) 40 N

23. A closed container filled with water to it's full length $H.x$ is the point at $H/3$ level from ground and y is point at 2H/3 level from ground. Pressure difference between x and y is initially P. Then extra force of 20 N is applied at top, then pressure difference between them becomes xP. The value of x is.

24. **Statement-I :** Pressure is always compressive in nature.

Statement-II : According to Pascal law, pressure in moving fluid is same at all points which are present at same height.

(*a*) Both Statements I and Statement II are true.
(*b*) Statement I is true but Statement II is false.
(*c*) Both Statement I and Statement II are false.
(*d*) Statement I is false but Statement II is true.

Gauge Pressure

25. Gauge pressure
(*a*) May be positive (*b*) May be negative
(*c*) May be zero (*d*) All of these

Barometer

26. The atmospheric pressure at a place is 10^5 Pa. If tribromomethane (specific gravity = 2.9) be employed as the barometric liquid, the barometric height is

(*a*) 3.52 m (*b*) 1.52 m (*c*) 4.52 m (*d*) 2.52 m

27. A barometer is constructed using a liquid (density = 760 kg/m^3). What would be the height of the liquid column, when a mercury barometer reads 76 cm ? (density of mercury = 13600 kg/m^3).

(*a*) 13.6 m (*b*) 136 m (*c*) 0.76 m (*d*) 1.36 m

28. Barometer kept in an elevator reads 76 cm when it is at rest. If the elevator goes up with some acceleration, the reading will be

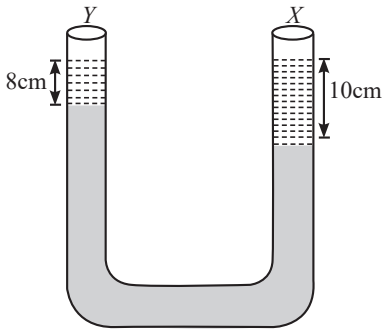
(*a*) 76 cm (*b*) >76 cm (*c*) < 76 cm (*d*) Zero

29. A barometer kept in an elevator reads 76 cm when the elevator is accelerating upwards. The most likely pressure inside the elevator (in cm of Hg) is

(*a*) 74 (*b*) 75 (*c*) 76 (*d*) 77

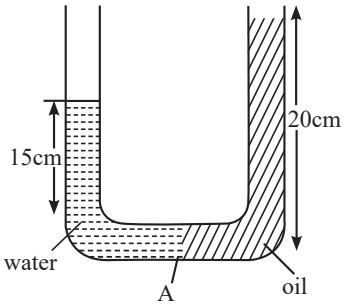
U Tube

30. A liquid X of density 3.36 gcm^{-3} is poured in a U-tube, which contains Hg . Another liquid Y is poured in left arm with height 8cm, upper levels of X and Y are same. What is density of Y ?



(*a*) 0.8 gcc^{-1} (*b*) 1.2 gcc^{-1} (*c*) 1.4 gcc^{-1} (*d*) 1.6 gcc^{-1}

31. In a U-tube as shown in the figure water and oil are in the left side and right side of the tube respectively. The heights from the bottom for water and oil columns are 15 cm and 20 cm respectively. The density of the oil is



(*a*) 1333 kg/m^3 (*b*) 1200 kg/m^3
(*c*) 750 kg/m^3 (*d*) 1000 kg/m^3

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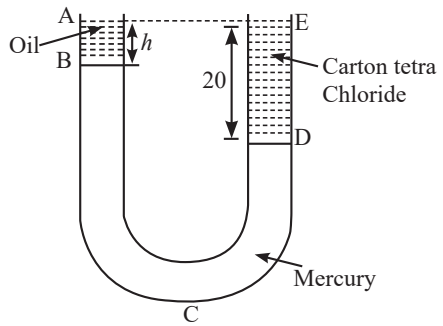
32. Calculate the value of h in U-tube shown in the following figure.

Density of oil = 0.9 g/cm^3

Density of carbon tetra chloride = 1.6 g/cm^3

Density of mercury = 13.6 g/cm^3



(*a*) 18.9 cm (*b*) 20.9 cm (*c*) 16.9 (*d*) 14.9

33. Initially filled with a liquid of specific gravity 3*S*. A lighter liquid of specific gravity *S* is then poured into one of the limbs such that the length of column of lighter liquid is *x*. What is the resulting movement of the meniscus of the heavier liquid in the other limb?

(*a*) x (*b*) $\frac{x}{2}$ (*c*) $\frac{x}{3}$ (*d*) $\frac{x}{6}$

Pressure Variation Accelerated Container

34. A beaker containing a liquid of density ρ moves up with an acceleration '*a*'. The pressure due to the liquid at a depth *h* below free surface of the liquid is

(*a*) $h\rho g$ (*b*) $h\rho\,(g - a)$

(*c*) $h\rho\,(g + a)$ (*d*) $2h\rho g\left(\frac{g+a}{g-a}\right)$

Horizontal Accelerating Container

35. A vessel containing water is given a constant acceleration a towards the right along a straight horizontal path. Which of the following diagrams represents the surface of the liquid?

(*a*)

(*b*)

(*c*)

(*d*) None of these

36. A vessel contain a liquid has a constant acceleration 19.6 m/s^2 in horizontal direction. The free surface of water get sloped with horizontal at angle

(*a*) $\tan^{-1}\left[\frac{1}{2}\right]$ (*b*) $\sin^{-1}2$

(*c*) $\tan^{-1}\left[\sqrt{2}\right]$ (*d*) $\sin^{-1}\left[\frac{2}{\sqrt{5}}\right]$

Manometer

37. A manometer tube contains a liquid of density (3×10^3 kg m^{-3}) When connected to a vessel containing a gas, the liquid level in the other arm of the tube is higher by 10 cm . When connected to another sample of enclosed gas, the liquid level in the other arm of the manometer tube falls 7 cm below the liquid level in the first arm. Which of the two samples exerts more pressure and by what amount?

38. A manometer tube contains mercury of density 13.6×10^3 kg m^{-3}. What difference in the levels of mercury in the two arms is indicated by a gauge pressure of 1.03×10^5 Pa?

Buoyant Force

39. **Statement-I :** Buoyant force doesn't depend on density of liquid in which object is suspended.

Statement-I : Buoyant force doesn't depend on location of object inside liquid.

(*a*) Both Statements I and Statement II are true.

(*b*) Statement I is true but Statement II is false.

(*c*) Both Statement I and Statement II are false.

(*d*) Statement I is false but Statement II is true.

40. **Assertion (A):** A needle placed carefully on surface of H_2O may float, whereas ball of same material will always sink.

Reason (R): The buoyancy of an object depends both on material and shape of object

(*a*) (A) is false but (R) is true

(*b*) Both (A) and (R) are true but (R) is not the correct explanation of (A)

(*c*) Both (A) and (R) are true and (R) is the correct explanation of (A)

(*d*) (A) is true but (R) is false

Archimedes Principle

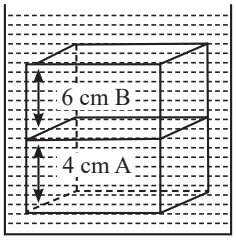
41. An object of mass *m* is floating in a liquid of density σ. If the object is made up of density ρ, then apparent weight of the object in the liquid is

(*a*) mg (*b*) $mg\left(1-\frac{\sigma}{\rho}\right)$

(*c*) $mg\left(1-\frac{\rho}{\sigma}\right)$ (*d*) Zero

42. A solid body floating in water has 1/5th of its volume immersed in it. What fraction of its volume will be immersed, if it floats in a liquid of specific gravity 1.2 ?

43. A cube of edge length 10 cm is just balanced at the interface of two liquid *A* and *B* as shown in figure. If *A* and *B* has specific gravity 0.6 and 0.4 respectively, then mass of cube is



(*a*) 240 *g* (*b*) 360 *g*

(*c*) 480 *g* (*d*) 540 *g*

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44. A solid of density 2.5 kgm^{-3} floats in a fluid with one-third of its volume immersed in it What is the density of the fluid?

45. The density of ice is 0.9 g/cm^3. What percentage by volume of the block of ice floats outside the water?

(*a*) 10% (*b*) 45%
(*c*) 75% (*d*) 90%

46. A block of steel of size $5 \times 5 \times 5cm^3$ is weighed in water If relative density of steel is 7, its apparent weight is

(*a*) $6 \times 5 \times 5 \times 5$ g *wt* (*b*) $4 \times 4 \times 4 \times 7$ g *wt*
(*c*) $5 \times 5 \times 5 \times 7$ g *wt* (*d*) $4 \times 4 \times 4 \times 6$ g *wt*

47. A block of wood floats in water with $\frac{4}{5}th$ of its volume submerged but it just floats in another liquid. The density of liquid is (in kg/m^3)

(*a*) 750 (*b*) 800
(*c*) 1000 (*d*) 1250

Mechanical Properties of Fluids

48. A rectangular block is 10 cm × 10 cm × 15 cm in size in floating in water with 10 cm side vertical. If it floats with 15 cm side vertical, then the level of water will

(*a*) Rise
(*b*) Fall
(*c*) Remain Same
(*d*) Change according to density of black

49. Two non-mixing liquids of densities ρ and $n\rho$ ($n > 1$) are put in a container. The height of each liquid is h. A solid cylinder of length L and density d is put in this container. The cylinder floats with its axis vertical and length pL ($p < 1$) in the denser liquid. The density d is equal to

(*a*) $\{1 + (n-1)p\}\rho$ (*b*) $\{1 + (n+1)p\}\rho$
(*c*) $\{2 + (n+1)p\}\rho$ (*d*) $\{2 + (n-1)p\}\rho$

50. A piece of solid weighs 120 g in air, 80 g in water and 60 g in a liquid. The relative density of the solid and that of the liquid are respectively

(*a*) 3,2 (*b*) $2,\frac{3}{4}$ (*c*) $\frac{5}{2},3$ (*d*) $\frac{3}{2},2$

51. A solid sphere of volume V and density ρ floats at the interface of two immiscible liquids of densities ρ_1 and ρ_2 respectively. If $\rho_1 > \rho > \rho_2$, then the ratio of volume of the parts of the sphere in upper and lower liquid is

(*a*) $\frac{\rho_2 - \rho}{\rho - \rho_1}$ (*b*) $\frac{\rho + \rho_1}{\rho + \rho_2}$ (*c*) $\frac{\rho + \rho_2}{\rho + \rho_1}$ (*d*) $\frac{\sqrt{\rho_1\rho_2}}{\rho}$

52. A metallic sphere weighing 3*kg* in air is held by a string so as to be completely immersed in a liquid of relative density 0.8. The relative density of metallic is 10. The tension in the string is

(*a*) 18.7 N (*b*) 42.5 N
(*c*) 32.7 N (*d*) 27.6 N

53. Two solids *A* and *B* float in water It is observed that A floats with half its volume immersed and *B* floats with 2/3 of its volume immersed. Compare the densities of A and B:

(*a*) 4 : 3 (*b*) 2 : 3
(*c*) 3 : 4 (*d*) 1 : 3

54. A body weights *W* in air and 0.8 *W* in water. Density of the material of the body is

(*a*) 1.25×10^3 kgm^{-3} (*b*) 1.8×10^3 kgm^{-3}
(*c*) 5×10^3 kgm^{-3} (*d*) 2.5×10^3 kgm^{-3}

55. Will an object of density ρ float in a fluid of density 1.5 ρ? If yes, what fraction of the object's volume will remain above the fluid?

56. A piece of gold weighs 10g in air and 9g in water. What is the volume of cavity?

(Density of gold = 19.3 gcm^{-3})

(*a*) 0.182 cc (*b*) 0.282 cc (*c*) 0.382 cc (*d*) 0.482 cc

57. An ice cube contains a large air bubble. The cube is floating on the horizontal surface of water contained in a trough. What will happen to the water level, when the cube melts?

(*a*) It will remain unchanged
(*b*) It will fall
(*c*) It will rise
(*d*) First it will fall and then rise

58. A block of ice floats in an oil in a vessel when the ice melts, the level of oil

(*a*) Go up
(*b*) Go down
(*c*) Remain same
(*d*) Go up or down depending on quantity of ice

59. Match the following column-I and Column-II:

	Column-I	Column-II
A.	Block of ice float on oil and then melts	I. level in container remains same
B.	Block of ice floats on water & then melts	II. Level in container rises
C.	Block of ice floats in liquid of specific gravity 1.2 & then ice melts	III. Level in container decreases

(*a*) A-III, B-I, C-II (*b*) A-I, B-II, C-III
(*c*) A-III, B-II, C-I (*d*) A-II, B-III, C-I

60. A boat having some iron pieces is floating in a pond. If iron pieces are thrown in the liquid then level of liquid.

(*a*) Increases
(*b*) Decreases
(*c*) May increase or decrease
(*d*) Neither increases nor decreases

Fluid Dynamics

61. Which of the following is not the property of an ideal fluid?

(*a*) Fluid flow is irrational (*b*) Fluid flow is streamline
(*c*) Fluid is incompressible (*d*) Fluid is viscous

62. Which of the following statements is false about properties of streamlines ?

(*a*) The tangent at any point of a streamline gives direction of flow of fluid particle at that point.
(*b*) In a steady flow, no two streamlines can cross each other.
(*c*) Fluid velocity is slower at regions whereas streamlines are closely spaced.
(*d*) Fluid velocity remains constant at any point of streamline, but it may be different at different points of same streamline.

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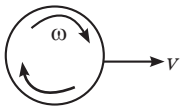
63. If ball is spinning in the air as shown, then



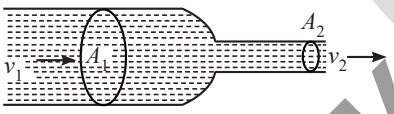
(*a*) Streamlines will be more crowded at bottom of ball.
(*b*) Streamlines will be more crowded at upper surface of ball.
(*c*) Streamlines will be equally crowded at both upper & lower ends
(*d*) The ball will be dragged downwards according to Bernoulli's principle.

Equation of Continuity

64. Equation of continuity is based on
(*a*) Low of conservation of momentum
(*b*) Law of conservation of mass
(*c*) Law of conservation of energy
(*d*) Low of conservation of density

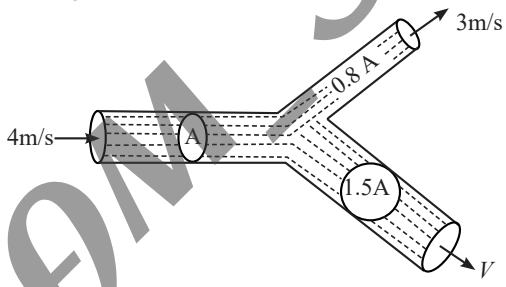
65. An incompressible liquid is flowing steadily through a pipe of variable circular cross section. Velocity of fluid is found to be 20 cms^{-1} through a cross-section of radius 2cm. Velocity of fluid through another cross section of radius 1cm nearly equals to
(*a*) $5cms^{-1}$ (*b*) $20cms^{-1}$ (*c*) $40cms^{-1}$ (*d*) $80cms^{-1}$

66. A liquid flows in the tube from left to right as shown in figure A_1 and A_2 are the cross-section of the portions of the tube as shown. The ratio of speed $\left(\frac{v_1}{v_2}\right)$ will be

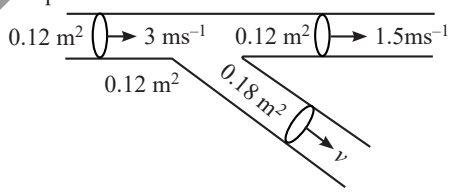


(*a*) $\frac{A_1}{A_2}$ (*b*) $\frac{A_2}{A_1}$ (*c*) $\sqrt{\frac{A_2}{A_1}}$ (*d*) $\sqrt{\frac{A_1}{A_2}}$

67. An incompressible liquid is flowing through a horizontal pipe as show in figure. Find the value of *v*.



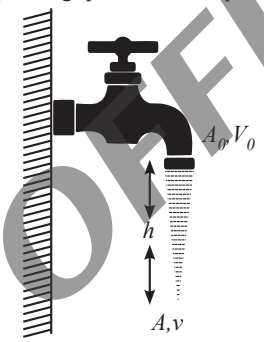
68. An incompressible liquid travels as shown in the figure. The speed *v* of the liquid in the lower ranch is



(*a*) $1\ ms^{-1}$ (*b*) $1.5\ ms^{-1}$
(*c*) $2.25\ ms^{-1}$ (*d*) $3\ ms^{-1}$

69. The cylindrical tube of a spray pump has radius *R*, one end of which has *n* fine holes, each of radius *r*. If the speed of the liquid in the tube is *V*, the speed of the ejection of the liquid through the holes is
(*a*) $\frac{V^2R}{nr}$ (*b*) $\frac{VR^2}{n^2r^2}$ (*c*) $\frac{VR^2}{nr^2}$ (*d*) $\frac{VR^2}{n^3r^2}$

70. As water falls from a tap, the velocity of water goes on increasing, hence from the equation continuity, the cross-section of water-steam goes on decreasing. If A_0= area of cross-section of the mouth of the tap and V_0 is the velocity of water at this point, and *A, v* are corresponding quantities at depth *h* find *V*,



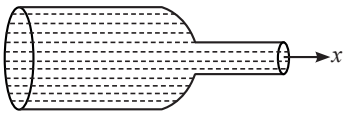
Bernoulli's Principle

71. In which conditions, Bernoulli's principle can not be applicable ?
(*a*) For incompressible fluid
(*b*) For Non-viscous fluid
(*c*) Bernoulli's principle is universal and can be applied in any condition.
(*d*) (If flow of fluid is not streamlined

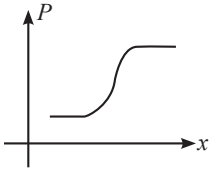
72. Consider the following equation of Bernoulli's theorem.

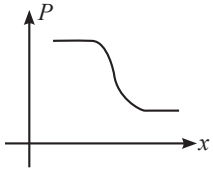
$\mathbf{P} + \frac{1}{2}\rho V^2 + \rho gh = K$ (constant) The dimensions of *K/P* are same as that of which of the following
(*a*) Thrust (*b*) Pressure
(*c*) Angle (*d*) Viscosity

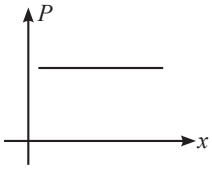
73. A non-viscous liquid is flowing through a frictionless duct, with cross-section varying as shown in figure.

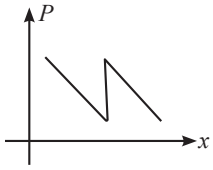


Which of the following graph represents the variation of pressure *P* along the axis of tube?

(*a*) 

(*b*) 

(*c*) 

(*d*) 

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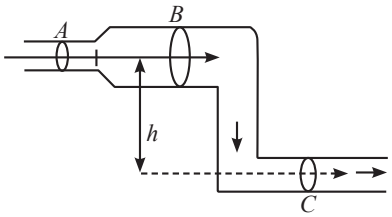
74. Water is flowing through a channel (lying in a vertical plane) as shown in the figure. Three sections *A, B* and *C* are shown. Sections *B* and *C* have equal area of cross section. If P_A, P_B and P_C are the pressures at *A,B* and *C* respectively then



(*a*) $P_A > P_B = P_C$ (*b*) $P_A < P_B = P_C$
(*c*) $P_A < P_B = P_C$ (*d*) $P_A < P_B < P_C$

75. A horizontal pipeline carries water in a streamline flow. At a point along the pipe, where the cross-sectional area is 10 cm^2, the water velocity is 1m/s and pressure is 2000 *Pa*. The pressure of water at another point where cross-sectional area is 5cm^2, is $k \times 10^2$ Pa , the value of *k* is then

(*a*) 700 *Pa* (*b*) 5 *Pa* (*c*) 600 *Pa* (*d*) 800 *Pa*

76. Air streams horizontally past an air plane. The speed over the top surface is 60m/s and that under the bottom surface is 45m/s. The density of air is 1.293 kg/m^3, then the difference in pressure is.

(*a*) 1018 N/m^2 (*b*) 516 N/m^2
(*c*) 1140 N/m^2 (*d*) 2250 N/m^2

77. In a wind tunnel experiment, the pressure on the upper and lower surface of the wings are 5×10^5 *Pa* and 10×10^5 Pa respectively. If the area of the wing is 80 m^2, the net lifting force on the wing is

(*a*) 4×10^7 N (*b*) 5×10^7 N (*c*) 3×10^7 N (*d*) 2×10^7 N

78. A plane is in level flight at constant speed and each of its two wings has an area of 40m^2. If the speed of the air is 50 m/s over the lower wing surface and 70 m/s over the upper wing surface, the mass of the plane is __kg.

79. A wind with speed 40m/s blows parallel to the roof of a house. The area of the roof is 250m^2. Assuming that the pressure inside the house is atmospheric pressure, the force exerted by the wind on the roof and the direction of the force will be (P_{air} = 1.2 kg/m^3)

(*a*) 2.4×10^5 N, downwards (*b*) 4.8×10^5 N, downwards
(*c*) 4.8×10^5 N, upward (*d*) 2.4×10^5 N, upward

80. At what speed, the velocity head of water is equal to pressure head of 40 cm of mercury?

(*a*) 10.32 m/s (*b*) 5.12 m/s
(*c*) 40 m/s (*d*) 28.19 m/s

Velocity of Efflux

81. Water (ρ = 1000 kg/m^3) and kerosene (σ = 800 kg/m^3) are filled in two identical cylindrical vessels. Both vessels have small holes at their bottom. The speed of the water and kerosene coming out of their holes are v_1 and v_2 respectively. Select the correct alternative

(*a*) $v_1 = v_2$ (*b*) $v_1 = 0.8v_2$
(*c*) $0.8v_1 = v_2$ (*d*) $v_i = \sqrt{0.8}v_2$

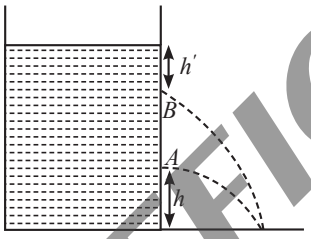
82. A tank is filled with water to a height *H*. *A* hole is made on one of the walls at a depth *D* below the water surface. The distance *x* from the foot of the wall at which the stream of water coming out of the tank strikes the ground is given by

(*a*) $x = 2[D(H - D)]^{1/2}$ (*b*) $x = 2\,(gD)^{1/2}$
(*c*) $x = 2[D(H + D)]^{1/2}$ (*d*) None of these

83. A small hole of area of cross-section 2mm^2 is present near the bottom of a fully filled open tank of height 2*m* . Taking g =10m/s^2, the rate of flow of water through the open hole would be nearly

(*a*) $12.6 \times 10^{-6}m^3/s$ (*b*) $8.9 \times 10^{-6}m^3/s$
(*c*) $2.23 \times 10^{-6}m^3/s$ (*d*) $6.4 \times 10^{-6}m^3/s$

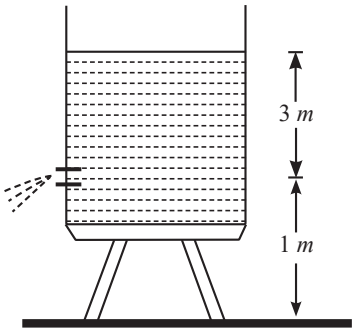
84. A tank is filled with water and two holes *A* and *B* are made in it. For getting same range, ratio of $\frac{h}{h'}$ is



(*a*) 2 (*b*) $\frac{1}{2}$ (*c*) $\frac{1}{3}$ (*d*) 1

Mechanical Properties of Fluids

85. Water is filled in a tank upto 3m height. The base of the tank is at height 1m above the ground. What should be the height of a hole made in it, so that water cane be sprayed upto maximum horizontal distance on ground?

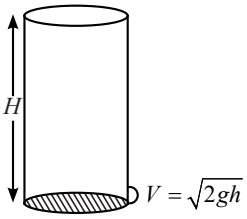


(*a*) 3 m from ground (*b*) 1.5 m from ground
(*c*) 1.5 m from base of tank (*d*) 2 m from ground

86. A large open tank has two holes in its wall. One is a square of side *a* at a depth *x* from the top and the other is a circular hole of radius rat depth 4*x* from the top. When the tank is completely filled with water, the quantities of water flowing out per second from both holes are the same. Then *r* is equal to

(*a*) $2\pi a$ (*b*) a (*c*) $\frac{a}{\sqrt{2\pi}}$ (*d*) $\frac{a}{\pi}$

87. Find forcer on container



88. A massless cylindrical container of base area *A* is filled with a fluid of density ρ and height *H*. A hole at the base allows fluid to escape, exerting a horizontal force on the container. Find the minimum coefficient of friction μ_{min} required to prevent the container from sliding. (Cross-section area of hole is *a*)

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89. The bottom of cylinder of diameter D having hole of radius r then speed of liquid level is $\frac{r^2}{D^2}\sqrt{xgh}$. The value of x is____[D>>r]

90. A large tank filled with water to a height 'h' is to be emptied through a small hole at the bottom. The ratio of time taken for the level of water to fall from h to $\frac{h}{2}$ and from $\frac{h}{2}$ to bottom is

(*a*) $\sqrt{2}$ (*b*) 1/2

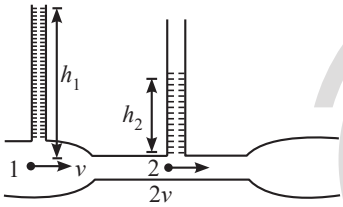
(*c*) $\sqrt{2}-1$ (*d*) $\frac{1}{\sqrt{2}-1}$

91. A rectangular vessel when full of water, takes 10 min to be emptied through an orifice in its bottom. How much time will it take to be emptied when half filled with water?

(*a*) 9 min (*b*) 7 min (*c*) 5 min (*d*) 3 min

Venturimeter

92. In the shown Venturimeter, fluid velocities at two points are indicated. What is the difference in the levels of liquid in tube at the two points? [Given density of the liquid = ρ]



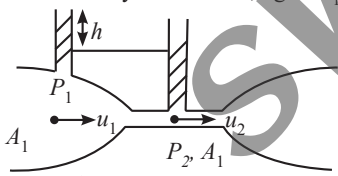
93. The working of venturimeter is based on

(*a*) Torricelli's law (*b*) Pascal's law

(*c*) Bernoulli's principle (*d*) Archimede's principle

94. **Statement-I:** When speed of liquid is zero everywhere, pressure difference at any two points depends on equation $P_1 - P_2 = \rho g [h_2 - h_1]$

Statement-II: In Ventury tube shown, $2gh = v_1^2 = v_2^2$



(*a*) Both Statements I and Statement II are true.

(*b*) Statement I is true but Statement II is false.

(*c*) Both Statement I and Statement II are false.

(*d*) Statement I is false but Statement II is true.

Viscosity

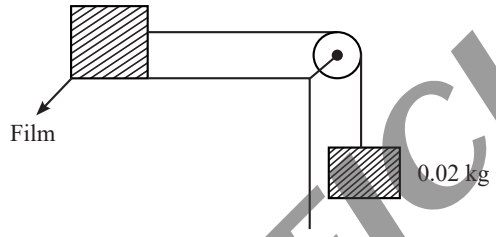
95. A layer of glycerin of thickness 3 mm is present between a large surface area and a surface area of 0.2 m^2, with what force the small surface is to be pulled, so that it can move with a velocity of 5 m/s ? ($\eta = 0.09\ kgm^{-1}\ S^{-1}$).

(*a*) 10 N (*b*) 30 N (*c*) 40 N (*d*) 50 N

96. A flat plate of area 0.1m^2 is placed on a flat surface and is separated from it by a film of oil 10^{-5}m thick whose coefficient of viscosity is 1.5 Nsm^{-2}. The force required to cause the plate to slide on the surface at constant speed of 1 mm s^{-1} is

(*a*) 10 N (*b*) 15 N (*c*) 20 N (*d*) 25 N

97. A metal block of base area 0.2 m^2 is connected to a 0.02 kg mass via a string that passes over an ideal pulley as shown in figure. A liquid film of thickness 0.6 mm is placed between the block and the table. When released the block moves to the right with a constant speed of 0.17 m/s. The coefficient of viscosity of the liquid is:



(*a*) $3.45 \times 10^3\ Pa-s$ (*b*) $3.45 \times 10^{-2}\ Pa-s$

(*c*) $3.45 \times 10^{-3}\ Pa-s$ (*d*) $3.45 \times 10^2\ Pa-s$

98. A metal plate of area $10^3\ cm^2$ rests on a layer of oil 6mm thick. A tangential force 10^{-2} N is applied on it to move it with a constant velocity of 6 cms^{-1}. The coefficient of viscosity of the liquid is

(*a*) 0.1 poise (*b*) 0.5 poise

(*c*) 0.7 poise (*d*) 0.9 poise

99. A spherical body falling through a viscous liquid of infinite extent ultimately attains a constant value, when

(*a*) Upthrust + weight = viscous drag

(*b*) Weight + viscous drag = upthrust

(*c*) Viscous drag + upthrust = weight

(*d*) Viscous drag + upthrust > weight

100. Match the following column-I and Column-II:

Column-I		Column-II	
A.	Fluid resistance in Pipe	I.	L^3T^{-1}
B.	Rate of volume flow	II.	$M^0L^0T^0$
C.	Coefficient of viscosity	III.	$M\ L^{-4}T^{-1}$
D.	Reynolds number	IV.	$M\ L^{-1}T^{-1}$

(*a*) A-IV, B-I, C-II, D-III

(*b*) A-I, B-II, C-III, D-IV

(*c*) A-III, B-IV, C-I, D-II

(*d*) A-II, B-III, C-I, D-IV

101. **Assertion (A):** The viscosity of water is less than blood

Reason (R): The viscosity of liquid-decreases with increases in temperature.

(*a*) (A) is false but (R) is true

(*b*) Both (A) and (R) are true but (R) is not the correct explanation of (A)

(*c*) Both (A) and (R) are true and (R) is the correct explanation of (A)

(*d*) (A) is true but (R) is false

102. **Statement-I :** Viscosity of gases is greater than that of liquids.

Statement-II : Surface tension of a liquid decreases due to the presence of insoluble impurities

(*a*) Both Statements I and Statement II are true.

(*b*) Statement I is true but Statement II is false.

(*c*) Both Statement I and Statement II are false.

(*d*) Statement I is false but Statement II is true.

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Stoke's Law & Terminal Velocity

103. The viscous drag acting on a metal sphere of diameter 1mm, falling through a fluid of viscosity 0.8 Pa *S* with a velocity of 2m/s is equal to__

104. The Small ball of mass *M* and density *d*, when thrown into a container filled with liquid having double the density as that of ball, with some velocity, came to rest after some time. The net force on ball when it has came to rest for an instance will be

(*a*) 2 Mg (*b*) Mg/2
(*c*) Mg (*d*) 3/2 Mg

105. Two small spherical drops having radii in the ratio 4 : 3 fall from a height through the atmosphere. Their momenta on reaching the earth are in the ratio

(*a*) 4 : 4 (*b*) 1 : 2
(*c*) 4 : 2 (*d*) 5 : 1

106. A drop of water of radius 0.0015mm is falling in air. If the co-efficient of viscosity of air is 1.8×10^{-5} kg $m^{-1}s^{-1}$ What will be the terminal velocity of the drop? (density of air can be neglected).

107. Two equal drops are falling through air with a steady velocity of 5cm/second. If two drops coalesce, then new terminal velocity will be

(*a*) $5\times(4)^{1/3}$ cm/s (*b*) $5\sqrt{2}$ cm / s
(*c*) $5/\sqrt{2}$ cm / s (*d*) 5×2 cm/s

108. Eight equal drops of water are falling through air with a steady velocity of 10 cms^{-1} If the drops combine to form a single drop big in size, then the terminal velocity of this big drop is

(*a*) 80 cms^{-1} (*b*) 30 cms^{-1}
(*c*) 10 cms^{-1} (*d*) 40 cms^{-1}

109. A ball of density σ and radius *r* is dropped on the surface of a liquid of density ρ from certain height. If speed of ball does not change even on entering in liquid and viscosity of liquid is η, then the height from which ball dropped is

(*a*) $2g\left[\frac{(\sigma-\rho)r}{9\eta}\right]^2$ (*b*) $\frac{2g(\sigma-\rho)^2r^2}{9\eta}$
(*c*) $\frac{2(\sigma-\rho)gr^2}{9\eta}$ (*d*) $2g\left[\frac{(\sigma-\rho)r^2}{9\eta}\right]^2$

110. If the terminal speed of a sphere of gold (density 19.5 kg/m^3) is 0.2m/s in a viscous liquid (density = 1.5 kg/m^3), find the terminal speed of a sphere of silver (density = 10.5 kg/m^3) of the same size in the same liquid.

(*a*) 0.2 m/s (*b*) 0.4 m/s
(*c*) 0.1 m/s (*d*) 0.133 m/s

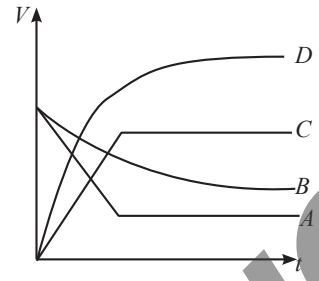
111. The terminal velocity of a small sized spherical body of radius *r* falling vertically in a viscous liquid is given by the proportionality

(*a*) $v\propto\frac{1}{r}$ (*b*) $v\propto r^2$
(*c*) $v\propto\frac{1}{r}$ (*d*) $v\propto r$

112. A small sphere of radius *r* falls from rest in a viscous liquid. As a result, heat is produced due to viscous force. The rate of production of heat when the sphere attains its terminal velocity, is proportional to

(*a*) r^3 (*b*) r^2 (*c*) r^4 (*d*) r^5

113. A ball is thrown downward with some velocity, greater than terminal speed into a viscous liquid. Which of the following curves represents correct variation for velocity versus time ?



(*a*) *A* (*b*) *B* (*c*) *C* (*d*) *D*

114. A small drop of water falls from rest through a large height *h* in air; the final velocity is

(*a*) proportional to $\sqrt{h}$ (*b*) proportional to *h*
(*c*) Inversely proportional to *h* (*d*) Almost independent of *h*

115. Two small spherical metal balls, having equal masses, are made from materials of densities ρ_1 and ρ_2 ($\rho_1 = 8\rho_2$) and have radii of 1 mm and 2 mm , respectively, they are made to fall vertically (from rest) in a viscous medium whose coefficient of viscosity equals η and whose density is 0.1 The ratio of their terminal velocities would be,

(*a*) $\frac{79}{36}$ (*b*) $\frac{79}{72}$ (*c*) $\frac{19}{36}$ (*d*) $\frac{39}{72}$

Poiseuille's Equation

116. Water flows in a stream line manner through a capillary tube of radius *a*. The pressure difference being *P* and the rate of flow is *Q*. If the radius is reduced to *a*/4 and the pressure is increased to 4 P , then the rate of flow becomes

(*a*) 4*Q* (*b*) $\frac{Q}{2}$ (*c*) *Q* (*d*) $\frac{Q}{64}$

Surface Tension

117. A square wire frame of side *l* is floating on the surface of liquid of surface tension T. The force required to pull out the frame from the liquid is

(*a*) T*l* (*b*) 2T*l* (*c*) 4 T*l* (*d*) 8T*l*

118. Soap helps in cleaning clothes, because

(*a*) It attracts the dirt particles
(*b*) It decreases the surface tension of water
(*c*) It increases the cohesive force between water molecules
(*d*) It increases the angle of contact

119. On increasing temperature of a liquid, its surface tension generally

(*a*) Increases
(*b*) Decreases
(*c*) Remains constant
(*d*) First increases and then decreases

120. Surface tension of a liquid, at critical temperature is

(*a*) Maximum (*b*) Unchanged
(*c*) Zero (*d*) None of these

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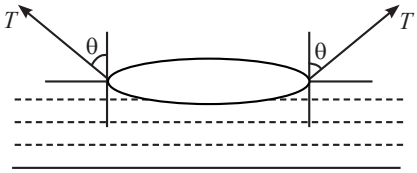
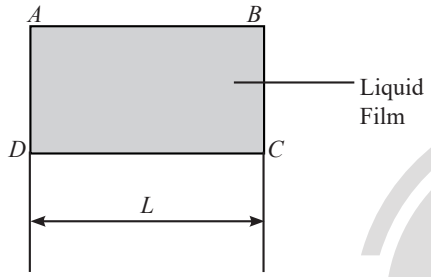
121. A thin metal disc of radius r floats on water surface and bends the surface downwards along the perimeter making an angle with vertical edge of disc. If the disc displaces a weight of water W and surface tension of water is T, then the weight of metal disc is



(*a*) $2\pi rT + W$ (*b*) $2\pi rT \cos\theta - W$
(*c*) $2\pi rT \cos\theta + W$ (*d*) $W - 2\pi rT \cos\theta$
(e) Weight of metal disc = total upward force

122. A liquid film is formed over a frame *ABCD* as shown in figure. Wire *CD* can slide without friction. The mass to be hung from *CD* to keep it in equilibrium is



(*a*) $\frac{TL}{g}$ (*b*) $\frac{2TL}{g}$ (*c*) $\frac{g}{2TL}$ (*d*) TL

123. **Assertion (A):** The impurities always decrease the surface tension of a liquid.

Reason (R): The changes in surface tension of liquid do not depend upon the degree of contamination of impurity.

(*a*) (A) and (R) is false
(*b*) Both (A) and (R) are true but (R) is not the correct explanation of (A)
(*c*) Both (A) and (R) are true and (R) is the correct explanation of (A)
(*d*) (A) is true but (R) is false Assertion (A) - it is better to wash clothes in cold soap solution.

124. **Assertion (A):** It is better to wash clothes in cold soap solution.

Reason (R): The surface tension of cold solution is less than the surface tension of hot solution

(*a*) (A) is false and (R) is false
(*b*) Both (A) and (R) are true but (R) is not the correct explanation of (A)
(*c*) Both (A) and (R) are true and (R) is the correct explanation of (A)
(*d*) (A) is true but (R) is false

Surface Energy

125. The radius of a soap bubble is r. The surface tension of soap solution is 'S'. Keeping temperature constant, the(radius of the soap bubble is doubled. The energy necessary for this will be

(*a*) $24\pi r^2S$ (*b*) $8\pi r^2S$
(*c*) $16\pi r^2S$ (*d*) $12\pi r^2S$

126. What will be the work done in increasing the radius of soap bubble from $\left(\frac{r}{2}\right)$ to $(2r)$ if surface tension of soap solution is T?

(*a*) $3\pi r^2T$ (*b*) $30\pi r^2T$
(*c*) $9\pi r^2T$ (*d*) $12\pi r^2T$

Mechanical Properties of Fluids

127. The surface tension of a liquid is 5 N/m. If a film is held on a ring of area 0.02 m^2, its surface energy is about

(*a*) 5×10^{-2}J (*b*) 2.5×10^{-2}J
(*c*) 2×10^{-1}J (*d*) 3×10^{-1}J

128. A rectangular Film of liquid is extended from (4 cm × 2 cm) to (5 cm × 4 cm). If the work done is 3×10^{-4} J, the value of the surface tension of the liquid is

(*a*) 0.250 Nm^{-1} (*b*) 0.125 Nm^{-1}
(*c*) 0.2 Nm^{-1} (*d*) 8.0 Nm^{-1}

129. The work done in blowing a soap bubble of 10 cm radius is (surface tension of soap solution is 0.03 N/m).

(*a*) 37.68×10^{-4}J (*b*) 75.36×10^{-4}J
(*c*) 126.82×10^{-4}J (*d*) 75.36×10^{-3}J

130. Two water droplets merge with each other to form a larger droplet. In this process

(*a*) Energy is liberated
(*b*) Energy is absorbed
(*c*) Energy is neither liberated nor absorbed
(*d*) Some mass is converted into energy

131. The work done to break a spherical drop of radius R in n drops of equal size is proportional to

(*a*) $\frac{1}{n^{2/3}} - 1$ (*b*) $\frac{1}{n^{1/3}} - 1$ (*c*) $n^{1/3} - 1$ (*d*) $n^{4/3} - 1$

132. If T is the surface tension of a fluid, then the energy needed to break a liquid drop of radius R into 64 equal drops is

(*a*) $6\pi R^2T$ (*b*) πR^2T
(*c*) $12\pi R^2T$ (*d*) $8\pi R^2T$

133. Two small drops of mercury, each of radius R , coalesce to form a single large drop. The ratio of the total surface energies before and after the change is

(*a*) $1 : 2^{1/3}$ (*b*) $2 : 1^{1/3}$ (*c*) 2 : 1 (*d*) 1 : 2

134. By blowing air in a soap bubble, the radius is increased form r to 3r. Then the percentage increase in the surface energy of the bubble is-

(*a*) 90% (*b*) 80 % (*c*) 800 % (*d*) 900%

135. A certain number of spherical drops of a liquid of radius r coalesce to form a single drop of radius R and volume V If T is the surface tension of the liquid, then

(*a*) Energy $= 4VT\left(\frac{1}{r} - \frac{1}{R}\right)$ is released

(*b*) Energy $= 3VT\left(\frac{1}{r} + \frac{1}{R}\right)$ is absorbed

(*c*) Energy $= 3VT\left(\frac{1}{r} - \frac{1}{R}\right)$ is released

(*d*) Energy is neither released nor absorbed

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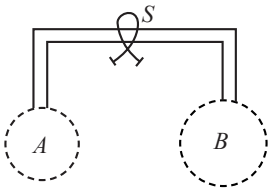
Excess Pressure

136. The excess pressure in a soap bubble is double that in other one. The ratio of their volume is

(*a*) 1 : 2 (*b*) 1 : 8
(*c*) 1 : 4 (*d*) 1 : 1

137. Two soap bubbles are connected by a tube as shown in figure. What happens when stopper *S* is removed?



(*a*) Size of bubble *A* increases
(*b*) Size of bubble *B* decreases
(*c*) Both bubble take the same size
(*d*) Size of bubble *A* decreases and size of bubble *B* increases

138. Pressure inside two soap bubbles are 1.02 atm and 1.05 atm respectively. The ratio of their surface area is

(*a*) $\frac{125}{8}$ (*b*) $\frac{25}{4}$ (*c*) $\frac{5}{2}$ (*d*) $\frac{2}{5}$

139. The excess pressure a spherical drop of water is four times that of another drop. Then their respective mass ratio is

(*a*) 1 :16 (*b*) 1 : 64 (*c*) 1 : 4 (*d*) 1 : 8

140. Two soap bubbles of radii 2 cm and 4 cm join to form a double bubble In air. Then radius of curvature of interface is

(*a*) $2\sqrt{3}\,cm$ (*b*) 2 cm
(*c*) 4cm (*d*) $\sqrt{3}\,cm$

141. Two liquid drop of radius R_1 & R_2 is coalesce to form a Single liquid drop in isothermal conditions, find Radius of single drop?

142. A spherical drop of water has 1mm radius. If the surface tension of water is 75×10^{-3} N/m, then difference of pressure between inside and outside of the drop is

(*a*) 35 N/m^2 (*b*) 70 N/m^2
(*c*) 140 N/m^2 (*d*) 150 N/m^2

143. A soap bubble, having radius of 1mm , is blown from a detergent solution having a surface tension of 2.5×10^{-2} N/m The pressure inside the bubble equals at a point ZQ below the free surface of water in a container. Taking g = 10 m/s^2, density of water =10^3 kg/m^3, the value of Z_0 is

(*a*) 100 cm (*b*) 10 cm
(*c*) 1 cm (*d*) 0.5 cm

144. If the excess pressure inside a soap bubble is balanced by an oil column of height 2 mm , then the surface tension of soap solution will be (r = 1), density of oil: = 0.8 g/cm^3)

(*a*) 3.9 N/m (*b*) 3.9×10^{-2} N/m
(*c*) 3.9×10^{-3} N/m (*d*) 3.9×10^{-1} N/m

145. There is small hole in a hollow sphere. The water enters in it when it is taken to a depth of 40 cm under water. The surface tension of water is 0.07 N/m. The diameter of hole is ??

(*a*) 7 mm (*b*) 0.07 mm
(*c*) 0.0007 mm (*d*) 0.7 *m*

146. **Assertion (A) :** The shape of liquid drop is spherical.

Reason (R): The pressure inside drop is greater than that of outside.

(*a*) (A) is false but (R) is true
(*b*) Both (A) and (R) are true but (R) is not the correct explanation of (A)
(*c*) Both (A) and (R) are true and (R) is the correct explanation of (A)
(*d*) (A) is true but (R) is false

147. **Assertion (A):** When a large soap bubble and a small soap bubble are connected by a capillary tube the large bubble expands while the small bubble shrinks.

Reason (R): The excess pressure inside bubble is inversely proportional to radius.

(*a*) (A) is false and (R) is false
(*b*) Both (A) and (R) are true but (R) is not the correct explanation of (A)
(*c*) Both (A) and (R) are true and (R) is the correct explanation of (A)
(*d*) (A) is true but (R) is false

Contact Angle

148. Three liquids of densities ρ_1, ρ_2 and ρ_3 (with $\rho_1 > \rho_2 > \rho_3$), having the same value of surface tension *T*, rise to the same height in three identical capillaries. The angles of contact θ_1 , θ_2 and θ_3 obey

(*a*) $\frac{\pi}{2} > \theta_1 > \theta_2 > \theta_3 \geq 0$ (*b*) $0 \leq \theta_1 < \theta_2 < \theta_3 < \frac{\pi}{2}$
(*c*) $\frac{\pi}{2} < \theta_1 < \theta_2 < \theta_3 < \pi$ (*d*) $\pi > \theta_1 > \theta_2 > \theta_3 > \frac{\pi}{2}$

149. A liquid does not wet the sides of a surface, if the angle of contact is

(*a*) Obtuse (*b*) 90º (*c*) Acute (*d*) Zero

150. The wettability of a surface by a liquid depends primarily on:

(*a*) Surface tension
(*b*) Density
(*c*) Angle of contact between the surface and the liquid
(*d*) Viscosity

151. The raincoats are made water proof by coating it with a material, which

(*a*) Absorb water
(*b*) Increase surface tension of water
(*c*) Increase the angle of contact
(*d*) Decreases the density of water

152. **Assertion (A):** The angle of contact of liquid decrease with increase in temperature.

Reason (R) : With increases in temperature, the surface tension of liquid increase.

(*a*) (A) is false but (R) is true
(*b*) Both (A) and (R) are true but (R) is not the correct explanation of (A)
(*c*) Both (A) and (R) are true and (R) is the correct explanation of (A)
(*d*) (A) is true but (R) is false

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Rise in Capillary Tube

153. A capillary tube is dipped in water and it is 20 cm outside water. The water rises unto 8 cm . If the entire arrangement is put in freely falling elevator the length of water column in the capillary tube will be

(*a*) 20 cm (*b*) 4cm
(*c*) Infinite (*d*) 8 cm

154. A capillary tube of radius *r* is immersed in a liquid and mass of liquid, which rises up in it is *M*. If the radius of tube is doubled then the mass of liquid which will rise in capillary tube will be

(*a*) 2 *M* (*b*) *M*
(*c*) *M*/2 (*d*) *M*/4

155. Kerosene oil in a lantern and melted wax in a candle, rise in the capillaries in the cotton wick.

(*a*) True (*b*) False

156. The water from the soil rises in capillaries in the stems of plants and trees and reaches the branches and leaves.

(*a*) True (*b*) False

157. In a gravity free space, a liquid in a capillary tube will rise to full length of the tube.

(*a*) True (*b*) False

158. Water rises to a height *h* in capillary tube. If the length of capillary tube above the surface of water is made less than *h*, then

(*a*) Water does not rise at all
(*b*) Water rises upto the tip of capillary tube and then starts overflowing like a fountain
(*c*) Water rises upto the top of capillary tube and stays there without overflowing
(*d*) Water rises upto a point a little below the top and stays there

159. A capillary tube of radius *r* is immersed in water and water rises in it to height *h*. The mass of water in capillary is 5 g . If the radius of capillary tube is increased by *xr* [keeping it's length same], mass of water that rises in this tube is 10 g . Find *x*.

160. **Assertion (A):** When height of tube is less than liquid rise in capillary tube, the liquid does not overflow.

Reason (R) : Product of radius of meniscus & height of liquid in capillary tube always remain constant.

(*a*) (A) is false but (R) is true
(*b*) Both (A) and (R) are true but (R) is not the correct explanation of (A)
(*c*) Both (A) and (R) are true and (R) is the correct explanation of (A)
(*d*) (A) is true but (R) is false

161. When a glass capillary tube of radius 0.015 cm is dipped in water, the water rises to a height of 15cm within it. Assuming contact angle between water and glass to be 0^0, the surface tension of water is [ρ_{water} = 1000 kg] m^{-3}, 9.81 ms^{-2}]

(*a*) 0.11 Nm^{-1} (*b*) 0.7 Nm^{-1}
(*c*) 0.072 Nm^{-1} (*d*) None of these

162. **Statement-1:** When a spherical ball is dropped in a liquid it's speed start decreasing as viscous force starts acting on opposite direction. [Assuming it enters fluid with spaced lesser than terminal velocity]

Statement-2: Potential energy of liquid rise in capillary tube is directly proportional to radius of capillary tube.

Statement-3: Rain coats are made water proof by coating it with material which decreases the angle of contact.

(*a*) False, False, True (*b*) False, False, False
(*c*) False, True, False (*d*) True, True, False

163. **Statement-I:** The contact angle between a solid and liquid property of the material of solid and liquid as well.

Statement-II: The rise of a liquid in a capillary tube doesn't depend on the inner radius of the tube.

(*a*) Both Statements I and Statement II are true.
(*b*) Statement I is true but Statement II is false.
(*c*) Both Statement I and Statement II are false.
(*d*) Statement I is false but Statement II is true.

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1. **Assertion I:** A liquid can easily change its shape but a solid can not.

   Reason II: The density of liquid is smaller than that of a solid.

2. **Statement I:** Equal mass of three liquids are kept in 3 identical cylindrical vessels A, B & C. The density are of 3 liquids are related as $\rho_A < \rho_B < \rho_C$. The force on base will be equal in all the vessels.

   Statement II: The three vessels as shown in figure have same base area equal volume of liquid are poured in three vessels. The force on the base will be equal in all the vessels.

3. **Statement I:** Suppose the pressure at the surface of mercury in barometer tube is P_1 and the pressure at the surface of mercury in cup is P_2. Then $P_1 = P_2 =$ atmospheric pressure.

   Statement II: If a barometer kept in an elevator accelerating upward reads 76 cm. The air pressure in the elevator is greater than 76 cm.

4. **Statement I:** A closed cubical box is completely filled with water and is accelerated horizontally towards right with an acceleration *a* the resultant normal force by the water on top of box will pass through a point to the left of the centre.

   Statement II: Considering the situation given above, if water pushes the left wall by force F_1 and right wall by force F_2, then $F_1 > F_2$

5. **Statement I:** Bernoulli theorem is Based on conservation of energy.

   Statement II: Water is flowing through a long horizontal tube. If P_A and P_B be the pressures at two points A and B of tube, then P_A must be equal to P_B.

6. **Statement I:** Water and mercury are filled in two cylindrical vessels up to same height. Both vessels have a hole in the wall near the bottom. The velocity of water and mercury coming out of the holes have relation of $V_1 = \sqrt{13.6}\, V_2$

   Statement II: A solid floats in a liquid in a partially dipped position. The weight of the dipped part of solid is equal to the weight of displaced liquid.

7. **Statement I:** A solid is completely immersed in a liquid. The force exerted by the liquid on the solid will increase if it is pushed deeper inside the liquid.

   Statement II: A solid is completely immersed in a liquid. The force extended by the liquid on the solid will change if its orientation is changed.

8. **Statement I:** A closed vessel is half filled with H_2O. There is hole near the top of vessel and air is pumped out from this hole. The force by the water on the bottom of vessel will decrease.

   Statement II: Water flows through two identical tubes A and B. A volume V_o of water passes through tube A and $2V_o$ through B in given Time. It may be possible that flow is steady in B bud turbulent in A.

9. **Statement I:** In a streamline flow, the velocity of particle always remain same.

   Statement II: In a streamline flow, the kinetic energies of all the particles arriving at given point are the same.

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Answer Key

1. (*d*) **2.** 1kg **3.** 1.04kg **4.** $\frac{\rho_1+\rho_2}{2}$ **5.** $\frac{2\rho_1\rho_2}{\rho_1+\rho_2}$ **6.** 19.3 **7.** 920 kg/m^3 **8.** 1.5 atm

9. 51 atm **10.** (*c*) **11.** H = 10*m* **12.** (*c*) **13.** (*d*) **14.** (*a*) **15.** (*b*) **16.** 1000cm **17.** (*c*) **18.** (*b*)

19. (*c*) **20.** (*a*) **21.** (*b*) **22.** (*c*) **23.** (1) **24.** (*c*) **25.** (*d*) **26.** (*a*) **27.** (*a*) **28.** (*c*)

29. (*d*) **30.** (*a*) **31.** (*c*) **32.** (*a*) **33.** (*d*) **34.** (*c*) **35.** (*b*) **36.** (*d*)

37. Gas in first Sample exert more pressure, 51 × 10^2 N/m^2

38. H = 75.5 cm **39.** (*d*) **40.** (*d*) **41.** (*d*) **42.** $\frac{1}{6}$ **43.** (*c*) **44.** 7.5 kg m^{-3} **45.** (*a*)

46. (*a*) **47.** (*b*) **48.** (*c*) **49.** (*a*) **50.** (*d*) **51.** (*a*) **52.** (*d*) **53.** (*c*) **54.** (*c*) **55.** $\frac{1}{3}$

56. (*d*) **57.** (*a*) **58.** (*b*) **59.** (*a*) **60.** (*b*) **61.** (*d*) **62.** (*c*) **63.** (*b*) **64.** (*b*) **65.** (*d*)

66. (*b*) **67.** 1.1 **68.** (*a*) **69.** (*c*) **70.** $\sqrt{\left(\frac{A_0^2}{A_0^2-A_2}\right)2gh}$ **71.** (*d*) **72.** (*c*) **73.** (*b*) **74.** (*d*)

75. (*b*) **76.** (*a*) **77.** (*a*) **78.** 9600 **79.** (*d*) **80.** (*a*) **81.** (*a*) **82.** (*a*) **83.** (*a*) **84.** (*d*)

85. (*d*) **86.** (*c*) **87.** F=ρAV^2 = 2ρAgH **88.** $\mu = \frac{2a}{A}$ **89.** x = 32 **90.** (*c*) **91.** (*b*)

92. $h_1 - h_2 = \left(\frac{3v^2}{2g}\right)$ **93.** (*c*) **94.** (*b*) **95.** (*b*) **96.** (*b*) **97.** (*c*) **98.** (*a*) **99.** (*c*) **100.** (*c*)

101. (*b*) **102.** (*d*) **103.** 4.8 π × 10^{-3} N **104.** (*c*) **105.** (*c*) **106.** 2.7 ×10^{-4} **107.** (*a*) **108.** (*d*)

109. (*d*) **110.** (*c*) **111.** (*b*) **112.** (*d*) **113.** (*b*) **114.** (*d*) **115.** (*a*) **116.** (*d*) **117.** (*d*) **118.** (*b*)

119. (*b*) **120.** (*c*) **121.** (*c*) **122.** (*b*) **123.** (*a*) **124.** (*a*) **125.** (*a*) **126.** (*b*) **127.** (*c*) **128.** (*b*)

129. (*b*) **130.** (*a*) **131.** (*b*) **132.** (*c*) **133.** (*a*) **134.** (*c*) **135.** (*c*) **136.** (*b*) **137.** (*d*) **138.** (*b*)

139. (*b*) **140.** (*c*) **141.** $R_1^2 + R_1^2 = R^2$ **142.** (*d*) **143.** (*b*) **144.** (*a*) **145.** (*b*) **146.** (*b*) **147.** (*c*)

148. (*b*) **149.** (*a*) **150.** (*c*) **151.** (*c*) **152.** (*d*) **153.** (*a*) **154.** (*a*) **155.** (*a*) **156.** (*a*) **157.** (*a*)

158. (*c*) **159.** (1) **160.** (*c*) **161.** (*a*) **162.** (*a*) **163.** (*b*)

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1. Both A and R are correct but R is not correct explanation of A. **2.** True, II. - False **3.** I. False, II. True

4. Both are correct **5.** I. True, II. False **6.** Both are False **7.** Both are False

8. I. True, II. False **9.** I. False, II. True

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MR PHYSICS for questions practice

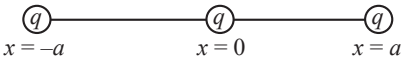
Electrostatic potential and capacitance

(Practice Questions)

Electrostatic Potential Energy

1. Electric potential energy of system of three point charge is zero then find relation between q and. Q

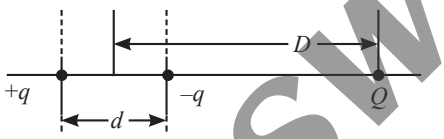
2. Three charges are placed along x-axis at $x = a$, $x = 0$ and $x = a$ as shown in the figure. The potential energy of the system is



(*a*) $-\left(\frac{1}{4\pi\varepsilon_0}\right)\frac{q^2}{a}$ (*b*) $-\left(\frac{1}{4\pi\varepsilon_0}\right)\frac{3q^2}{2a}$

(*c*) $\left[\frac{5q^2}{8\pi\varepsilon a}\right]$ (*d*) $+\left(\frac{1}{4\pi\varepsilon_0}\right)\frac{3q^2}{2a}$

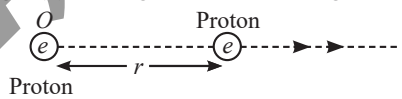
3. A system of three charges are placed as shown in the figure if $D >> d$, the potential energy of the system is best given by



(*a*) $\frac{1}{4\pi\varepsilon_0}\left[-\frac{q^2}{d}-\frac{qQd}{D^2}\right]$ (*b*) $\frac{1}{4\pi\varepsilon_0}\left[+\frac{q^2}{d}+\frac{qQd}{D^2}\right]$

(*c*) $\frac{1}{4\pi\varepsilon_0}\left[-\frac{q^2}{d}-\frac{2qQd}{D^2}\right]$ (*d*) $\frac{1}{4\pi\varepsilon_0}\left[-\frac{q^2}{d}-\frac{qQd}{2D^2}\right]$

4. A proton is fixed at origin. Another proton is released from rest, from a point at a distance r from origin. Taking charge of proton as e and mass as m, find the speed of the proton (i) at a distance $2r$ from origin (ii) at a large distance from origin.

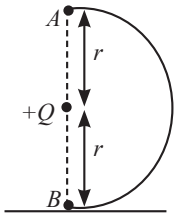


5. The charge q is fired towards another charged particle Q which is fixed, with a speed v. It approaches Q upto a closest distance r and then returns. If q were given a speed $2v$, the closest distance of approach would be

(*a*) r (*b*) $2r$ (*c*) $r/2$ (*d*) $r/4$

6. Calculate the work required to be done to make an arrangement of three particles each having a charge $+q$ such that the particles lie at the vertices of an equilateral triangle of side a, What work will be done by electric field when the particles are shifted away so that the side of triangle becomes $2a$?

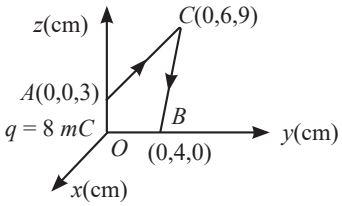
7. The work done in slowly moving an electron of charge e and mass m from A to B along a semicircular path (as shown in the figure) in vertical plane in the field of charge Q is



(*a*) $-2\,mgr$ (*b*) $-Qe/r$

(*c*) $2mgr + \frac{2Qe}{r}$ (*d*) Zero

8. Calculate the work done in taking a charge -2×10^{-9}C from A to B via C (in diagram)



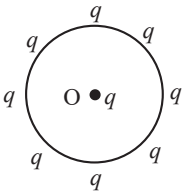
(*a*) 0.2 joule (*b*) 1.2 joule (*c*) 2.2 joule (*d*) zero

9. Two electrons are moving towards each other, each with a velocity of 10^6 m/s. What will be closest distance of approach between them?

(*a*) 1.5×10^{-8} m (*b*) 2.53×10^{-10} m

(*c*) 2.53×10^{-6} m (*d*) Zero

10. A point charge q is surrounded by eight identical charges at distance r as shown in figure. How much work is done by the forces of electrostatic repulsion when the point charge at the centre is removed to infinity?



(*a*) Zero (*b*) $\frac{8q^2}{4\pi\varepsilon_0 r}$ (*c*) $\frac{8q}{4\pi\varepsilon_0 r}$ (*d*) $\frac{64q^2}{4\pi\varepsilon_0 r}$

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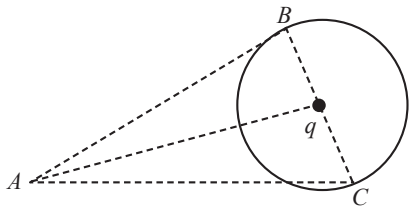
11. A point charge q is held at the centre of a circle of radius r. B, C are two points on the circumference of the circle and A is a point outside the circle. If W_{AB} represents work done by electric field in taking a charge q_0 from A to B and W_{AC} represents the work done from A to C, then



(*a*) $W_{AB} > W_{AC}$ (*b*) $W_{AB} < W_{AC}$

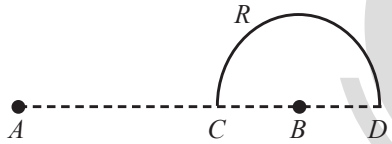
(*c*) $W_{AB} = W_{AC} = 0$ (*d*) $W_{AB} = W_{AC} \neq 0$

12. The work which is required to be done to make an arrangement of four particles each having a charge $+q$ such that the particle lie at the four corners of a square of side a is

(*a*) $(4+\sqrt{2})\frac{kq^2}{a}$ (*b*) $4\frac{kq^2}{a}$

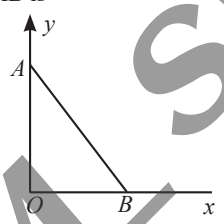
(*c*) $(2+\sqrt{2})\frac{kq^2}{a}$ (*d*) $2\frac{kq^2}{a}$

13. Charges +q and -q are placed at points A and B respectively which are a distance $2L$ apart, C is the midpoint between A and B. The work done in moving a charge $+Q$ along the semicircle CRD is



(*a*) $-\frac{qQ}{6\pi\varepsilon_0 L}$ (*b*) $-\frac{qQ}{4\pi\varepsilon_0 L}$ (*c*) $\frac{qQ}{2\pi\varepsilon_0 L}$ (*d*) $-\frac{qQ}{2\pi\varepsilon_0 L}$

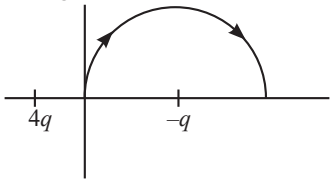
14. As per the diagram a point charge $+q$ is placed at the origin O. Work done in taking another point charge $-Q$ from the point A [coordinates $(0, a)$] to another point B [coordinates $(a, 0)$] along the straight path AB is



(*a*) Zero (*b*) $\left(\frac{-qQ}{4\pi\varepsilon_0}\frac{1}{a^2}\right)\cdot\sqrt{2a}$

(*c*) $\left(\frac{-q}{4\pi\varepsilon_0}\frac{1}{a^2}\right)\cdot\frac{a}{\sqrt{2}}$ (*d*) $\left(\frac{qQ}{4\pi\varepsilon_0}\frac{1}{a^2}\right)\sqrt{2}a$

15. A two point charges $4q$ and $-q$ are fixed on the x-axis at $x = -d/2$ and $x = d/2$ respectively. If a third point charge 'q' is taken from the origin to $x = d$ along the semicircle as shown in the figure, the energy of the charge will :



(*a*) Increased by $\frac{3q^2}{4\pi\varepsilon_0 d}$ (*b*) Increased by $\frac{2q^2}{3\pi\varepsilon_0 d}$

(*c*) Increased by $\frac{q^2}{4\pi\varepsilon_0 d}$ (*d*) Increased by $\frac{4q^2}{3\pi\varepsilon_0 d}$

16. **Statement I:** Negative of work done in bringing Q charge from infinite to point slowly (without change in kinetic energy) in electric field is called potential energy stored in charge Q.

Statement II: Work done by electrostatic force in bringing Q charge from infinity to point in electric field is called potential energy stored in charge Q.

(*a*) Statement I is true but Statement II is false

(*b*) Both Statement I and Statement II are false

(*c*) Both Statement I and Statement II are true

(*d*) Statement I is false but Statement II is true

Electric Potential

17. Negative work done by electric force in bringing Unit Positive charge from infinity to the Point in a field is Called electric Potential at that Point.

(*a*) True (*b*) False

18. Work done in bringing unit Positive charge slowly from infinity to the Point in electric field is called electric Potential.

(*a*) True (*b*) False

19. Change in electric potential energy per unit positive charge is called change in electric potential.

(*a*) True (*b*) False

20. Electric Potential energy per unit positive charge is called electric Potential.

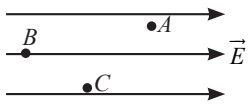
(*a*) True (*b*) False

21. Electric potential at distance r away from to +Q change _____ be $\frac{+kQ}{r}$.

(*a*) Must (*b*) Must not

(*c*) May (*d*) Cannot

22. A, B and C are three points in a uniform electric field. The electric potential is



(*a*) Maximum at B

(*b*) Maximum at C

(*c*) Same at all the three points A, B and C

(*d*) Maximum at A

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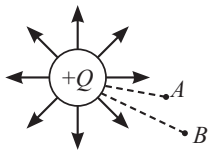
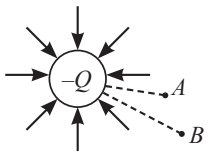
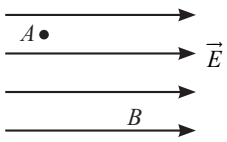
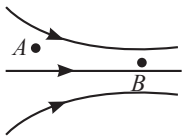
23. Match the column I with column II.

Column-I		Column-II	
A.		I.	$E_A = E_B$, $V_A > V_B$
B.		II.	$E_A > E_B$, $V_A > V_B$
C.		III.	$E_B > E_A$, $V_A > V_B$
D.		IV.	$E_A > E_B$, $V_B > V_A$

24. If electric field is zero then electric potential must be zero

(*a*) True (*b*) False

25. If electric field is constant, then potential must be constant

(*a*) True (*b*) False

26. If electric potential constant then electric field must be zero

(*a*) True (*b*) False

27. If potential is constant electric field may be non-zero

(*a*) True (*b*) False

28. If electric field is zero then potential may be non-zero.

(*a*) True (*b*) False

29. Determine the electric field strength vector if the potential of this field depends on x, y coordinates as $V = 10\,axy$

(*a*) $10a(y\hat{i} + x\hat{j})$ (*b*) $-10a[y\hat{i} + x\hat{j}]$

(*c*) $-a[y\hat{i} + x\hat{j}]$ (*d*) $-10a[x\hat{i} + y\hat{j}]$

30. The electric potential V at a point $P(x, y, z)$ in space is given by $V = 4x^2$ volt. Electric field at a point (1m, 0, 2m) in V/m is

(*a*) 8 along –ve x-axis (*b*) 8 along +ve x-axis

(*c*) 16 along –ve x-axis (*d*) 16 along +ve x-axis

31. If electrostatic potential is given as $V = x^2yz + xy^2 + 2zy^2$ find electric field at (1,1,1)

32. **Assertion (A):** Electric potential at a point which is a r distance away from $-Q$ charge can be positive potential.

Reason (R): Electric potential is a scalar quantity.

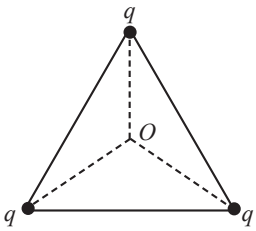
(*a*) Both A and R are true and R is the correct explanation of A.

(*b*) Both A and R are true but R is NOT the correct explanation of

(*c*) A is true but R is false

(*d*) A is false but R is true

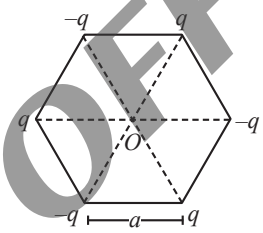
33. Three isolated equal charges are placed at the three corners of an equilateral triangle as shown in figure. The statement which is true for net electric potential V and net electric field intensity E at the centre of the triangle is



(*a*) $E = 0, V = 0$ (*b*) $V = 0, E \neq 0$

(*c*) $V \neq 0, E = 0$ (*d*) $V \neq 0, E \neq 0$

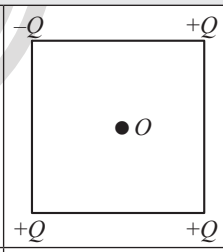
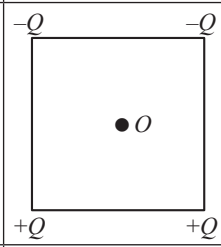
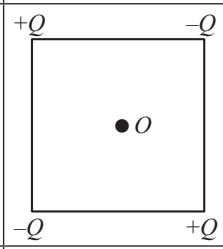
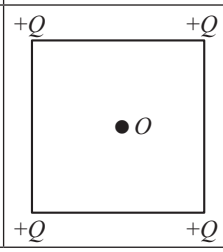
34. Six point charges are placed at the vertices of a regular hexagon of side a as shown. If E represents electric field and V represents electric potential at 0, then



(*a*) $E = 0$ but $V \neq 0$ (*b*) $E \neq 0$ but $V = 0$

(*c*) $E = 0$ and $V = 0$ (*d*) $E \neq 0$ and $V \neq 0$

35. Match the column I with column II.

Column-I		Column-II	
A.		I.	$E = 0,\ V \neq 0$
B.		II.	$E \neq 0,\ V = 0$
C.		III.	$E = 0,\ V = 0$
D.		IV.	$E \neq 0,\ V \neq 0$

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36. Considering a group of positive charges, which of the following statements is correct?

(*a*) Net potential of the system cannot be zero at a point but net electric field can be zero at that point

(*b*) Net potential of the system at a point can be zero but net electric field can't be zero at that point.

(*c*) Both the net potential and the net electric field cannot be zero at a point.

(*d*) Both the net potential and the net field can be zero at a point.

37. **Statement I:** If potential is non-zero then electric field must be non-zero.

Statement II: If electric field is zero, potential may be zero on non-zero

(*a*) Statement I is true but Statement II is false

(*b*) Both Statement I and Statement II are false

(*c*) Both Statement I and Statement II are true

(*d*) Statement I is false but Statement II is true

38. Two small spheres each carrying a charge q are placed, distance r apart. If one of the spheres is taken around the other in a circular path, the work done will be equal to

(*a*) Force between them × r

(*b*) $\dfrac{\text{Force between them}}{2\pi r}$

(*c*) Force between them × 2π

(*d*) Zero

39. When a test charge is brought in from infinity along the perpendicular bisector of an electric dipole, to the centre of dipole, then find work done?

(*a*) Positive (*b*) Zero

(*c*) Negative (*d*) None of these

40. If you know $\vec{E}$ at a given point, can you calculate V at that point? If not, what further information do you need?

41. How can you insure that the electric potential in a given region of space will have a constant value?

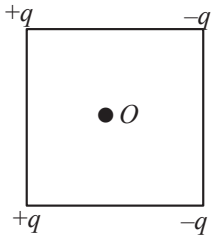
42. An electric charge 10^{-6} μC is placed at origin (0, 0) m of X - Y co-ordinate system. Two points P and Q are situated at $(\sqrt{3},\sqrt{3})m$ and $(\sqrt{6},0)m$ respectively. The potential difference between the points P and Q will be :

(*a*) $\sqrt{3}\,V$ (*b*) $\sqrt{6}\,V$ (*c*) 0 V (*d*) 3 V

43. If 50 joule of work must be done to move an electric charge of $2C$ from a point, where potential is –10 volt to another point, where potential is V volt, the value of V is

(*a*) 5 V (*b*) –15 V (*c*) + 15 V (*d*) + 10 V

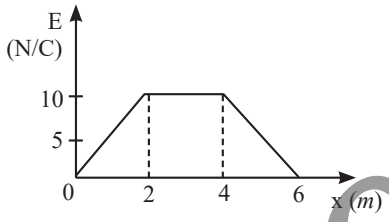
44. Four electric charges $+q$, $+q$, $-q$ and $-q$ are placed at the corners of a square of side 2L (see figure). The electric potential at point A, midway between the two charges $+q$ and $+q$, is



(*a*) Zero (*b*) $\dfrac{1}{4\pi\varepsilon_0}\dfrac{2q}{L}(1+\sqrt{5})$

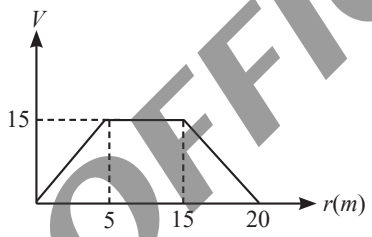
(*c*) $\dfrac{1}{4\pi\varepsilon_0}\dfrac{2q}{L}\left(1+\dfrac{1}{\sqrt{5}}\right)$ (*d*) $\dfrac{1}{4\pi\varepsilon_0}\dfrac{2q}{L}\left(1-\dfrac{1}{\sqrt{5}}\right)$

45. Figure shows the variation of electric field intensity E versus distance x. What is the potential difference between the points at x = 2 m and at x = 6m from 0?



(*a*) 30V (*b*) 60 V (*c*) 40 V (*d*) 80 V

46. Find electric field at r = 17 m.



(*a*) –3 N/C (*b*) +3 N/C (*c*) 15 N/C (*d*) –15 N/C

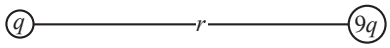
47. A particle A has charge $+q$ and particle B has charge $+4q$ with each of them having the same mass m. When allowed to fall from rest through the same electric potential difference, the ratio of their speeds V_A/V_B will become

(*a*) 1 : 2 (*b*) 2 : 1 (*c*) 1 : 4 (*d*) 4 : 1

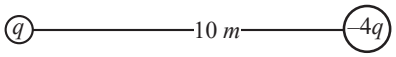
48. Find Potential at origin?

V = ?	q	q	q	q	q	upto
•	•	•	•	•	•	•
(0, 0)	(1, 0)	(2, 0)	(4, 0)	(8, 0)	(16, 0)	Infinity

49. Find potential at a point where electric field is zero?



50. Find potential at a point where electric field is zero



51. Find point where electric potential is zero?

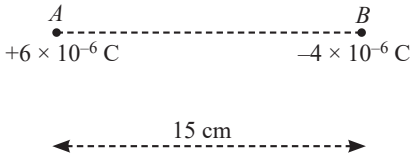
52. A charge Q is placed at each corner of a cube of side a. The potential at the centre of the cube is:

(*a*) $\dfrac{8Q}{\pi\varepsilon_0 a}$ (*b*) $\dfrac{4Q}{4\pi\varepsilon_0 a}$

(*c*) $\dfrac{4Q}{\sqrt{3}\pi\varepsilon_0 a}$ (*d*) $\dfrac{2Q}{\pi\varepsilon_0 a}$

53. Two point charges –5 μC and +3 μC are placed 64 cm apart. At what points on the line joining the two charges is the electric potential zero. Assume the potential at infinity to be zero.

54. Two charges +6 μC and –4 μC are placed 15 cm apart as shown. At what distance from A to its right, the electrostatic potential is zero (distance in cm)



(*a*) 4, 9, 60 (*b*) 9, 45, infinity

(*c*) 20, 45, infinity (*d*) 9, 15, 45

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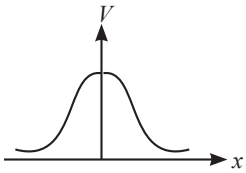
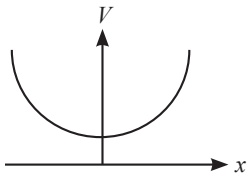
55. n small drops of same size are charged to V volts each. If they coalesce to form a single large drop, then its potential will be

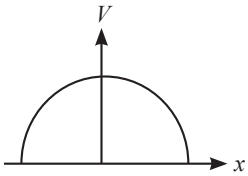
(*a*) V / n (*b*) Vn

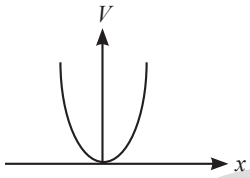
(*c*) $Vn^{2/3}$ (*d*) $Vn^{1/3}$

56. Two identical positive charges are placed on the y-axis at $y = -a$ and $y = +a$. The variation of V (electric potential) along x-axis is shown by graph

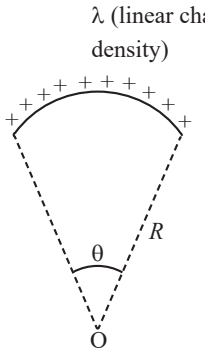
(*a*)


(*b*)


(*c*)


(*d*)


57. Find potential at 'O'



58. Two thin wire rings each having a radius R are placed at a distance d apart with their axes coinciding. The charges on the two rings are $+q$ and $-q$. The potential difference between the centres of the two rings is

(*a*) Zero (*b*) $\frac{q}{4\pi\varepsilon_0}\left\{\frac{1}{R}-\frac{1}{\sqrt{R^2+d^2}}\right\}$

(*c*) $\frac{qR}{4\pi\varepsilon_0 d^2}$ (*d*) $\frac{q}{2\pi\varepsilon_0}\left\{\frac{1}{R}-\frac{1}{\sqrt{R^2+d^2}}\right\}$

59. A positively charged ring is in $y-z$ plane with its centre at origin. A positive test charge q_0, held at origin is released along x-axis, then its speed

(*a*) Increases continuously

(*b*) Decreases continuously

(*c*) First increases then decreases

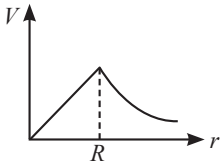
(*d*) First decreases then increases

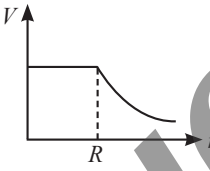
60. Three charged particles having charges q, $-2q$ & q are placed in a line at point $(-a, 0)$, $(0, 0)$ and $(a, 0)$ respectively. The expression for electric potential at $P(r, 0)$ for $r >> a$ is

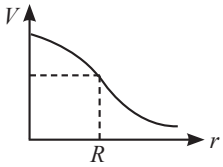
(*a*) $\frac{1}{4\pi\varepsilon_0}\frac{qa^2}{r^4}$ (*b*) $\frac{1}{4\pi\varepsilon_0}\frac{2qa^2}{r^3}$

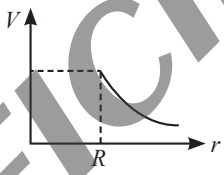
(*c*) $\frac{1}{4\pi\varepsilon_0}\frac{4qa^2}{r^2}$ (*d*) $\frac{1}{4\pi\varepsilon_0}\frac{8qa^2}{r}$

61. Which graph best represents the variation of electric potential as a function of distance from the centre of a conducting charged solid sphere of charge of radius R?

(*a*)


(*b*)


(*c*)


(*d*)


62. A hollow spherical conductor of radius r potential of 100 V at its outer surface. The potential inside the hollow at a distance of $r/2$ from its centre is

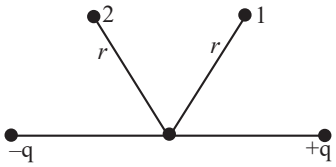
(*a*) 100 V (*b*) 50 V (*c*) 200 V (*d*) Zero

63. A point dipole $\vec{p} = -p_0\hat{x}$ is kept at the origin. The potential and electric field due to this dipole on the y-axis at a distance d are, respectively. (Take $V = 0$ at infinity)

(*a*) $\frac{|\vec{P}|}{4\pi\varepsilon_0 d^2}, \frac{\vec{P}}{4\pi\varepsilon_0 d^3}$ (*b*) $\frac{|\vec{P}|}{4\pi\varepsilon_0 d^2}, \frac{-\vec{P}}{4\pi\varepsilon_0 d^3}$

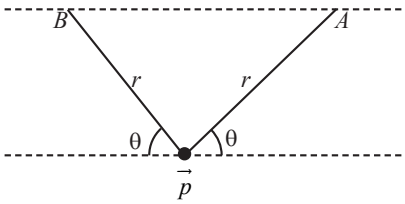
(*c*) $0, \frac{-\vec{P}}{4\pi\varepsilon_0 d^3}$ (*d*) $0, \frac{\vec{P}}{4\pi\varepsilon_0 d^3}$

64. Which of the following is correct



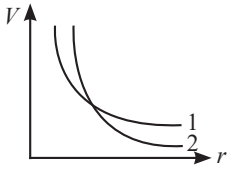
(*a*) $V_1 = V_2$ (*b*) $V_1 > V_2$ (*c*) $V_1 < V_2$ (*d*) Cont say

65. A charge q is moved from A to B in the region of a fixed ideal dipole $\vec{p}$. Find the work done on the charge (Assume gravity free space).



66. **Statement I:** Work done in bringing $+Q$ charge from infinity to the center of dipole along equatorial line is zero.

Statement II: In the given figure, 1 is variation of electric field w.r.t. distance for a point charge while 2 is variation of electric potential w.r.t distance for a point charge.



(*a*) Statement I is true but Statement II is false

(*b*) Both Statement I and Statement II are false

(*c*) Both Statement I and Statement II are true

(*d*) Statement I is false but Statement II is true

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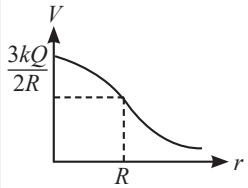
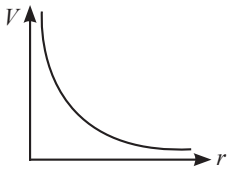
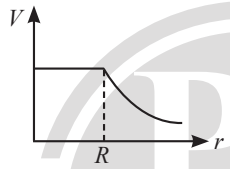
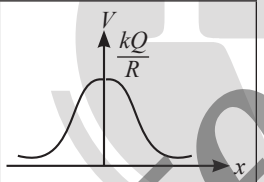
67. Consider a sphere of radius R having charge q uniformly distributed inside it. At what minimum distance from its surface the electric potential is half of the electric potential at its centre?

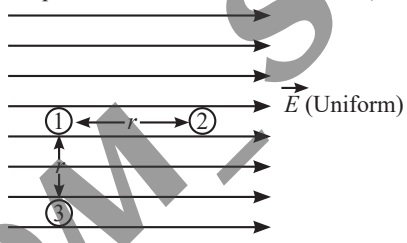
(*a*) R (*b*) $R/2$ (*c*) $4R/3$ (*d*) $R/3$

68. Match the column I with column II.

	Column-I		Column-II
A.	Electric potential due to ring on it's axis	I.	
B.	Electric potential due to solid non-conducting sphere	II.	
C.	Electric potential due to point charge.	III.	
D.	Electric potential due to hollow sphere	IV.	

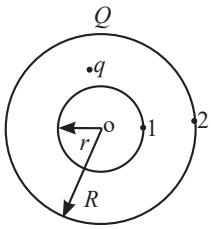
69. A uniformly charged sphere has a total charge Q and radius R. Assume that the potential at the surface of the sphere is zero. Find the electric potential at the center of the sphere.

70. In a region of uniform electric field E, two points, 1 and 2, are separated by a distance r. The potential at point 1 is greater than at point 2. Assuming the potential at point 1 is V_1 and at point 2 is V_2, find the potential difference between these two points.

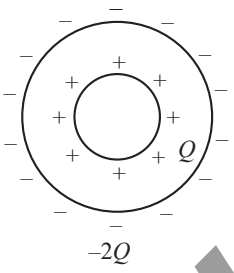


Also, find the potential difference between point 1 and 3.

71. a spherical shell with an inner radius r and outer radius R, carrying a charge Q. The potential at point 1 (on the inner surface) is V_1, and the potential at point 2 (on the outer surface) is V_2. Find the potential difference between the surfaces of the inner and outer spheres.



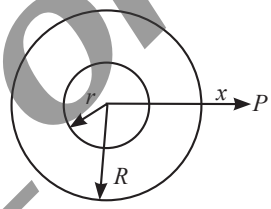
72. Two concentric conducting spheres of radii R. and $2R$ are carrying charges Q and $–2Q$ respectively. If the charge on inner sphere is doubled, the potential difference between the two spheres will



(*a*) Become two times (*b*) Become four times

(*c*) Be halved (*d*) Remain same

73. Two concentric hollow conducting spheres of radius r and R are shown. The charge on outer shell is Q. What charge should be given to inner sphere so that the potential at any point P outside the outer sphere is zero?

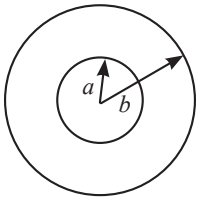


(*a*) $-\frac{Qr}{R}$ (*b*) $-\frac{QR}{r}$

(*c*) $-Q$ (*d*) $-\frac{2QR}{r}$

74. **Assertion (A):** For the given figure, potential difference between surfaces of these concentric hollow sphere only depend on charge present on inner sphere.

Reason (R): Potential due to charge on outer sphere is same at surface of both these spheres.



(*a*) Both A and R are true and Ris the correct explanation of A

(*b*) Both A and R are true but R is NOT the correct explanation of A.

(*c*) A is true but R is false

(*d*) A is false but R is true.

75. A hollow charged metal sphere has radius r. If the potential difference between its surface and a point at a distance $3r$ from the centre is V, then the electric field intensity at distance $3r$ from the centre is

(*a*) $\frac{V}{3r}$ (*b*) $\frac{V}{4r}$ (*c*) $\frac{V}{6r}$ (*d*) $\frac{V}{2r}$

76. A spherical conductor having charge q and radius r is placed at the centre of a spherical shell of radius R and having charge Q ($R > r$). The potential difference between the two is

(*a*) Proportional to Q

(*b*) Proportional to q

(*c*) Dependent on both Q and q

(*d*) Independent of both Q and q

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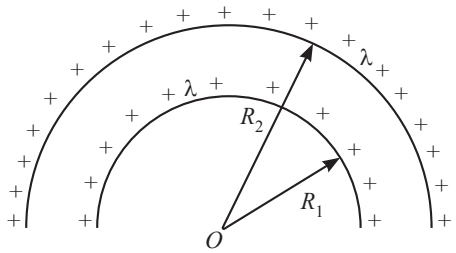
77. A bullet of mass 2 g is having a charge of 2μC. Through what potential difference must it be accelerated, starting from rest, to acquire a speed of 10 m/s?

(*a*) 5 kV (*b*) 50 kV

(*c*) 5 V (*d*) 50 V

78. The electric potential at the centre of two concentric half rings of radii R_1 and R_2, having same linear charge density A is:



(*a*) $\frac{\lambda}{2\epsilon_0}$ (*b*) $\frac{\lambda}{\epsilon_0}$

(*c*) $\frac{2\lambda}{\epsilon_0}$ (*d*) $\frac{\lambda}{4\epsilon_0}$

79. If r represents the distance of point from the center of the sphere and R represent the radius of sphere, then which of the following statements are incorrect?

I. Electric field for $r > R$ is same as it would be for an equal charge placed at center in case of conducting sphere.

II. Potential for $r > R$ is the same as it would be an equal charge placed at center in case of conducting sphere.

III. Potential for $r < R$ is same as it would be for an equal charge placed at center of sphere in case of uniformly charged solid non-conducting sphere.

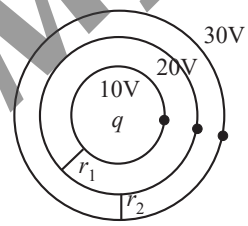
(*a*) Both I and II (*b*) Both I and III

(*c*) Only III (*d*) Both II and III

80. Charge q given to Inner sphere and Q on outer concentric sphere they are connect with wire then find final charge on each sphere.

Equipotential Surface

81. Equipotential surface due to point charge then compare r_1 and r_2.

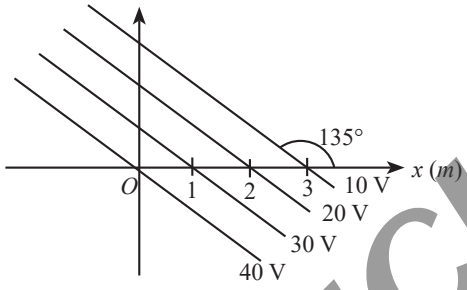


82. An infinite conducting sheet has surface charge density σ. The distance between two equipotential surfaces is r. The potential difference between these two surfaces is

(*a*) $\frac{\sigma r}{2\varepsilon_0}$ (*b*) $\frac{\sigma r}{\varepsilon_0}$

(*c*) $\frac{\sigma}{\varepsilon_0 r}$ (*d*) $\frac{\sigma}{2\varepsilon_0 r}$

83. Figure shows a set of equipotential surfaces. The magnitude and direction of direction of electric field that exists in the region is



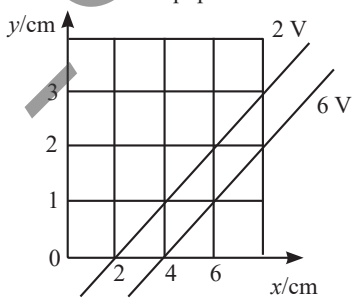
(*a*) $10\sqrt{2}\,V/m$ at 45° with x-axis

(*b*) $10\sqrt{2}\,V/m$ at –45° with x-axis

(*c*) $\frac{10}{\sqrt{2}}$ V/m at 45° with x-axis

(*d*) $10\sqrt{2}\,V/m$ at –45° with x-axis

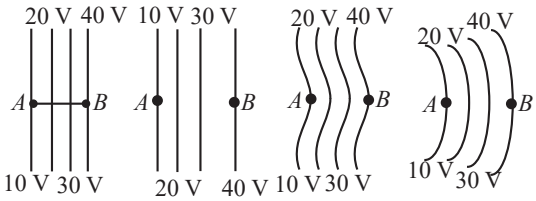
84. Figure shows two equipotential lines in xy-plane for an electric field. The x-component E_x and y component E_y of the electric field in the space between these equipotential lines are, respectively.



(*a*) +150 V/m, –300 V/m (*b*) –150 V/m – 300 V/m

(*c*) –200 V/m, 1400 V/m (*d*) –200V/m,–100V/m

85. The diagrams below show regions of equipotential.



A positive charge is moved from A to B in each diagram.

(*a*) Maximum work is required to move q in figure (c).

(*b*) In all the four cases the work done is the same

(*c*) Minimum work is required to move q in figure (a)

(*d*) Maximum work is required to move q in figure (b).

86. **Assertion (A)**: Work done by electric field on moving a positive charge on an equipotential surface is always zero.

Reason (R): Electric lines of forces are always perpendicular to equipotential surfaces.

In the light of the above statements, choose the most appropriate answer from the options given below :

(*a*) Both (A) and (R) are correct and (R) is the correct explanation of (A)

(*b*) (A) is correct but (R) is not correct

(*c*) Both (A) and (R) are correct but (R) is not the correct explanation of (A)

(*d*) (A) is not correct but (R) is correct

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Properties of Conductor

87. Electric find inside conductor is always zero

(*a*) True (*b*) False

88. Electric field inside Isolated conductor is zero where conducting matter is present

(*a*) True (*b*) False

89. **Statement I:** Electrostatic force on q_2 due to q_1 doesn't depend upon medium.

Statement II: Net electrostatic force on q_2 depends upon medium but not on presence of other charges.

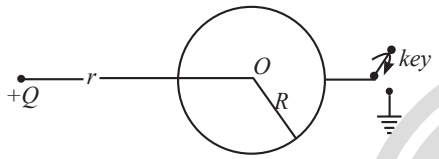
(*a*) I is true but II is false

(*b*) I is false but II is true

(*c*) Both I and II are true but II is not the correct explanation of I

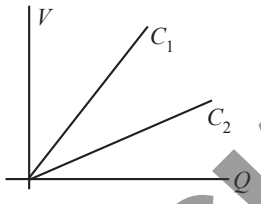
(*d*) Both I and II are true and II is the correct explanation of I

90. Find final charge on sphere when key is closed?



Capacitance

91. For two capacitor graph between potential and charge is given then which of the following option is correct?

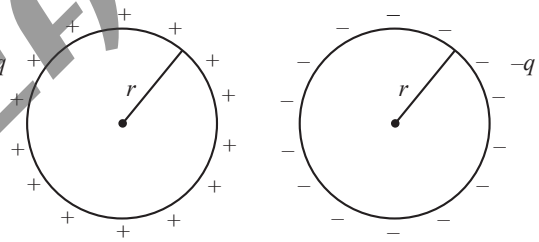


(*a*) $C_1 = C_2$ (*b*) $C_1 > C_2$ (*c*) $C_1 < C_2$ (*d*) Non of these

Spherical Capacitor

92. What is capacitance of earth?

93. Two similar conducting balls having charges $+q$ and $-q$ are placed at a separation d from each other in air. The radius of each ball is r and the separation between their centres is d ($d >> r$). Calculate the capacitance of the two ball system



(*a*) $4\pi\varepsilon_0 r$ (*b*) $2\pi\varepsilon_0 r$

(*c*) $4\pi \log_e \frac{\varepsilon_0 r}{d}$ (*d*) $4\pi \log_e \frac{r}{d}$

94. 1000 small water drops each of capacitance C join together to form one large spherical drop. The capacitance of bigger sphere is

(*a*) C (*b*) $10\,C$ (*c*) $100\,C$ (*d*) $1000\,C$

95. **Assertion (A):** Two metallic)spheres are charged to the same potential. One of them is hollow and another is solid, and both have the same radii. Solid sphere will have lower charge than the hollow one.

Reason R: Capacitance of metallic spheres depend on the radii of: spheres. In light of the above statements, choose the correct answer from the options given below.

(*a*) Both A and R are true but R is not the correct explanation of A

(*b*) Both A and R are true and R is the correct explanation of A

(*c*) A is false but R is true

(*d*) A is true but R is false

96. From the given graph of V (potential) v/s charge (Q) for the two sphere 1 and 2 of radius R_1 and R_2, we can conclude that

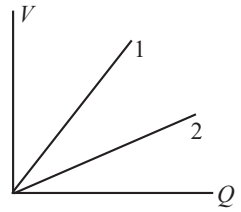
I. $R_2 > R_1$

II. $R_1 > R_2$

III. 2nd sphere has more capacity to store charge for same potential applied

IV. Both sphere have some capacitance as it doesn't depend upon charge and Potential.

The correct statement from above given statement are



(*a*) Both I and II (*b*) Both I and III

(*c*) Only III (*d*) Both II and III

97. Capacitance of an isolated conducting sphere of radius R_1 becomes n times when it is enclosed by a concentric conducting sphere of radius R_2 connected to earth. The ratio of their radii $\left(\frac{R_2}{R_1}\right)$ is:

(*a*) $\frac{n}{n-1}$ (*b*) $\frac{2n}{2n+1}$

(*c*) $\frac{n+1}{n}$ (*d*) $\frac{2n+1}{n}$

Parallel Plate Capacitance

98. The capacitance of a parallel plate capacitor with air as medium is $6\mu F$. With the introduction of a dielectric medium, the capacitance becomes $30\mu F$. The permittivity of the medium is ($\varepsilon_0 = 8.85 \times 10^{-12}\, C^2\, N^{-1}\, m^{-2}$)

(*a*) $0.44 \times 10^{-13} C^2\, N^{-1}\, m^{-2}$ (*b*) $1.77 \times 10^{-12} C^2\, N^{-1} m^{-2}$

(*c*) $0.44 \times 10^{-10} C^2\, N^{-1}\, m^{-2}$ (*d*) $5.00 C^2\, N^{-1}\, m^{-2}$

99. A parallel plate condenser with oil between the plates (dielectric constant of oil $K = 2$) has a capacitance C. If the oil is removed, then capacitance of the capacitor becomes

(*a*) $C/\sqrt{2}$ (*b*) $2C$ (*c*) $\sqrt{2}C$ (*d*) $C/2$

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100. The electrostatic force between the metal plates of an isolated parallel plate capacitor C having a charge Q and area A, is

(*a*) independent of the distance between the plates
(*b*) linearly proportional to the distance between the plates
(*c*) proportional to the square root of the distance between the plates
(*d*) inversely proportional to the distance between the plates

101. A parallel plate air capacitor has capacity C, distance of separation between plates is d and potential difference V is applied between the plates. Force of attraction between the plates of the parallel plate air capacitor is

(*a*) $\frac{CV^2}{d}$ (*b*) $\frac{C^2V^2}{2d^2}$ (*c*) $\frac{C^2V^2}{2d}$ (*d*) $\frac{CV^2}{2d}$

102. A force of 10 N acts on a charged particle placed between two plates of a charged capacitor. If one plate of capacitor is removed, then the force acting on that particle will be

(*a*) 5 N (*b*) 10 N (*c*) 20 N (*d*) Zero

103. Statement I: Two plates having surface area a are having charges $+Q$ and are separated by distance d. One plate will experience force of alteration $F = \frac{Q^2}{A\varepsilon_0}$ due to

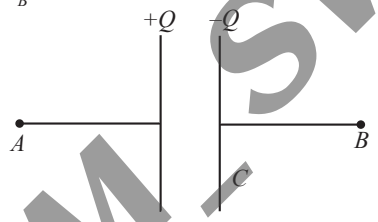
Statement II: Capacitance of this system doesn't depend upon Q charge present on parallel plates.

(*a*) Statement I is true but Statement II is false
(*b*) Both Statement I and Statement II are false
(*c*) Both Statement I and Statement II are true
(*d*) Statement I is false but Statement II is true

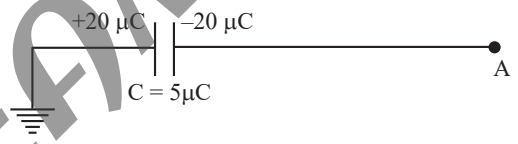
104. A parallel plate air capacitor is charged to a potential difference of V volts. After disconnecting the charging battery the distance between the plates of the capacitor is increased using an insulating handle. As a result the potential difference between the plates

(*a*) increases (*b*) decreases
(*c*) does not change (*d*) becomes zero

105. Find $V_A - V_B$



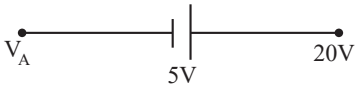
106. Find $V_A = ?$



Battery and Work Done by Battery

107. Find V_B

108. Find V_A

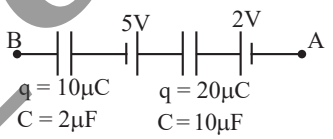


109. Find V_A

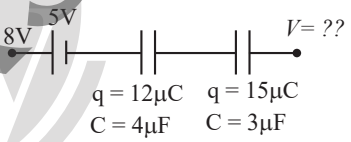
110. Find V

Simple Circuit of Battery and Capacitor

111. In the given circuit Find $V_A - V_B$

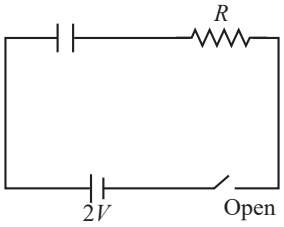


112.



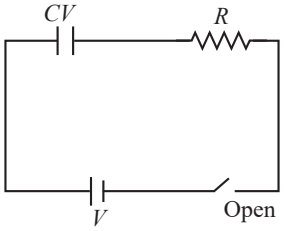
Charging & Discharging of Capacitor

113. In the given circuit, a capacitor C is initially uncharged ($Q = 0$, $V = 0$) and is connected to a 2V battery with an open switch and a resistor R. The circuit is in steady state after the switch is closed



Find final maximum charge on capacitor and energy loss

114. In the circuit a capacitor is initially uncharged and is connected to a battery with e.m.f V and a resistor R via a switch. When the switch is closed, the capacitor starts charging. Find the final maximum charge on the capacitor once the system reaches a steady state and Energy Loss in the circuit.



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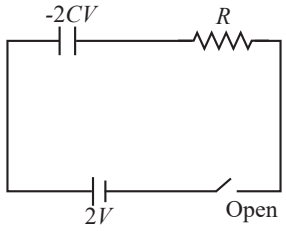
115. If a capacitor is initially charged to a certain potential $2V$ and is connected to a battery with e.m.f $2V$ and a resistor R. then find the final maximum charge on the capacitor once the system reaches a steady state and Energy Loss in the circuit.



116. If capacitor is initially charged to a certain potential V and is connected to a battery with e.m.f $2V$ and a resistor R. Then Find the final maximum charge on the capacitor and Energy Loss in the circuit.

117. In a metallic conductor, under the effect of applied electric field, the free electrons of the conductor:

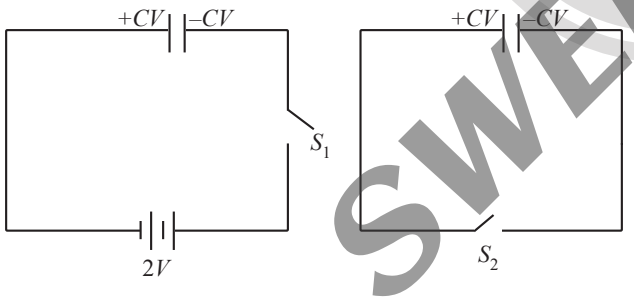
(*a*) Move in the straight line paths in the same direction

(*b*) Move with the uniform velocity throughout from lower potential to higher potential

(*c*) Drift from higher potential to lower potential

(*d*) Move in the curved paths from lower potential to higher potential

118. For the given two figures (a) and (b) energy lost in form of heat when switch S, is closed is x times as compared to Energy lost when switch S_2 is closed find value of x



(*a*) 0 (*b*) 1 (*c*) 3 (*d*) 9

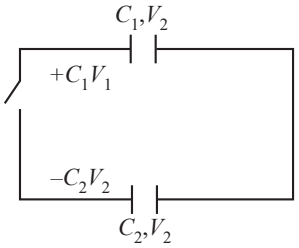
Connection of Two Capacitor

119. Two capacitor is connected with same Polarity

(i) Find Common Potential

(ii) Final charge on each capacitor

(iv) Energy loss

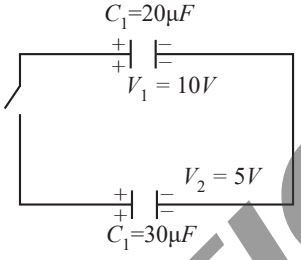


120. When Key is closed then find

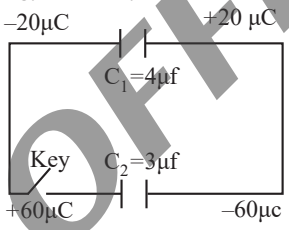
(i) Common Potential

(ii) Final change on each capacitor

(iii) Total loss in energy.



121. Find loss in energy when key is closed?



122. A capacitor of capacitance 'C_1' is charged unto potential 'V' and is then disconnected from the battery. It is then connected to uncharged capacitor, in parallel, whose capacitance is 'C_2'. The potential difference across each capacitor is_____.

(*a*) $\frac{C_1+C_2}{C_2V}$ (*b*) $\frac{C_2V}{C_1+C_2}$

(*c*) $\frac{C_1+C_2}{C_1V}$ (*d*) $\frac{C_1V}{C_1+C_2}$

123. There are two identical capacitors, first one is uncharged and filled with dielectric of constant k while other one is changed to potential v having air between it's plates. If two capacitors are joined end to end, the common potential will be

(*a*) $\frac{V}{K-1}$ (*b*) $\frac{KV}{K+1}$

(*c*) $\frac{KV}{K-1}$ (*d*) $\frac{V}{k+1}$

124. A capacitor is charged with a battery and energy stored is U. After disconnecting battery another capacitor is of same capacity is connected in parallel with it. Then energy stored in each capacitor is:

(*a*) U/2 (*b*) U/4 (*c*) 4U (*d*) 2U

125. A capacitor is charged by a battery. The battery is removed and another identical uncharged capacitor is connected in parallel. The total electrostatic energy of resulting system:

(*a*) Increase by a factor of 2

(*b*) Increase by a factor of 4

(*c*) Decreases by a factor of 2

(*d*) Remains the same

126. An uncharged parallel plate capacitor having a dielectric of constant K is connected to a similar air cored parallel capacitor charged to a potential V. The two capacitors share charges and the common potential is V'. The dielectric constant K is

(*a*) $\frac{V'-V}{V'+V}$ (*b*) $\frac{V'-V}{V'}$

(*c*) $\frac{V'-V}{V}$ (*d*) $\frac{V-V'}{V'}$

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127. A 10 mF capacitor is fully charged to a potential difference of 50 V. After removing the source voltage, it is connected to an uncharged capacitor in parallel. Now potential difference across them becomes 20 V. The capacitance of the second capacitor is:

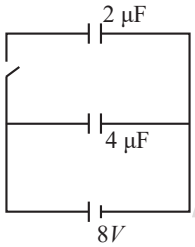
(*a*) 15 μF (*b*) 20 μF (*c*) 10 μF (*d*) 30 μF

128. Two capacitors of capacitances C and $2C$ are charged to potential differences V and $2\ V$, respectively. These are then connected in parallel in such a manner that the positive terminal of one is connected to the negative terminal of the other. (The final energy of this configuration is:)

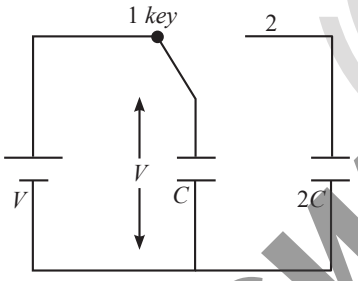
(*a*) $\frac{3}{2}CV^2$ (*b*) $\frac{9}{2}CV^2$ (*c*) $\frac{25}{6}CV^2$ (*d*) 0

129. A 600 pF capacitor is charged by 200 V supply. It is then disconnected form the supply and is connected to another uncharged 600 pF capacitor. Electrostatic energy lost in the process is_____μJ.

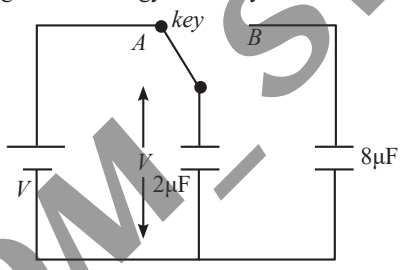
130. Find total change in charge on 4 μF capacitor, when Key is closet



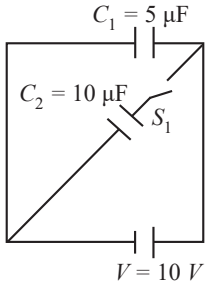
131. Find percentage loss in energy when Key is shifted from (1) to (2) after large time.



132. Percentage loss in energy when key Shifted form A to B



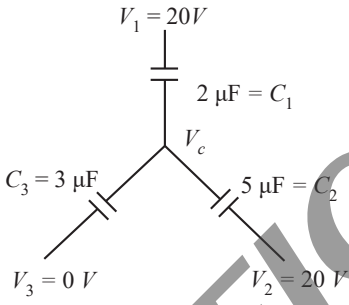
133. If Q_1 is charge on C_1 before switch S_1 is closed and Q_2 is charge on C_1 after closing the switch S_1. Find $Q_1 - Q_2$.



(*a*) 0 (*b*) 1 (*c*) 3 (*d*) 9

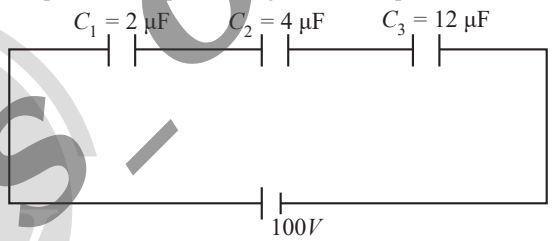
Kirchhoff's Law

134. Find common potential and charge on each plate.

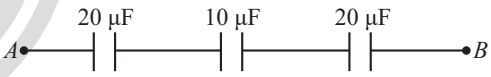


Series & Parallel Combination of Capacitor

135. Find potential drop and charge on each capacitor.

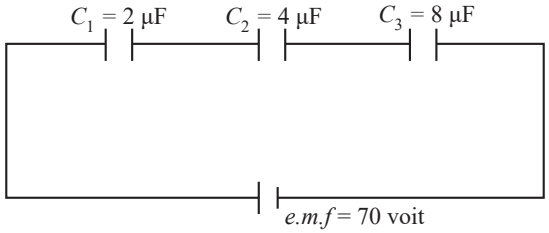


136. Find equivalent capacitance between A and B.

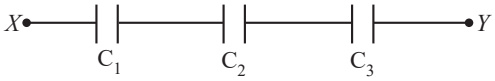


137. n capacitor of equal capacitance 'C' connected in series then find equivalent capacitance.

138. Find charge and potential drop across each capacitor.

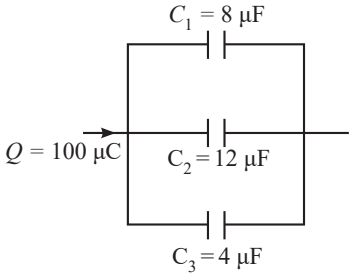


139. In the circuit below $C_1 = 20$ μF, $C_2 = 40$ μF and $C_3 = 50$ μF and $C_3 = 50$ μF. If no capacitor can sustain more than $50V$, then maximum potential difference between X and Y is



(*a*) 95 V (*b*) 150 V (*c*) 75 V (*d*) 65 V

140. Find charge on each capacitor?



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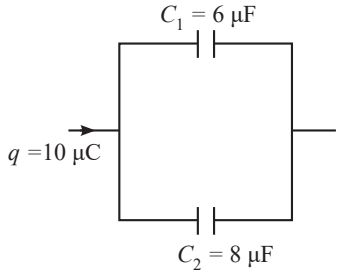
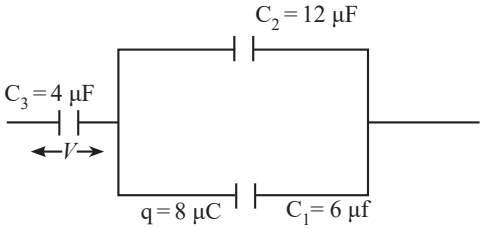
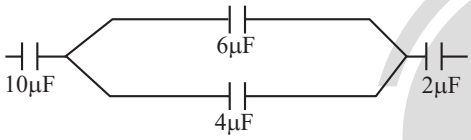
141. Find charge on each capacitor



142. Charge on 6 μF is 8 μC then find potential drop across 4 μF.

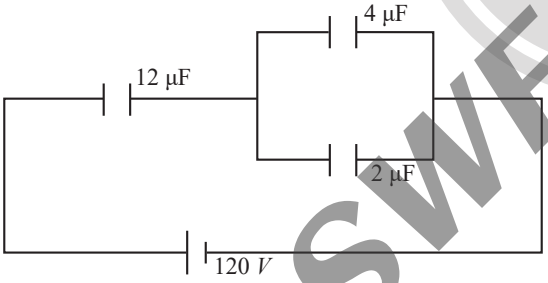


143. In the figure shown below, the charge on the left plate of the 10 μF capacitor is –30 μC. The charge on the right plate of the 6 μF capacitor is

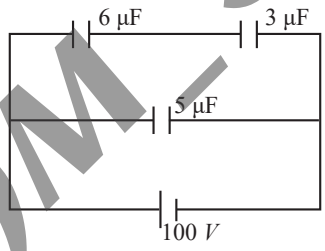


(*a*) + 18 μC (*b*) –12 μC
(*c*) +12 μC (*d*) –18 μC

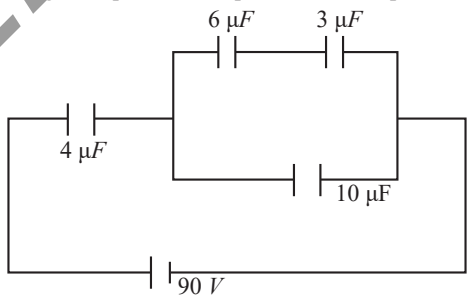
144. Find charge and potential across each capacitor.



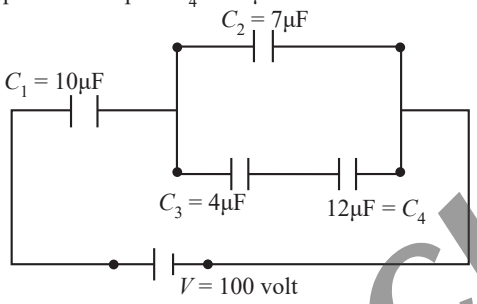
145. Find charge and potential drop across each capacitor.



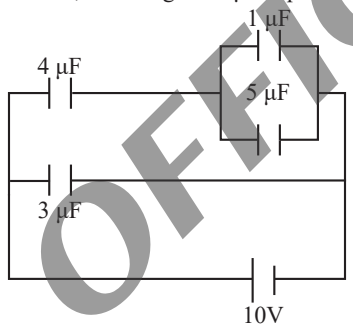
146. Find charge and potential drop across each capacitor.



147. Find potential drop on C_4 = 12 μF

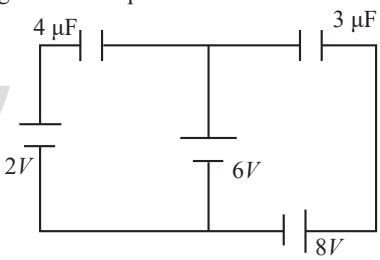


148. In the given circuit, the charge on 4μF capacitor will be:

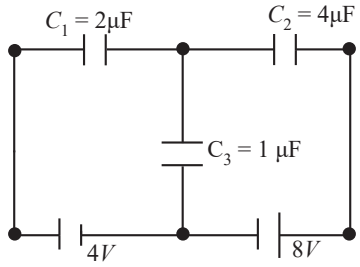


(*a*) 13.4 μC (*b*) 24 μC
(*c*) 9.6 μC (*d*) 5.4 μC

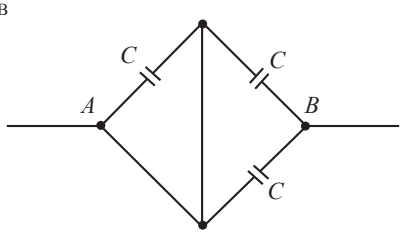
149. Find charge on each capacitor.



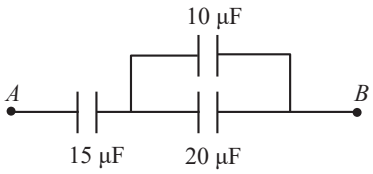
150. find charge on each capacitor



151. Find C_{AB}



152. In the arrangement shown, find the equivalent capacitance between *A* and B.



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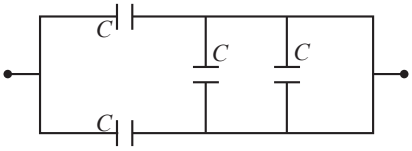
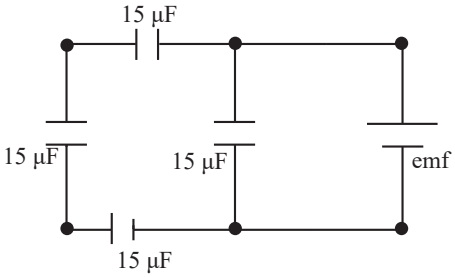
153. The equivalent capacitance of the combination shown is:



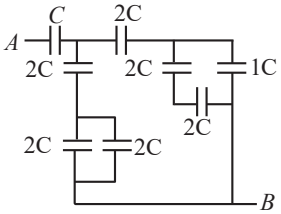
(*a*) $\frac{C}{2}$ (*b*) 4C (*c*) $\frac{5}{3}C$ (*d*) 2C

154. Find equivalent capacitance across battery.



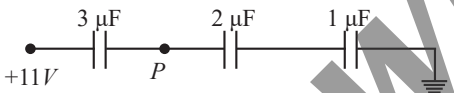
(*a*) 5 μF (*b*) 10 μF (*c*) 15 μF (*d*) 20 μF

155. In the circuit shown, find C if the effective capacitance of the whole circuit is to be 0.5 μF. All values in the circuit are in μF.

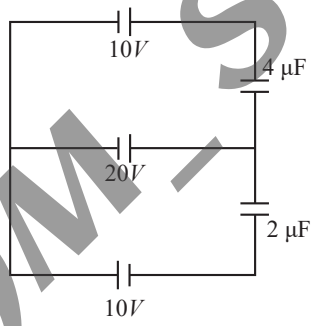


(*a*) $\frac{7}{11}\mu$ F (*b*) 4 μf (*c*) $\frac{6}{5}\mu$ F (*d*) $\frac{7}{10}\mu F$

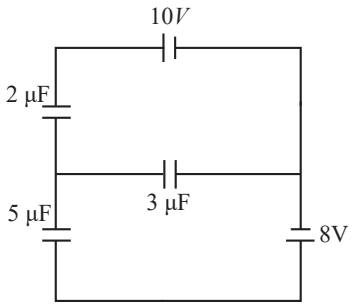
156. In the given circuit, the electric potential at 'P' will be



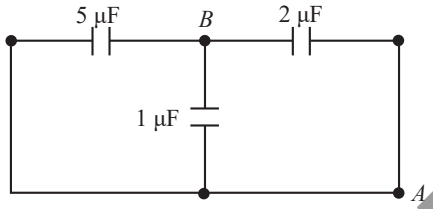
157. Find charge on 4 μF.



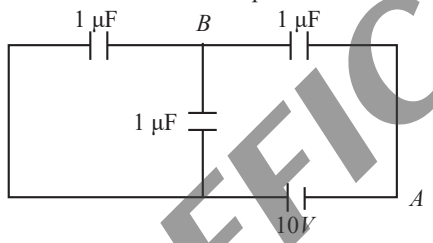
158. Find charge on 5 μF.



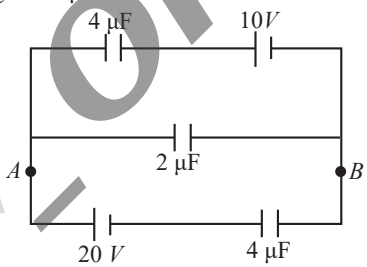
159. If potential at A is 50 V then find potential at B.



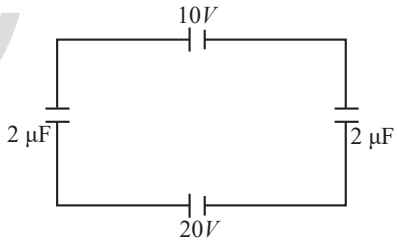
160. If potential at A is 10 V then find potential at B.



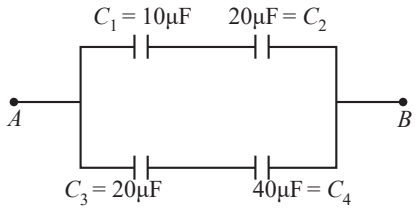
161. Find charge on 2 μF.



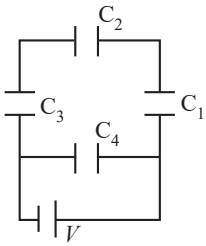
162. Find charge on 2 μF



163. If charge on C_1 is 10 μF then find potential difference between A and B.



164. A network of four capacitors of capacity equal to $C_1 = C$, $C_2 = 2C$, $C_3 = 3C$ and $C_4 = 4C$ are connected to a battery as shown in the figure. The ratio of the charges on C_2 and C_4 is



(*a*) $\frac{22}{3}$ (*b*) $\frac{3}{22}$

(*c*) $\frac{7}{4}$ (*d*) $\frac{4}{7}$

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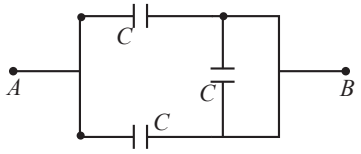
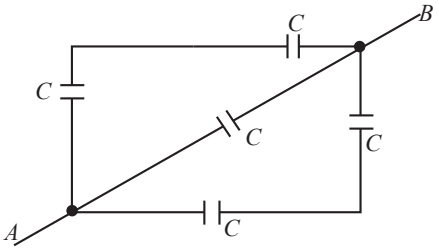
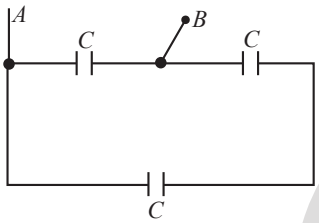
165. Find equivalent capacitance between A & B



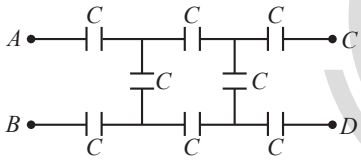
166. Find equivalent capacitance



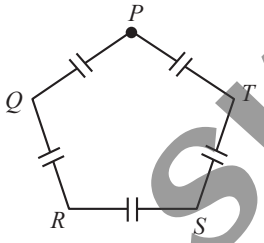
167. Find equivalent capacitance between A & B



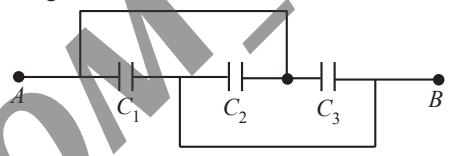
168. Find equivalent capacitance between A & B.



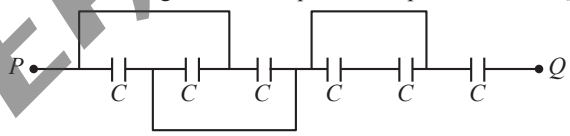
169. Find C_{PQ}/C_{PR} = ??



170. Find the equivalent capacitance of the combination between *A* and *B* in the figure.

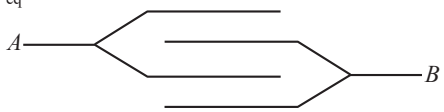


171. For the following circuit the equivalent capacitance *P* and *Q* is

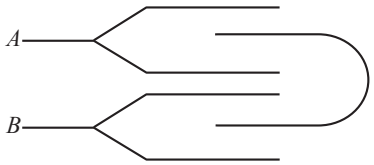


(*a*) 6 C (*b*) 4 C (*c*) $\frac{3C}{2}$ (*d*) $\frac{3C}{4}$

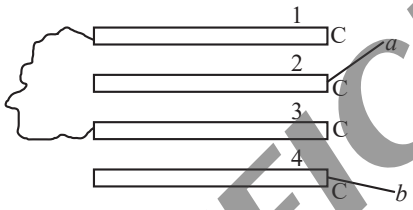
172. Find C_{eq} between A & B



173. Find C_{eq} between A & B



174. Capacitance between *a* and *b*.



175. Effective capacitance of parallel combination of two capacitors C_1 and C_2 is 10 μF. When these capacitors are individually connected to a voltage source of 1 *V*, the energy stored in the capacitor C_2 is 4 times that of C_1. If these capacitors are connected in series, their effective capacitance will be:

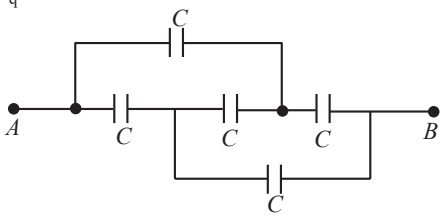
(*a*) 4.2 μF (*b*) 88.4 μF (*c*) 1.6 μF (*d*) 0.32 μF

176. A series combination of n_1 capacitors, each of value C_1, is charged by a source of potential difference 4 *V*. When another parallel combination of n_2 capacitors, each of value C_2, is charged by a source of potential difference *V*, it has the same (total) energy stored in it, as the first combination has. The value of C_2, in terms of C_1, is then

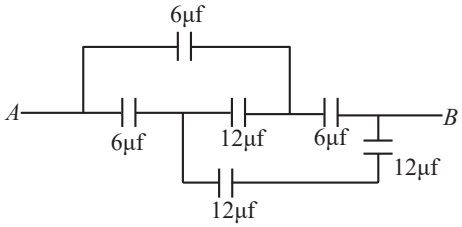
(*a*) $\frac{16C_1}{n_1n_2}$ (*b*) $\frac{2C_1}{n_1n_2}$ (*c*) $16\frac{n_2}{n_1}C_1$ (*d*) $2\frac{n_2}{n_1}C_1$

Wheatstone Bridge

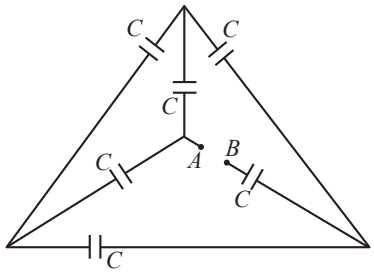
177. Find C_q between *A* & *B*



178. Find equivalent capacitance between *A* & *B*



179. Find equivalent capacitance between *A* & *B*



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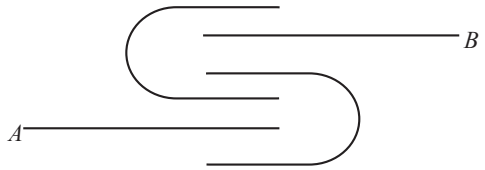
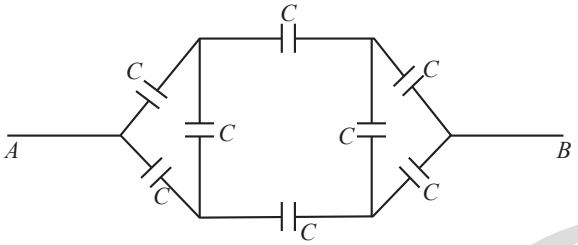
180. Find equivalent capacitance between A & B

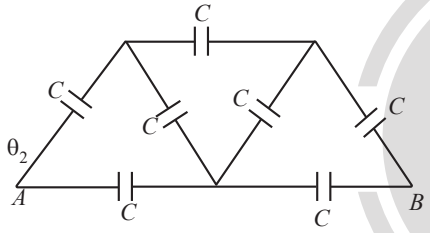


Symmetric circuit

181. Symmetric circuit

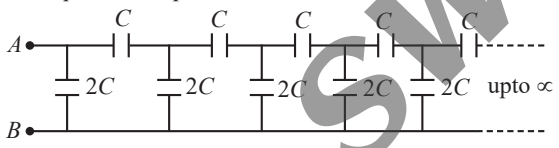


182. Symmetric circuit



Ladder network

183. Find equivalent capacitance between A & B



(*a*) $(\sqrt{3}+1)$ C (*b*) $(\sqrt{3}-1)$ C

(*c*) $(\sqrt{5}+1)$ C (*d*) 3C

184. **Assertion (A):** Resultant capacitance of the given ladder system must be less than C.

Reason (R): Capacitance in series combination must be less than the smallest capacitance.

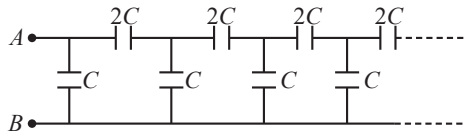
(*a*) Both (A) and (R) are correct and (R) is the correct explanation of (A)

(*b*) (A) is correct but (R) is not correct

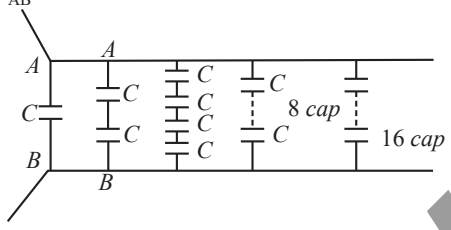
(*c*) Both (A) and (R) are correct but (R) is not the correct explanation of (A)

(*d*) (A) is not correct but (R) is correct

185. Find the equivalent capacitance of the infinite ladder shown in the figure between the points *A* and *B*.



186. Find C_{AB} = ??



Dielectric inside Capacitor

187. A capacitor with plate separation *d* is charged to *v* volts. The battery and a dielectric slab of thickness *d*/2 and dielectric constant ' 2 ' is inserted between plates. The potential difference across its terminal become

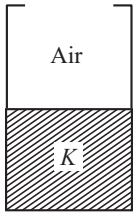
(*a*) V (*b*) $2V$ (*c*) $\frac{4V}{3}$ (*d*) $\frac{3V}{4}$

188. A parallel plate capacitor has plate area 40 cm^2 and plate separation 2 mm. The space between the plates is filled with a dielectric medium of thickness 1 mm and dielectric constant 5 . The new capacitance of the system is:

(*a*) $24\varepsilon_0$F (*b*) $\frac{3}{10}\varepsilon_0$ F (*c*) $\frac{10}{3}\varepsilon_0$ F (*d*) $10\varepsilon_0$F

Dielectric in Series and Parallel Combination

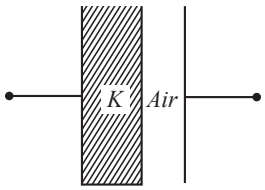
189. A parallel plate air capacitor has capacitance *C*. Now half of the space is filled with a dielectric material with dielectric Constant *K* as shown in figure. The new capacitance is *C*. Then



(*a*) $C' = \frac{C}{2}[1+K]$ (*b*) C' = C [1 + K]

(*c*) $C' = C\left[1+\frac{K}{2}\right]$ (*d*) $C' = C\left[\frac{1}{2}+K\right]$

190. A parallel plate air capacitor has capacitance C. Half of space between the plates is filled with dielectric of dielectric constant K as shown in figure. The new capacitance is *C'*. Then



(*a*) $C' = C\left[\frac{K}{K+1}\right]$ (*b*) $C' = C\left[\frac{2K}{K+1}\right]$

(*c*) $C' = \frac{2C}{K+1}$ (*d*) $C' = C\left[1+\frac{K}{2}\right]$

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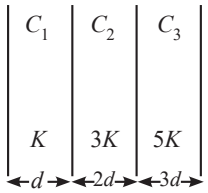
191. In the reported figure, a capacitor is formed by placing a compound dielectric between the plates of parallel plate capacitor. The expression of the capacity of the said capacitor will be: (Given area of plate = A)



(*a*) $\frac{15}{34}\frac{K\varepsilon_0 A}{d}$ (*b*) $\frac{15}{6}\frac{K\varepsilon_0 A}{d}$

(*c*) $\frac{25}{6}\frac{K\varepsilon_0 A}{d}$ (*d*) $\frac{9}{6}\frac{K\varepsilon_0 A}{d}$

192. An air filled parallel plate condenser has a capacity of 2 pF . The separation of the plates is doubled and the space between the plates is filled with wax. If the capacity is increased to 6 pF , the dielectric constant of wax is

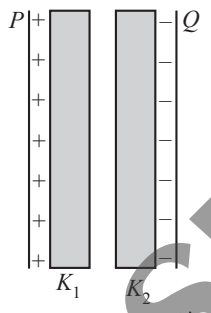
(*a*) 2 (*b*) 3 (*c*) 4 (*d*) 6

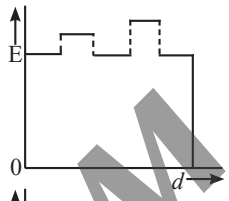
193. A parallel plate capacitor after charging is kept connected to a battery and the plates are pulled apart with the help of insulating handles. Now which of the following quantities will decrease?

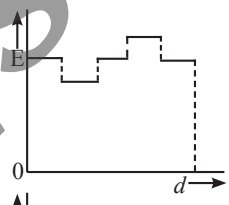
(*a*) Charge (*b*) Capacitance

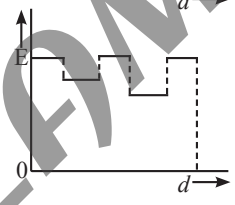
(*c*) Energy stored (*d*) All of these

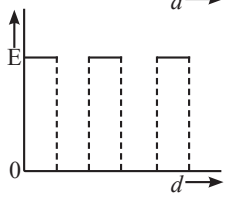
194. Two thin dielectric slabs of dielectric constants K_1 and K_2 $(K_1 < K_2)$ are inserted between plates of a parallel plate capacitor, as shown in the figure. The variation of electric field E between the plates with distance d as measured from plate P is correctly shown by



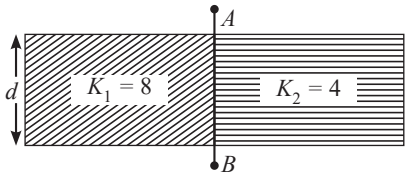
(*a*)


(*b*)


(*c*)


(*d*)


195. A capacitor having capacitance 1μF with air is filled half-half with two dielectrics as shown. How many times capacitance will become?

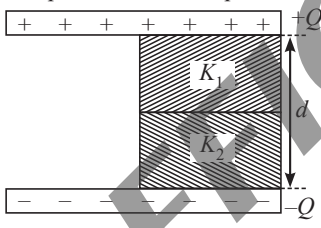


(*a*) 12 (*b*) 6 (*c*) 8/3 (*d*) 3

196. A parallel plate capacitor of capacity 5μF and plate separation 6 cm is connected to a 1 V battery and is charged. A dielectric of constant 4 and thickness 4 cm is introduced into the capacitor. The additional charge that flows into the capacitor from the battery is

(*a*) 2 μC (*b*) 3 μC (*c*) 5 μC (*d*) 10 μC

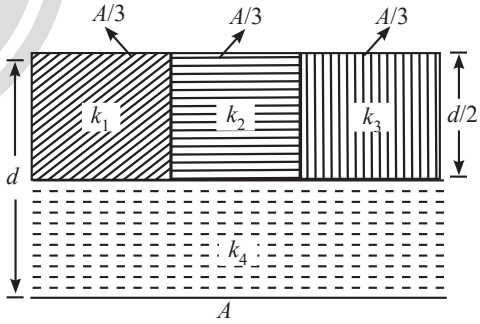
197. A parallel-plate capacitor with plate area A has separation d between the plates. Two dielectric slabs of dielectric constant K_1 and K_2 of same area $\frac{A}{2}$ and thickness $\frac{d}{2}$ are inserted in the space between the plates. The capacitance of the capacitor will be given by:



(*a*) $\frac{\varepsilon_0 A}{d}\left(\frac{1}{2}+\frac{K_1+K_2}{K_1 K_2}\right)$ (*b*) $\frac{\varepsilon_0 A}{d}\left(\frac{1}{2}+\frac{2(K_1+K_2)}{K_1K_2}\right)$

(*c*) $\frac{\varepsilon_0 A}{d}\left(\frac{1}{2}+\frac{K_1 K_2}{K_1+K_2}\right)$ (*d*) $\frac{\varepsilon_0 A}{d}\left(\frac{1}{2}+\frac{K_1 K_2}{2(K_1+K_2)}\right)$

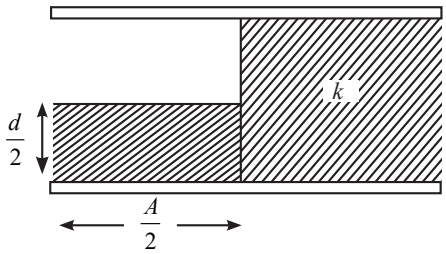
198. A parallel-plate capacitor of area A, plate separation d and capacitance C is filled with four dielectric materials having dielectric constants k_1, k_2, k_3 and k_4 as shown in the figure below. If a single dielectric material is to be used to have the same capacitance C in this capacitor, then its dielectric constant k is given by



(*a*) $k = k_1 + k_2 + k_3 + 3k_4$ (*b*) $k = \frac{2}{3}(k_1 + k_2 + k_3) + 2k_4$

(*c*) $\frac{2}{k} = \frac{3}{k_1 + k_2 + k_3} + \frac{1}{k_4}$ (*d*) $\frac{1}{k} = \frac{1}{k_1} + \frac{1}{k_2} + \frac{1}{k_3} + \frac{1}{2k_4}$

199. A parallel plate capacitor with plate area A and plate separation d , is filled with a dielectric slab as shown. What is the capacitance of the arrangement?



(*a*) $\left(\frac{k+1}{2}\right)\frac{\varepsilon_0 A}{d}$ (*b*) $\frac{3}{2}\frac{k\varepsilon_0 A}{2}$

(*c*) $\frac{4}{3}\frac{k\varepsilon_0 A}{d}$ (*d*) $\frac{k(k+3)}{2(k+1)}\frac{\varepsilon_0 A}{d}$

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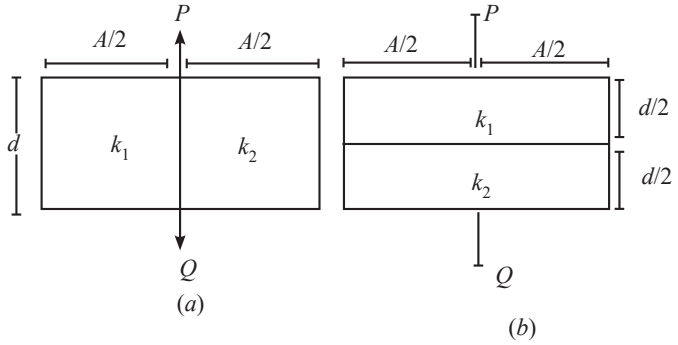
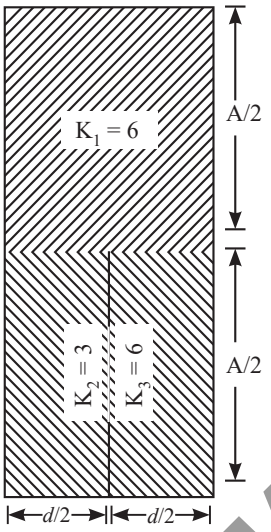
200. In the arrangement shown in figure, dielectric constant $k_1 = 2$ and $k_2 = 3$ If the capacitance across P and Q are C_1 and C_2 respectively, then C_1/C_2 will be the gaps shown are negligible)



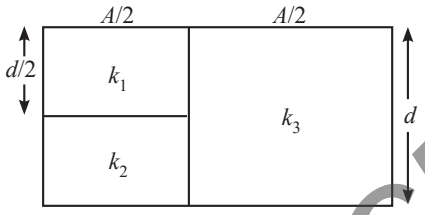
(*a*) 1 : 1 (*b*) 2 : 3 (*c*) 9 : 3 (*d*) 25 : 24

201. Three different dielectrics are filled in a parallel plate capacitor as shown. What should be the dielectric constant of a material, which when fully filled between the plates produces same capacitance?



(*a*) 4 (*b*) 6 (*c*) 5 (*d*) 9

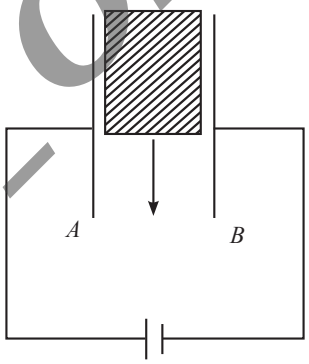
202. In the figure a capacitor is filled with dielectrics. The resultant capacitance is



(*a*) $\frac{2\varepsilon_0 A}{d}\left[\frac{1}{k_1}+\frac{1}{k_2}+\frac{1}{k_3}\right]$ (*b*) $\frac{\varepsilon_0 A}{d}\left[\frac{1}{k_1}+\frac{1}{k_2}+\frac{1}{k_3}\right]$

(*c*) $\frac{2\varepsilon_0 A}{d}\left[k_1+k_2+k_3\right]$ (*d*) None of these

203. An insulator plate is passed through the plates of a capacitor. Then current outside the capacitor.



(*a*) First flows from A to B and then from B to A

(*b*) First flows from B to A and then from A to B

(*c*) Always flows from B to A

(*d*) Always flows from A to B

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1. **Statement I:** The Capacitance of a capacitor does not depend on . the shape of the plates.

   Statement II: The Capacitance of a capacitor does depend upon the charges on the plates.

2. **Statement I:** If A dielectric slab is inserted between the plates of a isolated charged capacitor. The potential difference between the plates will remain the same.

   Statement II: The charge on the capacitor is Q and the magnitude of induced charge on each surface of the dielectric slab inserted between the plates of capacitor is Q'. Then Q must be smaller than Q.

3. **Statement I:** If the Separation between the plates of charged parallel plate capacitor is increased then Energy density between the plates will change.

   Statement II: A parallel plate is connected to a battery when a metal sheet of negligible thickness is inserted parallely between the plates, Then capacitance will increase.

4. **Statement I:** A capacitor of capacitance C is charged to potential V. The flux of the electric field through a closed surface enclosing the capacitor will be zero.

   Statement II: Two metal plates having charges Q, –Q face each other at some separation & are dipped into an oil Tank. If oil is pumped out, the Electric field Between the plates will decrease.

5. **Statement I:** Two capacitors each having capacitance C and breakdown voltage V are Joined in series. The capacitance & Breakdown voltage of combination will be $\frac{C}{2}$ and 2V Respectively.

   Statement II: If above given two capacitors are connected in parallel instead of connecting in series, then capacitance & Breakdown voltage of Combination will be 2C and $\frac{V}{2}$ Respectively.

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Answer Key

1. $q = -2Q$ **2.** (*c*) **3.** (*a*) **4.** (i) $\sqrt{\frac{Ke^2}{mr}}$ (ii) $\sqrt{\frac{2Ke^2}{mr}}$ **5.** (*d*) **6.** $\frac{3Kq^2}{2a}$ **7.** (*a*) **8.** (*b*) **9.** (*b*)

10. (*b*) **11.** (*d*) **12.** (*a*) **13.** (*a*) **14.** (*a*) **15.** (*d*) **16.** (*b*) **17.** (*a*) **18.** (*a*) **19.** (*a*)

20. (*a*) **21.** (*c*) **22.** (*a*) **23.** A - II, B-IV, C–I, D–III **24.** (*b*) **25.** (*b*) **26.** (*a*) **27.** (*b*) **28.** (*a*)

29. (*b*) **30.** (*a*) **31.** $7\hat{j}$ **32.** (*b*) **33.** (*c*) **34.** (*c*) **35.** A–IV, B–II, C–III, D–I **36.** (*a*) **37.** (*d*)

38. (*d*) **39.** (*b*) **40.** No, we need reference point because V depends on reference point **41.** If E = O **42.** (*c*)

43. (*c*) **44.** (*d*) **45.** (*a*) **46.** (*b*) **47.** (*a*) **48.** $\frac{q}{2\pi\varepsilon_0}$ **49.** $\frac{16kq}{3r}$ **50.** $\frac{-kq}{10}$ **51.** 2m **52.** (*c*)

53. 96 cm From +3 μC **54.** (*b*) **55.** (*c*) **56.** (*a*) **57.** Kλθ **58.** (*d*) **59.** (*a*) **60.** (*b*) **61.** (*b*)

62. (*a*) **63.** (*c*) **64.** (*b*) **65.** $W = -\frac{2KP\cos\theta.q}{r^2}$ **66.** (*a*) **67.** (*d*) **68.** A-IV, B-I, C-II, D-III **69.** $\frac{KQ}{2R}$

70. $V_1 - V_2 = Er$, $V_1 - V_3 = 0$ **71.** $Kq\left[\frac{1}{r} - \frac{1}{R}\right]$ **72.** (*a*) **73.** (*c*) **74.** (*a*) **75.** (*c*) **76.** (*b*)

77. (*b*) **78.** (*a*) **79.** (*c*) **80.** Charge on inner sphere = 0, charge on outer sphere = $q + Q$ **81.** $r_1 < r_2$ **82.** (*b*)

83. (*a*) **84.** (*c*) **85.** (*b*) **86.** (*a*) **87.** (*b*) **88.** (*a*) **89.** (*a*) **90.** $-\frac{QR}{r}$ **91.** (*c*)

92. 711×10^{-6} F **93.** (*b*) **94.** (*b*) **95.** (*c*) **96.** (*b*) **97.** (*a*) **98.** (*c*) **99.** (*d*) **100.** (*a*)

101. (*d*) **102.** (*a*) **103.** (*d*) **104.** (*a*) **105.** $\frac{Q}{C}$ **106.** – 4 V **107.** 13 V **108.** 15 V **109.** 28 V **110.** 12 V

111. 10 V **112.** 5 V **113.** $q_{max} = 2CV, 2CV^2$ **114.** $q_{max} = +CV$, $U_{loss} = 1/2\ CV^2$ **115.** $q_{max} = 0$, $U_{loss} = 0$

116. $q_{max} = CV, U_{loss} = \frac{1}{2}CV^2$ **117.** (*d*) **118.** (*d*)

119. (i) $\frac{C_1V_1 + C_2V_2}{C_1 + C_2}$, (ii) $Q_1 = C_1\left[\frac{C_1V_1 + C_2V_2}{C_1 + C_2}\right]$, (iii) $\frac{1}{2}\frac{C_1C_2}{C_1 + C_2}(V_1 - V_2)^2, Q_2 = C_2\left[\frac{C_1V_1 + C_2V_2}{C_1 + C_2}\right]$

120. (i) 7V, (ii) $(q_1)_{final} = 140\mu C$, $(q_2)_{final} = 210\mu C$, (iii)1150μJ **121.** 535.7 μf **122.** (*d*) **123.** (*d*) **124.** (*b*)

125. (*c*) **126.** (*d*) **127.** (*a*) **128.** (*a*) **129.** 6 **130.** (0) **131.** 66.66% **132.** 80% **133.** (*a*)

134. $V_c = 19V$, charge on $C_1 = 2\mu C$, Charge on $C_2 = 55\mu C$, Charge on $C_3 = 57\mu C$

135. $(Q)_{all\ capacitor} = 12\ \mu C$, $V_1 = 60\ V$, $V_2 = 30\ V$, $V_3 = 10\ V$ **136.** 5μF **137.** $C_{eq} = \frac{c}{n}$

138. Q = 80 μC, $V_1 = 40\ V$, $V_2 = 20\ V$, $V_3 = 10\ V$ **139.** (*a*) **140.** $q_1 = \frac{100}{3}\mu C, q_2 = 50\mu C, q_3 = \frac{50}{3}\mu C$

141. $Q_1 = \frac{30}{7}\mu C, Q_2 = \frac{40}{7}\mu C$ **142.** 6 V **143.** (*a*)

144. $q_{12\mu F} = 480\ \mu C$, $V_{12\mu F} = 40$ V, $q_{4\mu F} = 320\ \mu C$, $V_{4\mu F} = 80$ V, $q_{2\mu F} = 160\mu C$, $V_{2\mu F} = 80$ V **145.** $q_{6\mu F} = q_{3\mu F} = 200\mu C$, $q_{5\mu F} = 50\mu C$

146. $q_{6\mu F} = 45\ \mu C$, $V_{6\mu F} = 7.5$ V, $q_{3\mu F} = 45\ \mu C$, $V_{3\mu F} = 15$ V, $q_{4\mu F} = 270\ \mu C$, $V_{4\mu F} = 67.5$ V, $q_{10\mu F} = 225\ \mu C$, $V_{10\mu F} = 22.5$ V **147.** $\frac{50}{4}$ volt

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148. (*b*) **149.** $q_{4\mu F} = 16\mu C$, $Q_{3\mu F} = 3\mu C$ **150.** $Q_1 = \frac{24}{7}\mu C, Q_2 = \frac{64}{7}\mu C, Q_3 = \frac{40}{7}\mu C$ **151.** $C_{AB} = 2C$ **152.** 10 μF

153. (*d*) **154.** (*d*) **155.** (*a*) **156.** $V_P = 9V$ **157.** $q_{4\mu F} = 40\mu C$ **158.** 10 μC **159.** $V_A = 50$ V **160.** $V_B = \frac{50}{3}V$

161. $q_{2\mu F} = 24\mu C$ **162.** 10 μC **163.** $V_A - V_B = \frac{3}{2}V$ **164.** (*b*) **165.** 2C **166.** 2C **167.** $\frac{3C}{2}$ **168.** $\frac{4C}{11}$

169. $\frac{3}{2}$ **170.** $C_1 + C_2 + C_3$ **171.** (*d*) **172.** 3C **173.** $C_{AB} = 2C$ **174.** $\frac{2C}{3}$ **175.** (*c*) **176.** (*a*)

177. C **178.** 6μF **179.** $\frac{C}{2}$ **180.** $C = \frac{A\varepsilon_0}{d}$ **181.** $\frac{2C}{3}$ **182.** $\frac{7C}{8}$ **183.** (*b*) **184.** (*a*) **185.** 2C

186. 2C **87.** (*d*) **188.** (*c*) **189.** (*a*) **190.** (*b*) **191.** (*a*) **192.** (*d*) **193.** (*d*) **194.** (*c*) **195.** (*b*)

196. (*c*) **197.** (*c*) **198.** (*c*) **199.** (*d*) **200.** (*d*) **201.** (*c*) **202.** (*d*) **203.** (*b*)

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1. I. False, II. True **2.** I. False, II. False **3.** Both are false **4.** Both are True **5.** I. True, II. False

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Wave Motion

(Practice Questions)

Properties of Waves

1. When a wave propagating through a medium encounters a change in medium, then which of the following property remains same?

(*a*) Speed (*b*) Amplitude
(*c*) Frequency (*d*) Wavelength

2. The waves which cannot travel without medium are-

(*a*) X-rays (*b*) Radio waves
(*c*) Light waves (*d*) Sound waves

3. Which of the following phenomenon cannot take place with sound waves?

(*a*) Polarisation (*b*) Refraction
(*c*) Diffraction (*d*) Reflection

4. The speed of sound in air is independent from its-

(*a*) Amplitude (*b*) Frequency
(*c*) Phase (*d*) All of these

5. The frequency of a mechanical wave is 256 Hz. Calculate its wavelength when its speed is 512 m/s.

Type of Waves

6. Given below are two statements:

Statement-I: Mechanical transverse waves cannot be generated in gaseous medium.

Statement-II: Mechanical transverse waves can be produced only in such medium which have shearing property.

(*a*) Both statement-I and statement-II are correct.
(*b*) Statement-I is correct and statement-II is incorrect.
(*c*) Statement-I is is incorrect and statement-II is correct.
(*d*) Both statement-I and statement-II are incorrect.

7. An earthquake generates both transverse (*S*) and longitudinal (*P*) sound waves in the earth. The speed of *S* waves is about 4.5 km/s and that of *P* waves is about 8.0 km/s. A seismograph records *P* and *S* waves from an earthquake. The first *P* wave arrives 4.0 min before the first *S* wave. The epicentre of the earthquake is located at distance about-

(*a*) 25 km (*b*) 250 km
(*c*) 2500 km (*d*) 5000 km

8. It is possible to distinguish between the transverse and longitudinal waves by studying the property of-

(*a*) Interference (*b*) Diffraction
(*c*) Reflection (*d*) Polarisation

9. For a transverse wave travelling along a straight line, the distance between two peaks (crests) is 5m, while the distance between one crest and one trough is 1.5m. The possible wavelengths (in m) of the waves are:

(*a*) 1, 3, 5, (*b*) $\frac{1}{1}, \frac{1}{3}, \frac{1}{5}, \frac{1}{4}$
(*c*) $\frac{1}{2}, \frac{1}{4}, \frac{1}{6}, \frac{1}{4}$ (*d*) 1, 2, 3,

10. Which one of the following statements is true?

(*a*) Both light and sound waves in air are transverse.
(*b*) The sound waves in air are longitudinal while the light waves are transverse.
(*c*) Both light and sound waves in air are longitudinal.
(*d*) Both light and sound waves can travel in vacuum.

Wave Equation

11. The equation of travelling wave is given by (all quantities are in SI units) $y = 0.02 \sin 2\pi(10t - 5x)$

Column-I		Column-II	
(*i*)	Speed of wave	A.	20π
(*ii*)	Angular frequency of wave	B.	0.4π
(*iii*)	Wavelength of wave	C.	2
(*iv*)	Maximum particle speed	D.	0.2

(*a*) i→C, ii→A, iii→D, iv→C
(*b*) i→A, ii→B, iii→C, iv→D
(*c*) i→C, ii→B, iii→A, iv→D
(*d*) i→C, ii→A, iii→D, iv→B

12. In a resonance tube experiment, a close organ pipe of length 120 cm resonate when tuned with a tuning fork of frequency 340 Hz. If water is poured in the pipe then (given v_{air} = 340m/sec.):

A. Minimum length of water column to have the resonance is 45 cm.
B. The distance between two successive nodes is 50 cm.
C. The maximum length of water column to create the resonance is 95 cm.
D. None of these.

Choose the correct statements:

(*a*) 1, 2, 3 (*b*) 2, 3
(*c*) 1, 3 (*d*) None

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13. The equation for the displacement of a stretched string is given by $y = 4\sin 2\pi\left[\frac{t}{0.02} - \frac{x}{100}\right]$ where y and x are in cm and t in second.

Column-I		Column-II	
A.	Amplitude of wave in cm	P	50
B.	Frequency of wave in Hz	Q	4
C.	Velocity of wave in ms^{-1}	R	4π
D.	Maximum particle velocity in cm/s	S	5000
		T	400π

(*a*) A→Q; B→P; C→P; D→T
(*b*) A→R; B→S; C→P; D→T
(*c*) A→Q; B→P; C→S; D→T
(*d*) A→R; B→S; C→S; D→T

14. A transverse wave travels along x-axis. The particles of medium move:
(*a*) Along x-axis
(*b*) Along y-axis
(*c*) Either along y-axis or z-axis
(*d*) Either along y-axis or x-axis

15. Which of the following equations represents a transverse wave travelling along $-y$ axis?
(*a*) $x = A\sin(\omega t - ky)$ (*b*) $x = A\sin(\omega t + ky)$
(*c*) $y_0 = A\sin(\omega t - ky)$ (*d*) $y_0 = A\sin(\omega t + ky)$

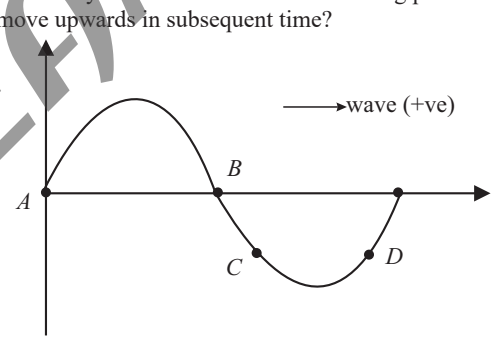
16. A plane progressive wave propagating along positive x-axis is-
(*a*) $y = A\sin(\omega t + kx)$ (*b*) $y = A\sin(\omega t - kx)$
(*c*) $y = A\sin\omega t\sin kx$ (*d*) $y = A[\sin\omega t]\ kx$

17. The equation of the progressive wave, where t is the time in second, x is the distance in metre is $y = A\cos 24\left(t - \frac{x}{12}\right)$, then speed of wave?

18. A wave travelling in the positive x-direction having displacement along y-direction as 1 m, wavelength $2\pi m$ and frequency of $\frac{1}{\pi}$ Hz is represented by-
(*a*) $y = \sin(2\pi x - 2\pi t)$ (*b*) $y = \sin(10\pi x - 20\pi t)$
(*c*) $y = \sin(2\pi x + 2\pi t)$ (*d*) $y = \sin(x - 2t)$

19. The equation of the progressive wave, where t is the time in second, x is the distance in metre is $y = A\cos 240(t - \frac{x}{12})$. The phase difference (in SI units) between two positions 0.5 m apart is-
(*a*) 40 (*b*) 20
(*c*) 10 (*d*) 5

20. A transverse pulse is shown in the figure, on which 4 points are shown at any instant. Which of the following points are in a state to move upwards in subsequent time?



(*a*) *A, B* (*b*) *A, D*
(*c*) *B, C* (*d*) *B, D*

21. The wave function of a pulse is given by $y = \frac{5}{(4x + 6t)^2}$, where x and y are in metre and t is in second. The velocity of pulse is in second. The velocity of pulse is-
(*a*) 2 m/s (*b*) 6 m/s
(*c*) 1.5 m/s (*d*) 3 m/s

22. A wave is represented by $x = 4\cos(8t - \frac{y}{2})$, where x and y are in metre and t in second. The frequency of the wave (in s^{-1})
(*a*) $\frac{4}{\pi}$ (*b*) $\frac{8}{\pi}$ (*c*) $\frac{2}{\pi}$ (*d*) $\frac{\pi}{4}$

23. A travelling wave in a string is represented by $y = 3\sin\left(\frac{\pi}{2}t - \frac{\pi}{4}x\right)$. The phase difference between two particles separated by a distance 4 cm is (Take x and y in cm and t in seconds)
(*a*) $\frac{\pi}{2}$ rad (*b*) $\frac{\pi}{4}$ rad
(*c*) π rad (*d*) 0

24. In sine wave, minimum distance between 2 particles which always have same speed is-
(*a*) $\frac{\lambda}{2}$ (*b*) $\frac{\lambda}{4}$ (*c*) $\frac{\lambda}{3}$ (*d*) λ

25. The equation of a simple harmonic progressive wave is given by $y = A\sin(100\pi t - 3x)$. Find the distance between 2 particles having a phase difference of $\frac{\pi}{3}$.
(*a*) $\frac{\pi}{9}$ (*b*) $\frac{\pi}{18}$
(*c*) $\frac{\pi}{6}$ (*d*) $\frac{\pi}{3}$

26. A wave is represented by $y = 3\sin 2\pi\left(\frac{t}{0.04} - \frac{X}{0.01}\right)$ cm. The frequency of the wave and the maximum acceleration under this frequency are-
(*a*) 25 Hz, 7.5×10^4 cm/s^2 (*b*) 100 Hz, 4.5×10^3 cm/s^2
(*c*) 50 Hz, 7.5×10^3 cm/s^2 (*d*) 25 Hz, 4.5×10^4 cm/s^2

27. A travelling wave is described by the equation $y = A\sin 2\pi(nt - x/\lambda_0)$. The maximum particle velocity is equal to 3 times the wave velocity if-
(*a*) $\lambda_0 = \frac{\pi A}{3}$ (*b*) $\lambda_0 = \frac{2\pi A}{3}$
(*c*) $\lambda_0 = \pi A$ (*d*) $\lambda_0 = 3\pi A$

28. A transverse wave is represented by $y = 2\sin(\omega t - kx)$ cm. The value of wavelength (in cm) for which the wave velocity becomes equal to the maximum particle velocity will be:
(*a*) 4π (*b*) 2π
(*c*) π (*d*) 2

29. If $\vec{u}$ is instantaneous velocity of particle and $\vec{v}$ is, velocity of wave, then
(*a*) $\vec{u}$ is perpendicular to $\vec{v}$
(*b*) $\vec{u}$ is parallel to $\vec{v}$
(*c*) $|\vec{u}|$ is equal to $|\vec{v}|$
(*d*) $|\vec{u}|$ = (slope of wave form) $|\vec{v}|$

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30. Which one of the following represents a wave?

(*a*) $y = A \sin(\omega t - kx)$

(*b*) $y = A \cos^2(at - bx + c) + A \sin^2(at - bx + c)$

(*c*) $y = A \sin kx$

(*d*) $y = A \sin \omega t$

31. Which of the following functions for y can never represent a travelling wave?

A. $(x^2 - vt)^2$ B. $\log\left[\frac{(x+vt)}{x_0}\right]$

C. $e^{\left\{-\frac{(x+vt)}{x_0}\right\}^2}$ D. $\frac{1}{x+vt}$

(*a*) Only 1 (*b*) 2 and 3

(*c*) 3 and 4 (*d*) Only 3

32. A sinusoidal wave of frequency 500 Hz has a speed of 350 m/s. The phase difference between two displacements at a certain point at times 1 ms apart is-

(*a*) $\frac{\pi}{4}$ (*b*) $\frac{\pi}{2}$ (*c*) π (*d*) $\frac{3\pi}{2}$

33. The equation of travelling wave is $y = a \sin 2\pi\left(pt - \frac{x}{5}\right)$. Then the ratio of maximum particle velocity to wave velocity is-

(*a*) $\frac{\pi a}{5}$ (*b*) $2\sqrt{5\pi a}$ (*c*) $\frac{2\pi a}{5}$ (*d*) $\frac{2\pi a}{\sqrt{5}}$

34. A travelling wave pulse is given by $y = \frac{4}{3x^2 + 48t^2 + 24xt + 2}$ where x and y are in metre and t is in second. The velocity of wave is-

(*a*) 4 m/s (*b*) 2 m/s

(*c*) 8 m/s (*d*) 12 m/s

35. The ratio of maximum particle velocity to wave velocity is [where symbols have their usual meanings]

(*a*) kA (*b*) $A\omega$ (*c*) $k\omega$ (*d*) ω/k

36. A transverse wave propagating along x-axis is represented by: $y(x, t) = 8 \sin(0.5\pi x - 4\pi t - \frac{\pi}{2})$ where x is in metres and t is in seconds. The speed of the wave is-

(*a*) 4π m/s (*b*) 0.5π m/s

(*c*) $\frac{\pi}{4}$ m/s (*d*) 8 m/s

37. A wave in a string has an amplitude of 2 cm. The wave travels in the positive direction of x-axis with a speed of 128 m/s and it is noted that 5 complete waves fit in 4 m length of the string. The equation describing the waves is-

(*a*) $y = (0.02)\, m \sin(15.7\, x + 2010t)$

(*b*) $y = (0.02)\, m \sin(15.7\, x - 2010t)$

(*c*) $y = (0.02)\, m \sin(7.85\, x + 1005t)$

(*d*) $y = (0.02)\, m \sin(7.85\, x - 1005t)$

38. A transverse wave is represented by $y = A \sin(\omega t - kx)$. For what value of the wavelength is the wave velocity equal to the maximum particle velocity?

(*a*) $\frac{\pi A}{2}$ (*b*) πA (*c*) $2\pi A$ (*d*) A

Transverse Wave in a String

39. A metallic wire of 1 m length has a mass of 10×10^{-3} kg. If a tension of 100 N is applied to a wire, what is the speed of transverse wave?

(*a*) 100 m/s (*b*) 10 m/s

(*c*) 200 m/s (*d*) 0.1 m/s

40. Calculate the velocity of the transverse wave in a string which is stretched by a load of 15 kg. The mass of the string is 3×10^{-2} kg and its length is 2 m.

41. A uniform rope of length L and mass m_1 hangs vertically from a rigid support. A block of mass m_2 is attached to the free end of the rope. A transverse pulse of wavelength λ_1 is produced at the lower end of the rope. The wavelength of the pulse when it reaches the top of the rope is λ_2. The ratios is λ_2/λ_1 is-

(*a*) $\sqrt{\frac{m_1 + m_2}{m_1}}$ (*b*) $\sqrt{\frac{m_1}{m_2}}$

(*c*) $\sqrt{\frac{m_1 + m_2}{m_2}}$ (*d*) $\sqrt{\frac{m_2}{m_1}}$

42. The extension in a string, obeying Hooke's law is x. The speed of transverse wave in the stretched string is V. If the extension in the string is increased to $1.5x$ the speed of the Transverse wave.

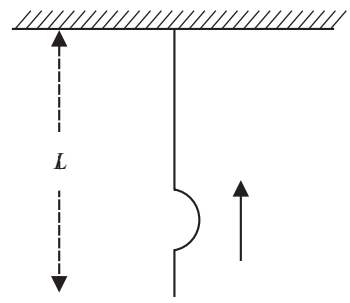
(*a*) 1.22 V (*b*) 0.61 V

(*c*) 1.50 V (*d*) 0.75 V

43. A steel wire 100 cm long has a mass of 10gm. If the wire is under a tension of 400 N, what is the speed of transverse waves in the wire?

Hint : $v = \sqrt{\frac{T}{\mu}}$ where $\mu = \frac{M}{L}$

44. A pulse is generated at lower end of a hanging rope of uniform density and length L. The speed of the pulse when it reaches the mid point of rope is-



(*a*) $\sqrt{2gL}$ (*b*) $\sqrt{gL}$

(*c*) $\sqrt{\frac{gL}{2}}$ (*d*) $\frac{\sqrt{gL}}{2}$

45. A transverse pulse generated at the bottom of a uniform rope of length L, travels in upward direction. The time taken by it to travel the full length of rope will be-

(*a*) $\sqrt{\frac{L}{2g}}$ (*b*) $\sqrt{\frac{2L}{g}}$

(*c*) $\sqrt{\frac{L}{g}}$ (*d*) $\sqrt{\frac{4L}{g}}$

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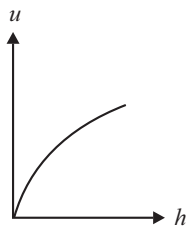
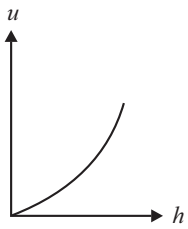
46. A rope of length L and mass M hangs freely from the ceiling. If the time taken by a transverse wave to travel from the bottom to the top of the rope is T, then time to cover first half length is-

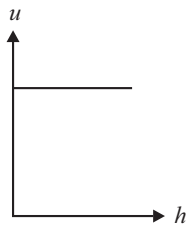
(*a*) T (*b*) $T\left(\frac{\sqrt{2}-1}{\sqrt{2}}\right)$

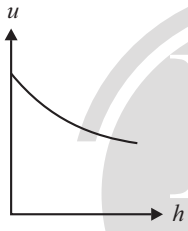
(*c*) $\frac{T}{\sqrt{2}}$ (*d*) $\frac{T}{2}$

47. A uniform rope having some mass hangs vertically from a rigid support. A transverse wave pulse is produced at the lower end. The speed (u) of the wave pulse varies with height (h) from the lower end as-

(*a*)


(*b*)


(*c*)


(*d*)


48. Two strings of same material are stretched to the same tension. If their radii are in the ratio 1:2, then respective wave velocities in them will be in ratio-

(*a*) 4:1 (*b*) 2:1 (*c*) 1:2 (*d*) 1:4

49. A copper wire is held at the two ends by rigid supports. At 50°C the wire is just taut, with negligible tension. If $Y = 1.2 \times 10^{11}\ N/m^2$, $\alpha = 1.6 \times 10^{-5}$ / °C and $\rho = 9.2 \times 10^3$ kg/m^3, then the speed of transverse waves in this wire at 30°C is-

(*a*) 64.6 m/s (*b*) 16.2 m/s

(*c*) 23.2 m/s (*d*) 32.2 m/s

50. The percentage increase in the speed of transverse waves produced in a stretched string if the tension is increased by 4%, will be _____%.

Sound Wave

51. At constant temperature if pressure becomes double then speed of sound will be?

52. If pressure becomes double at constant density, then speed of sound will be ?

53. Calculate the speed of the longitudinal wave in steel. Young's modulus for steel is $3 \times 10^{10}\ N/m^2$ and its density is 1.2×10^3 kg/m^3.

54. If the speed of longitudinal mechanical waves in water is 1400 m/s then calculate the Bulk modulus of elasticity of water. (given density of water is 1 g/cm^3).

55. The wavelength of sound waves in hydrogen gas corresponding to the lower limit of audibility is (speed of sound in hydrogen gas is about 1350 m/s)

(*a*) 60 m (*b*) 67.5 m (*c*) 100 m (*d*) 500 m

56. The speed of longitudinal mechanical wave in a material is 4200 m/s. Young's modulus of the material is $15 \times 10^9\ N/m^2$. What is the density of the material?

57. Speed of sound wave in a gas is v_1 and rms speed of molecules of the gas at the same temperature is v_2. Then

(*a*) $v_1 = v_2$ (*b*) $v_1 < v_2$

(*c*) $v_1 > v_2$ (*d*) $v_1 \le v_2$

58. If at STP, velocity of sound in a gas (γ= 1.5) is 600 m/s, the r.m.s. Velocity of the gas molecules at STP will be-

(*a*) 400 m/s (*b*) 600 m/s

(*c*) 600 $\sqrt{2}$ m/s (*d*) 300 $\sqrt{2}$ m/s

59. The speed of sound in air at NTP is 332 m/s. Calculate the percentage error in speed of sound as calculated from Newton's formula. Given that the density of air is 1.293 kg/m^3.

60. The speed of sound in hydrogen at NTP, is 1270 m/s. Then the speed in a mixture of hydrogen and oxygen in the ratio 4:1 by volume, (in m/s) will be-

(*a*) 635 (*b*) 318

(*c*) 158 (*d*) 1270

61. The ratio of speed of sound in hydrogen gas to the speed of sound in oxygen gas at the same temperature is-

(*a*) 4 : 1 (*b*) 1 : 2

(*c*) 1 : 4 (*d*) 1 : 1

62. Oxygen is 16 times heavier than hydrogen. Equal volume of hydrogen and oxygen are mixed. The ratio of speed of sound in the mixture to that in hydrogen is-

(*a*) $\sqrt{8}$ (*b*) $\sqrt{\frac{2}{17}}$

(*c*) $\sqrt{\frac{1}{8}}$ (*d*) $\sqrt{\frac{32}{17}}$

63. The speed of sound waves in air at 300 K is 332 m/s. At what temperature will the speed be 574 m/s?

64. Regarding speed of sound in gas match the following-

Column-I		Column-II	
(*i*)	Temperature of gas is made 4 times and pressure 2 times	A.	Speed becomes $2\sqrt{2}$ times
(*ii*)	Only pressure is made 4 times without change in temperature	B.	Speed becomes two times
(*iii*)	Only temperature changed to 4 times	C.	Speed remain unchanged
(*iv*)	Molecular mass of the gas is made 4 times	D.	Speed become half

(*a*) i→A, ii→C, iii→D, iv→B

(*b*) i→B, ii→C, iii→D, iv→A

(*c*) i→B, ii→C, iii→B, iv→D

(*d*) i→C, ii→B, iii→A, iv→C

65. The velocity of sound in air at 20°C is 340 m s^{-1}. Keeping the temperature constant, what will be the velocity of sound in air when the pressure of the gas is doubled?

66. Calculate the speed of sound in hydrogen at N.T.P., if density of hydrogen at N.T.P. is 1/16th of air. Given that the speed of sound in air is 332 m/s.

67. If speed of sound wave is V_0 at 0°C then find change in speed by increasing temperature by t °C.

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68. IF temperature increases by 3°C then speed of sound increased by?

69. Temperature at which the speed of sound in air becomes doubled its value at 0°C is-

(*a*) 1092°C (*b*) 819°C
(*c*) 819K (*d*) 546°C

70. What is the phase difference between the displacement wave and pressure wave in sound wave?

(*a*) Zero (*b*) $\pi/2$ (*c*) π (*d*) $\pi/4$

71. Stationary point source emits sound uniformly in all directions in non-absorbing medium two points *P* and *Q* are at a distance of 4 m and 9 m respectively from the source. The ratio of amplitudes of the waves at *P* and *Q* is-

(*a*) 3/2 (*b*) 4/9 (*c*) 2/3 (*d*) 9/4

72. A big explosion on the moon cannot be heard on the earth because-

(*a*) The explosion produces high frequency sound waves which are inaudible.
(*b*) Sound waves require a material medium for propagation.
(*c*) Sound waves are absorbed in the moon's atmosphere.
(*d*) Sound waves are absorbed in the earth's atmosphere.

73. The speed of sound in a medium depends on-

(*a*) The elastic property but not on the inertia property.
(*b*) The inertia property but not on the elastic property.
(*c*) The elastic property as well as the inertia property
(*d*) Neither the elastic property nor the inertia property.

74. The velocity of sound in air is affected by change in the-

A. Atmospheric pressure
B. Moisture content of air
C. Temperature of air
D. Composition of air

(*a*) (*i*), (*ii*), (*iii*) (*b*) (*i*), (*ii*), (*iv*)
(*c*) (*ii*), (*iii*), (*iv*) (*d*) (*ii*), (*iii*)

75. Velocity of sound in air-

A. Increases with temperature
B. Decreases with temperature
C. Increase with pressure
D. Is independent of pressure

Choose the correct answer.

(*a*) 1 and 2 (*b*) 1 and 3
(*c*) 2 and 3 (*d*) 1 and 4

76. Given below are two statements: One is labelled as Assertion (A) and the other is labelled as Reason (R).

Assertion (A): Sound travels faster on a rainy day than on a dry day.

Reason (R): Moisture increases the pressure.

In the light of the above statements, choose the most appropriate answer from the options given below:

(*a*) Both (A) and (R) are true and (R) is the correct explanation of (A).
(*b*) Both (A) and (R) are true and (R) is Not the correct explanation of (A).
(*c*) (A) is true but (R) is false.
(*d*) (A) is false but (R) is true.

Intensity of Wave

77. If amplitude becomes half and frequency becomes one-fourth then intensity of wave becomes-

78. A sound wave $y = A \sin(\omega t - kx)$ is propagating through a medium of density ρ. What is the sound energy per unit volume?

(*a*) $\frac{1}{2}\rho A^2\omega^2$ (*b*) $\rho A^2\omega^2$
(*c*) $2\rho A^2\omega^2$ (*d*) $4\rho A^2\omega^2$

79. As a wave propagates-

A. The wave intensity remains constant for a plane wave.
B. The wave intensity decreases as the inverse of the distance from the source for a spherical wave.
C. The wave intensity decreases as the inverse square of the distance from the source for a spherical wave.
D. Total intensity of the spherical wave over the spherical surface centered at the source remains constant at all times.

(*a*) 1, 2 (*b*) 1, 3
(*c*) 1, 2, 4 (*d*) 1, 3, 4

80. A line source emits a cylindrical expanding wave. If the medium absorbs no energy then the amplitude will vary with distance *r* from the source as proportional to-

(*a*) r^{-1} (*b*) r^{-2} (*c*) $r^{-1/2}$ (*d*) $r^{1/2}$

81. If the pressure amplitude in a sound wave is tripled, then by what factor the intensity of sound wave is increased?

(*a*) 3 (*b*) 6 (*c*) 9 (*d*) $\sqrt{3}$

82. If the intensity of sound is doubled, the intensity level will increase by nearly-

(*a*) 1 dB (*b*) 2dB (*c*) 3 dB (*d*) 4 dB

Loudness of Sound Wave

83. What is the intensity of sound of 70 decibel? (Given the reference intensity $I_0 = 10^{-12}$ watt/m^2).

84. If the intensity of sound is increased by a factor of 30, by how many decibels is the sound level increased?

(*a*) 12 dB (*b*) 14.77 dB
(*c*) 10 dB (*d*) 13 dB

85. The sound intensity level at a point 4 m from the point source is 10 dB, then the sound level at a distance 2 m from the same source will be-

(*a*) 26 dB (*b*) 16 dB
(*c*) 23 dB (*d*) 3 dB

86. A sound absorber attenuates the sound level by 20 dB. TV intensity decreases by a factor of-

(*a*) 100 (*b*) 1000
(*c*) 10000 (*d*) 10

87. A person speaking normally produces a sound intensity of 40 dB at a distance of 1 *m*. If the threshold intensity for reasonable audibility is 20 dB, the maximum distance at which he can be hear clearly is-

(*a*) 4 m (*b*) 5 m (*c*) 10 m (*d*) 20 m

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Superposition of Waves

88. If $y = 6 \sin (kx - \omega t)$, $y_2 = 4 \sin (kx - \omega t)$ then find net intensity and amplitude.

89. If $y_1 = 4 \sin (\omega t - kx)$, $y_2 = 4 \sin (kx - \omega t - \frac{\pi}{3})$ resultant amplitude.

90. Two waves represented by $y = a \sin (\omega t - kx)$ and $y = a \sin (\omega t - kx + \frac{2\pi}{3})$ are superposed. What will be the amplitude of the resultant wave?

91. Two waves represented by $y_1 = 3 \sin (200x - 150t)$ and $y_2 = 3 \cos (200x - 150t)$ are superposed where x and y are in metre and t is in second. Calculate the amplitude of resultant wave.

92. On the superposition of the two waves given as $y_1 = A_0 \sin (\omega t - kx)$ and $y_2 = A_0 \cos (\omega t + kx + \frac{\pi}{6})$, the resultant amplitude of oscillations will be-

(*a*) $\sqrt{3}\, A_0$ (*b*) $A_0/2$

(*c*) A_0 (*d*) $\frac{3}{2} A_0$

93. Two waves of amplitudes A_0 and xA_0 pass through a region. If $x > 1$, the difference in the maximum and minimum resultant amplitude possible is-

(*a*) $(x + 1) > A_0$ (*b*) $(x - 1) A_0$

(*c*) $2x A_0$ (*d*) $2A_0$

94. Two periodic waves of intensities I_1 and I_2 pass through a region at the same time in the same direction. The sum of the maximum and minimum intensities is-

(*a*) $2(I_1 + I_2)$ (*b*) $I_1 + I_2$

(*c*) $\left(\sqrt{I_1} + \sqrt{I_2}\right)^2$ (*d*) $\left(\sqrt{I_1} - \sqrt{I_2}\right)^2$

95. Two waves have equations $x_1 = a \sin (\omega t + \phi_1)$ $x_2 = a \sin (\omega t + \phi_2)$. If in the resultant wave the frequency and amplitude remain equal to amplitude of superimposing waves, the phase difference between them is-

(*a*) $\frac{\pi}{6}$ (*b*) $\frac{2\pi}{3}$ (*c*) $\frac{\pi}{4}$ (*d*) $\frac{\pi}{3}$

96. Two sound waves, each of amplitude A and frequency ω superpose at a point with phase difference of $\frac{\pi}{2}$. The amplitude and frequency of the resultant wave are respectively.

(*a*) $\frac{A}{\sqrt{2}}, \frac{\omega}{2}$ (*b*) $\frac{A}{\sqrt{2}}, \omega$ (*c*) $\sqrt{2}A, \frac{\omega}{2}$ (*d*) $\sqrt{2}A, \omega$

97. The ratio of intensities between two coherent sound source is 4 : 1. The difference of loudness in decibels (dB) between maximum and minimum intensities, when they interfere in space is-

(*a*) 10 log 2 (*b*) 20 log 3

(*c*) 10 log 3 (*d*) 20 log 2

98. If $\frac{I_1}{I_2} = \frac{9}{4}$ then find $\frac{I_{max}}{I_{min}} = ?$

99. $\frac{I_{max}}{I_{min}} = \frac{25}{16}$ then find $\frac{I_1}{I_2} = ?$

100. The equations of two waves are given by-

$y_1 = 5 \sin 2\pi(x - vt)$ cm

$y_2 = 3 \sin 2\pi(x - vt + 1.5)$ cm

These waves are simultaneously passing through a string. The amplitude of the resulting wave is-

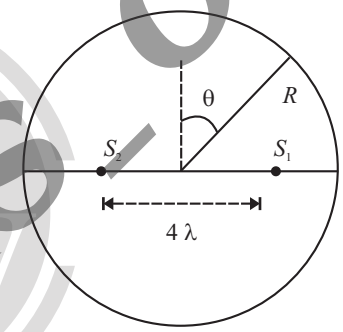
(*a*) 2 cm (*b*) 4 cm (*c*) 5.8 cm (*d*) 8 cm

101. In a hall, a person receives direct sound waves from a source 120m away. He also receives waves from the same source which reach him after being reflected from the 25m high ceiling at a point halfway between them. The two waves interfere constructively for wavelengths (in metres).

(*a*) 10, $\frac{10}{2} m \frac{10}{3}$ (*b*) 20, $\frac{20}{3} m \frac{20}{5}$

(*c*) 30, 20, 10 (*d*) 35, 25, 15

102. Two sources of sound are placed along the diameter of a circle of radius $R(R >> 4\lambda)$. How many minima will be heard as one moves along the perimeter of circle.



(*a*) 12 (*b*) 16 (*c*) 4 (*d*) 20

Reflection, Refraction of Wave

103. When sound wave is refracted from air to water, which of the following will remain unchanged?

(*a*) Wave number (*b*) Wavelength

(*c*) Wave velocity (*d*) Frequency

104. The sound waves of frequency 660 Hz fall normally on a perfectly reflecting wall. The shortest distance from the wall at which the air particles have maximum amplitude of vibration is (v = 330 m/s).

(*a*) 0.5 m (*b*) 0.25 m (*c*) 0.125 m (*d*) 1 m

Stationary Wave

105. A stationary wave is represented by $y = A \sin(100t) \cos(0.01x)$, where y and A are in millimetres, t is in second and x is in metre. The velocity of the constituent wave is-

(*a*) 10^4 m/s (*b*) Not derivable

(*c*) 1 m/s (*d*) 10^2 m/s

106. The equation given below represents a stationary wave set-up in a medium $y = 12 \sin(4\pi X) \sin(40\, \pi t)$, where y and x are in cm and t is in second. Calculate the amplitude, wavelength and velocity of the component waves.

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107. A wave $y = a \sin(\omega t - kx)$ on a string meets with another wave producing a node at $x = 0$. Then the equation of the unknown wave is-

(*a*) $y = a \sin(\omega t - kx)$ (*b*) $y = -a \sin(\omega t - kx)$
(*c*) $y = a \cos(\omega t - kx)$ (*d*) $y = -a \cos(\omega t - kx)$

108. In a stationary wave, what is the amplitude of oscillation for a particle located between a node and an antinode? Additionally, what is the frequency of oscillation for that particle?

109. The constituent waves of a stationary wave have amplitude, frequency and velocity as 8 cm, 25 Hz and 150 cm s^{-1} respectively. What is the amplitude of the stationary wave at $x = 2$ cm.

110. In a standing wave, all particles of the medium cross the mean position with-

(*a*) Different speeds at different instants
(*b*) Different speeds at same instant
(*c*) Same speed at different instants
(*d*) Same speed at same instant

111. In a stationary wave pattern, all the particles-

A. Of the medium vibrate in the same phase.
B. In the region between two antinodes vibrate in the same phase.
C. In the region between two succesive nodes vibrate in the same phase.
D. On either side of a node vibrate in opposite phase.

Choose the correct statement:

(*a*) 1, 3, 4 (*b*) 1, 2, 3, 4 (*c*) 3, 4 (*d*) 1, 2, 3

Stationary Wave in a String

112. A string 50 cm long is under a tension of 20 *N* force. Calculate the frequency of fundamental mode given that mass of the string is 1*g*.

113. The tension in a wire is decreased by 19%. The percentage decrease in frequency will be-

(*a*) 0.19% (*b*) 10% (*c*) 19% (*d*) 0.9%

114. The string of a violin has a frequency of 440 cps. If the violin string is shortened by one fifth, its frequency will be changed to-

(*a*) 440 cps (*b*) 880 cps
(*c*) 550 cps (*d*) 2200 cps

115. The string of a violin has a frequency of 440 cps. If the violin string is shortened to one fifth, its frequency will be changed to-

(*a*) 440 cps (*b*) 880 cps
(*c*) 550 cps (*d*) 2200 cps

116. A 12 *m* long vibrating string has the speed of wave 48 m/s. To what frequency it will resonate?

(*a*) 2 cps (*b*) 4 cps
(*c*) 6 cps (*d*) All of these

117. A certain string will resonate to several frequencies, the lowest of which is 200 cps. What are the next three higher frequencies to which it resonates?

(*a*) 400, 600, 800 (*b*) 300, 400, 500
(*c*) 100, 150, 200 (*d*) 200, 250, 300

118. A wire of length one metre under a certain initial tension emits a sound of fundamental frequency 256 Hz. When the tension is increased by 1 kg wt, the frequency of the fundamental mode increases to 320 Hz. The initial tension is-

(*a*) 3/4 kg wt (*b*) 4/3 kg wt
(*c*) 16/9 kg wt (*d*) 20/9 kg wt

119. A string is stretched between fixed points separated by 75.0 cm. It is observed to have resonant frequencies of 420 Hz and 315 Hz. There are no other resonant frequencies between these two. The lowest resonant frequency for this string is-

(*a*) 10.5 Hz (*b*) 105 Hz (*c*) 155 Hz (*d*) 205 Hz

120. A standing wave having 3 nodes and 2 antinodes is formed between two atoms having a distance 1.21 Å between them. The wavelength of the standing wave is-

(*a*) 6.05 Å (*b*) 242 Å (*c*) 1.21 Å (*d*) 3.63 Å

121. A wave disturbance in a medium is described by
$y(x, t) = 0.02 \cos(50\pi t + \pi/2) \cos(10\pi x)$,
Where x and y are in metres and t in seconds.

A. A node occurs at $x = 0.15$ m
B. An antinode occurs at $x = 0.3$ m
C. The speed of the wave is 5.0 m/s
D. The wavelength is 0.2 m

(*a*) A, C, D (*b*) B, C, D
(*c*) A, B, C, D (*d*) C, D

122. Standing waves are produced in 10m long stretched string. If the string vibrates in 5 segments and wave velocity is 20 m/s, the frequency is-

(*a*) 5 Hz (*b*) 10 Hz (*c*) 2 Hz (*d*) 4 Hz

123. A string is cut into three parts, having fundamental frequencies n_1, n_2, n_3 respectively. Then original fundamental frequency n related by the expression as-

(*a*) $\frac{1}{n} = \frac{1}{n_1} + \frac{1}{n_2} + \frac{1}{n_3}$ (*b*) $n = n_1 \times n_2 \times n_3$
(*c*) $n = n_1 + n_2 + n_3$ (*d*) $n = \frac{n_1 + n_2 + n_3}{3}$

124. A stretched string resonants with tuning fork frequency 512 Hz when length of the string is 0.5 m. The length of the string required to vibrate resonantly with a tuning fork of frequency 256 Hz would be-

(*a*) 0.25 m (*b*) 0.5 m (*c*) 1 m (*d*) 2 m

125. A uniform string resonates with a tuning fork, at a maximum tension of 32 *N*. If it is divided into two segments by placing a wedge at a distance one-fourth of length from one end, then to resonance with same frequency the maximum value of tension for string will be

(*a*) 2 *N* (*b*) 4 *N* (*c*) 8 *N* (*d*) 16 *N*

126. The tension in a stretched string fixed at both ends is changed by 2%, the fundamental frequency is found to get changed by 15 Hz.

A. Wavelength of the string of fundamental frequency does not change
B. Velocity of propagation of wave changes by 2%
C. Velocity of propagation of wave changes by 1%
D. Original frequency is 1500 Hz

Choose the correct statements(s)–

(*a*) 1, 2, 3, 4 (*b*) 1, 2, 4
(*c*) 1, 3, 4 (*d*) 1, 2, 3

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127. A string 2.0 m long and fixed at its end is driven by a 240 Hz vibrator. The string vibrates in its third harmonic mode. The speed of the wave and its fundamental frequency is-

(*a*) 320 m/s, 120 Hz (*b*) 180 m/s, 80 Hz
(*c*) 180 m/s, 120 Hz (*d*) 320 m/s, 80 Hz

128. A string is clamped at both the ends and it is vibrating in its 4th harmonic. The equation of the stationary wave is $Y = 0.3 \sin(0.157x)\cos(200\pi t)$. The length of the string is: (All quantities are in *SI* units.)

(*a*) 20 m (*b*) 80 m (*c*) 60 m (*d*) 40 m

129. A wire of length L and mass per unit length 6.0×10^{-3} kg m^{-1} is put under tension of 540 N. Two consecutive frequencies that it resonates at are 420 Hz and 490 Hz. Then L in meters is-

(*a*) 1.1 m (*b*) 5.1 m (*c*) 2.1 m (*d*) 8.1 m

Sonometer Wire

130. A sonometer wire is under a tension of 10 N and the length between the bridges is 2m. A metre long wire of sonometer has mass of 1.0 gm. Deduce the speed of transverse wave and the frequency of 1st harmonic.

131. The length of a sonometer wire is 0.75 m and density 9×10^3 kg/m^3. It can bear a stress of 8.1×10^8 N/m^2 without exceeding the elastic limit. The fundamental frequency that can be produced in the wire, is-

(*a*) 200 Hz (*b*) 150 Hz (*c*) 600 Hz (*d*) 450 Hz

132. If the tension and diameter of a sonometer wire of fundamental frequency n is doubled and density is halved then its fundamental frequency will become-

(*a*) $\frac{n}{2}$ (*b*) $\sqrt{2}\,n$ (*c*) n (*d*) $\frac{n}{\sqrt{2}}$

133. The length of a sonometer wire AB is 110 cm. Where should the two bridges be placed from A to divide the wire in 3 segments whose fundamental frequencies are in the ratio of 1 : 2 : 3 ?

(*a*) 60 cm and 90 cm (*b*) 30 cm and 60 cm
(*c*) 30 cm and 90 cm (*d*) 40 cm and 80 cm

134. The length of the wire between two ends of a sonometer is 100 cm. What should be the positions of two bridges below the wire so that the three segments of the wire have their fundamental frequencies in the ratio 1 : 3 : 5.

(*a*) $\frac{1500}{23}$ cm, $\frac{500}{23}$ cm (*b*) $\frac{1500}{23}$ cm, $\frac{300}{23}$ cm
(*c*) $\frac{300}{23}$ cm, $\frac{1500}{23}$ cm (*d*) $\frac{1500}{23}$ cm, $\frac{200}{23}$ cm

Open and Close Organ Pipe

135. If 7th overtone is 120 Hz then find fundamental frequency of open organ pipe.

136. A cylindrical tube, open at both ends, has a fundamental frequency f in air. The tube is dipped vertically in water so that half of it is in water. The fundamental frequency of the air column is now.

(*a*) $\frac{f}{2}$ (*b*) $\frac{3f}{4}$ (*c*) f (*d*) $2f$

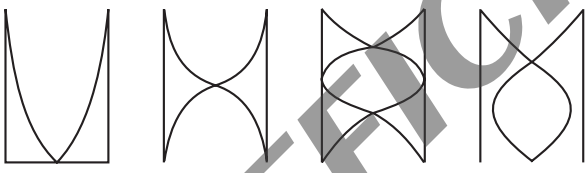
137. In case of closed pipe which harmonic the pth overtone will be-

(*a*) $2p + 1$ (*b*) $2p - 1$ (*c*) $p + 1$ (*d*) $p - 1$

138. A closed pipe of length 10 cm has its fundamental frequency half that of the second overtone of an open pipe. The length of the open pipe.

(*a*) 10 cm (*b*) 20 cm (*c*) 30 cm (*d*) 40 cm

139. The vibrations of four air columns under identical conditions are represented in the figure below. The ratio of frequencies $n_p : n_q : n_r : n_s$ will be-



p *q* *r* *s*

(*a*) 12 : 6 : 3 : 4 (*b*) 1 : 2 : 4 : 3
(*c*) 4 : 2 : 3 : 1 (*d*) 6 : 2 : 3 : 4

140. A closed organ pipe (closed at one end) is excited to support the third overtone. It is found that air in the pipe has-

(*a*) Three nodes and three antinodes
(*b*) Three nodes and four antinodes
(*c*) Four nodes and three antinodes
(*d*) Four nodes and four antinodes.

141. For a particular resonance tube, following are four of the six harmonics below 1000 Hz;

300, 600, 750 and 900 Hz

The two missing harmonics are-

(*a*) 75, 150 (*b*) 150, 450 (*c*) 400, 800 (*d*) 250, 400

142. The fundamental frequency of a closed organ pipe of length 20 cm is equal to the second overtone of an organ pipe open at both the ends. The length of organ pipe open at both the ends is-

(*a*) 140 cm (*b*) 80 cm (*c*) 100 cm (*d*) 120 cm

143. For a certain organ pipe, three successive resonance frequencies are observed at 425, 595, and 765 Hz respectively. Taking the speed of sound in air to be 340 m/s the fundamental frequency of the pipe (in Hz) is-

(*a*) 425 (*b*) 170 (*c*) 85 (*d*) 245

144. In a closed organ pipe of length 105 cm, standing waves are set up corresponding to third overtone. What distance from the closed end, a pressure node is formed?

(*a*) 5 cm (*b*) 15 cm (*c*) 25 cm (*d*) 30 cm

145. A second harmonic has to be generated in a string of length ℓ stretched between two rigid supports. The points where the string has to be plucked and touched are respectively.

(*a*) $\frac{\ell}{4}, \frac{\ell}{2}$ (*b*) $\frac{\ell}{4}, \frac{3\ell}{4}$ (*c*) $\frac{\ell}{2}, \frac{\ell}{2}$ (*d*) $\frac{\ell}{2}, \frac{3\ell}{4}$

146. The two nearest harmonics of a tube closed at one end and open at other end are 220 Hz and 260 Hz. What is the fundamental frequency of the system?

(*a*) 10 Hz (*b*) 20 Hz (*c*) 30 Hz (*d*) 40 Hz

147. The number of possible natural oscillations of air column in a pipe closed at one end of length 85 cm whose frequencies lie below 1250 Hz are (velocity of sound = 340 ms^{-1})

(*a*) 4 (*b*) 5 (*c*) 7 (*d*) 6

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148. The second overtone of an open organ pipe has the same frequency as the first overtone of a closed pipe L metre long. The length of the open pipe wil be-

(*a*) L (*b*) $2L$ (*c*) $L/2$ (*d*) $4L$

149. An air column, closed at one end and open at the other, resonates with a tuning fork when the smallest length of the column is 50cm. The next larger length of the column resonating with the same tuning fork is-

(*a*) 200 cm (*b*) 66.7 cm (*c*) 100 cm (*d*) 150 cm

150. If we study the vibration of a pipe open at both ends, then the following statement is not true:

(*a*) Odd harmonics of the fundamental frequency will be generated.

(*b*) All harmonics of the fundamental frequency will be generated.

(*c*) Pressure change will be maximum at both ends.

(*d*) Open end will be antinode.

151. The fundamental frequency of a vibrating organ pipe is 200 Hz.

A. The first overtone is 400 Hz.

B. The first overtone may be 400 Hz.

C. The first overtone may be 600 Hz.

D. 600 Hz is an overtone.

(*a*) 1, 4 (*b*) 1, 2, 3 (*c*) 3, 4 (*d*) 2, 3, 4

152. The fundamental frequency of a closed organ pipe is equal to the first overtone frequency of an open organ pipe. If length of the open pipe is 60 cm, the length of the closed pipe will be-

(*a*) 60 cm (*b*) 45 cm (*c*) 30 cm (*d*) 15 cm

153. A closed and an open organ pipe have same lengths. If the ratio of frequencies of their seventh overtones is $\left(\frac{a-1}{a}\right)$ then the value of a is _____.

154. A tuning fork of frequency 480 Hz is used in an experiment for measuring speed of sound (V) in air by resonance tube method. Resonance is observed to occur at two successive lengths of the air column, $\ell 1 = 30$ cm and $\ell 2 = 70$ cm. Then V is equal to-

(*a*) 332 ms^{-1} (*b*) 338 ms^{-1} (*c*) 384 ms^{-1} (*d*) 397 ms^{-1}

155. A closed organ pipe has a fundamental frequency of 1.5 kHz. The number of overtones that can be distinctly heard by a person with this organ pipe will be: (Assume that the highest frequency a person can hear is 20,000 Hz)

(*a*) 6 (*b*) 4 (*c*) 7 (*d*) 5

Beats

156. A tuning fork and an air column whose temperature is 51°C produce 4 beats in one second, when sounded together. When the temperature of air column decreases the number of beats per second decreases. When the temperature remains 16°C only one beat per second is produced. The frequency of the tuning fork is-

(*a*) 100 Hz (*b*) 75 Hz (*c*) 150 Hz (*d*) 50 Hz

157. A tuning fork resonates with a sonometer wire of length 1 m stretched with a tension of 6 N. When the tension in the wire is changed to 54 N, the same tuning fork produces 12 beats per second with it. The frequency of the tuning fork is_____ Hz.

158. Two vibrating tuning forks produce progressive waves given by $y_1 = 4 \sin 500\pi t$ and $y_2 = 2\sin 506\pi t$. Number of beats produced per minute is-

(*a*) 360 (*b*) 180 (*c*) 3 (*d*) 60

159. Two source of sound placed close to each other, are emitting progressive waves given by $y_1 = 4 \sin 600\pi t$ and $y_2 = 5 \sin (608\pi t)$. An observer located near these two source of sound will hear-

(*a*) 8 beats per second with intensity ratio 81 : 1 between waxing and waning.

(*b*) 4 beats per second with intensity ratio 81 : 1 between waxing and waning.

(*c*) 4 beats per second with intensity ratio 25 : 16 between waxing and waning.

(*d*) 8 beats per second with intensity ratio 25 : 16 between waxing and waning.

160. A source of unknown frequency gives 4 beats/s, when sounded with a source of known frequency 250 Hz. The second harmonic of the source of unknown frequency gives five beats per second, when sounded with a source of frequency 513 Hz. The unknown frequency is-

(*a*) 246 Hz (*b*) 240 Hz (*c*) 260 Hz (*d*) 254 Hz

161. The string of a violin emits a note of 205 Hz at its correct tension. the string is tightened slightly and then it produces six beats in two second with a tuning fork of frequency 205 Hz. The frequency of the note emitted by the taut string is-

(*a*) 211 Hz (*b*) 199 Hz (*c*) 208 Hz (*d*) 202 Hz

162. A source of frequency v gives 5 beats/second when sounded with a source of frequency 200 Hz. The second harmonic of frequency $2v$ of source gives 10 beats/second when sounded with a source of frequency 420 Hz. The value of v is-

(*a*) 205 Hz (*b*) 195 Hz (*c*) 200 Hz (*d*) 210 Hz

163. When two tuning forks (fork 1 and fork 2) are sounded together, 4 beats per second are heard. Now some tape is attached on the prong of the fork 2. When the tuning forks are sounded again, 6 beats per second are heard. If the frequency of fork 1 is 200 Hz, then what was the original frequency of fork 2?

(*a*) 204 Hz (*b*) 196 Hz (*c*) 202 Hz (*d*) 200 Hz

164. A tuning fork of unknown frequency produces 4 beats per second when sounded with another tuning fork of frequency 254 Hz. It gives the same number of beats per second when unknown tuning fork loaded with wax. The unknown frequency before loading with wax is-

(*a*) 258 (*b*) 254

(*c*) 250 (*d*) Can't be determined

165. Ten tuning forks are arranged in increased order of frequency in such a way that any two consecutive tuning forks produce 4 beats per second. The highest frequency is twice that of the lowest. Possible highest and lowest frequencies (in Hz) are-

(*a*) 80 and 40 (*b*) 100 and 50

(*c*) 44 and 22 (*d*) 72 and 36

166. Two tuning fork A and B are sounded together gives 5 beats per second. If frequency of B is 260 Hz and after loading B with wax the beat frequency increase the frequency of A is-

(*a*) 265 Hz (*b*) 255 Hz (*c*) 260 Hz (*d*) 250 Hz

167. A tuning fork A of unknown frequency produces 5 beats/s with a fork of known frequency 340 Hz. When fork A is filed, the beat frequency decreases to 2 beats/s. What is the frequency of fork A?

(*a*) 345 Hz (*b*) 338 Hz (*c*) 342 Hz (*d*) 335 Hz

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1. **Statement I:** A sine wave is Travelling in a medium The minimum distance Between The Two particles, always having same speed is equal to the wavelength of the wave.

   Statement II: A sine wave is Travelling in medium. A particular Particle has zero. Displacement at a certain instant The particle closest to it having zero displacement is at distance half of the wavelength of wave.

2. **Statement I:** The equation $y = A \sin^2 (kx - \omega t)$ represents a motion with Amplitude $\frac{A}{2}$ and Frequency $\frac{\omega}{\pi}$.

   Statement II: X-Ray's are mechanical wave.

3. **Statement I:** A cork floating in a calm pond executes SHM with frequency v when a wave generated by a boat passes by it, The frequency of wave generated will be $\frac{v}{2}$.

   Statement II: Two strings A and B, made of same material are stretched by same Tension, the radius of string A is double of the radius of B. A transverse wave travels on A with speed V_A and on B with speed V_B. The ratio $\frac{V_B}{V_A}$ will be equal to 4.

4. **Statement I:** A wave pulse, travelling on two-piece string, gets partially reflected and partially transmitted at the junction. The reflected wave is inverted in shape as compared to the incident wave. The wavelength of transmitted wave will be lesser in value as compared to wavelength of reflected wave and incident wave.

   Statement II: Two periodic waves of amplitudes A_1 and A_2 pass through a region. If $A_1 > A_2$, the difference in maximum and minimum resultant amplitude possible will be equal to two times the amplitude of second wave (A_2).

5. **Statement I:** A Sonometer wire of length l vibrates in fundamental mode when excited by a tuning fork of frequency 416 Hz. If the length is doubled keeping other quantities same, the string will vibrate with frequency of 208 Hz

   Statement II: Two particles A and B have phase difference π when a sine wave passes through the region. A and B will move in opposite direction.

6. **Statement I:** A Mechanical wave propagates in a medium along the X-axis. The particles of the medium must move on the Y axis or Z axis.

   Statement II: A Transverse wave travels along Z axis. The particle of medium must move in X-Y Plane.

7. **Statement I:** A Wave going in a solid must be transverse.

   Statement II: A wave moving in a gas must be longitudinal.

8. **Statement I:** A standing wave is produced on a string clamped at one end and free at the other. The length of the string must be an integral multiple of $\frac{\lambda}{4}$.

   Statement II: In a stationary wave, all the antinodes vibrate in same phase.

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Answer Key

1. (*c*) **2.** (*d*) **3.** (*a*) **4.** (*d*) **5.** 2 m **6.** (*a*) **7.** (*c*) **8.** (*d*) **9.** (*b*) **10.** (b)

11. (*d*) **12.** (*a*) **13.** (*a*) **14.** (*c*) **15.** (*b*) **16.** (*b*) **17.** 12 *m/s* **18.** (*d*) **19.** (*c*) **20.** (c)

21. (*c*) **22.** (*a*) **23.** (*c*) **24.** (*a*) **25.** (*a*) **26.** (*a*) **27.** (*b*) **28.** (*a*) **29.** (*d*) **30.** (*a*)

31. (*a*) **32.** (*c*) **33.** (*c*) **34.** (*a*) **35.** (*a*) **36.** (*d*) **37.** (*d*) **38.** (*c*) **39.** (*a*)

40. 100*m/s* **41.** (*c*) **42.** (*a*) **43.** 200 m/s **44.** (*c*) **45.** (*d*) **46.** (*c*) **47.** (*a*) **48.** (*b*) **49.** (a)

50. 2% **51.** Speed will not change **52.** Speed of sound become double **53.** 5000 m/s **54.** 196×10^7 N/m^2 **55.** (b)

56. 8.5×10^2 kg/m^3 **57.** (*b*) **58.** (*c*) **59.** 15% **60.** (*a*) **61.** (*a*) **62.** (*b*) **63.** 900 K **64.** (c)

65. Remain same **66.** 1328 m/s **67.** 0.61*t* ºC **68.** 1.83 m/s **69.** (*b*) **70.** (*b*) **71.** (*d*) **72.** (b)

73. (*c*) **74.** (*c*) **75.** (*d*) **76.** (*c*) **77.** Decrease by 64 time **78.** (*a*) **79.** (*d*) **80.** (*c*) **81.** (c)

82. (*c*) **83.** 10^{-5} *w/m*^{2} **84.** (*b*) **85.** (*b*) **86.** (*a*) **87.** (*c*) **88.** $A_{net} = 10$, $I_{net} = 100$ **89.** $4\sqrt{3}$

90. $A_{net} = a$ **91.** Amplitude of resultant wave $=3\sqrt{2}$ m. **92.** (*c*) **93.** (*d*) **94.** (*a*) **95.** (*b*) **96.** (*d*) **97.** (*b*)

98. 25/1 **99.** 81/1 **100.** (*a*) **101.** (*a*) **102.** (*a*) **103.** (*d*) **104.** (*c*) **105.** (*a*) **106.** $\lambda = 0.5\ m$, $v = 10 m/s$

107. (*b*) **108.** $A = \sqrt{2}A, f = \frac{\omega}{2\pi}$ **109.** $8\sqrt{3}cm$ **110.** (*b*) **111.** (*c*) **112.** 100 **113.** (*b*) **114.** (*c*) **115.** (*d*)

116. (*d*) **117.** (*a*) **118.** (*c*) **119.** (*b*) **120.** (*c*) **121.** (*c*) **122.** (*a*) **123.** (*a*) **124.** (*c*) **125.** (*a*)

126. (*c*) **127.** (*d*) **128.** (*b*) **129.** (*c*) **130.** 100 *m/s* **131.** (*a*) **132.** (*c*) **133.** (*a*) **134.** (*a*)

135. 15 Hz **136.** (*c*) **137.** (*a*) **138.** (*c*) **139.** (*b*) **140.** (*d*) **141.** (*b*) **142.** (*d*) **143.** (*c*) **144.** (*b*)

145. (*a*) **146.** (*b*) **147.** (*d*) **148.** (*b*) **149.** (*d*) **150.** (*c*) **151.** (*d*) **152.** (*d*) **153.** 6 **154.** (c)

155. (*c*) **156.** (*d*) **157.** 6 **158.** (*b*) **159.** (*b*) **160.** (*d*) **161.** (*c*) **162.** (*a*) **163.** (*b*) **164.** (*a*)

165. (*d*) **166.** (*a*) **167.** (*d*)

MR* CORNER

1. I. False, II. True **2.** I. True, II. False **3.** Both are false **4.** Both are True **5.** I. False, II. True
6. I. False, II. True **7.** I. False, II. True **8.** I. True, II. False

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Units and Measurements

(Practice Questions)

Physical Quantity

1. Which of the following group of physical quantity can be considered as a group of fundamental physical quantity.
(*a*) Force, mass time
(*b*) Mass, force, acceleration
(*c*) Velocity, time, displacement
(*d*) Velocity, momentum, mass
(*e*) None of the above

2. Which does not have same unit as other:-
(*a*) watt - sec (*b*) kilowatt - hour
(*c*) eV (*d*) Joule - sec

3. Unit of distance is :
(*a*) Femtometer (*b*) Angstrom
(*c*) Parsec (*d*) Light year
(*e*) All of these

4. **Assertion:** Astronomical unit, light year and parsec measures distance
Reason: Each has dimension of distance.
(*a*) If both Assertion & Reason are True & the Reason is a correct explanation of the Assertion.
(*b*) If both Assertion & Reason are True but Reason is not a correct explanation of the Assertion.
(*c*) If Assertion is True but the Reason is False.
(*d*) If both Assertion & Reason are false.

5. Which of the following is a characteristic of unit?
(*a*) The unit must be universally accepted
(*b*) It must be invariable and well defined
(*c*) It must be of suitable size and easily available
(*d*) All the above

6. Ratio of two similar physical quantity has units.
(*a*) True (*b*) False

Unit Conversion

7. The magnitude of physical quantity and units are directly proportional to each other.
(*a*) True (*b*) False

8. If Area of object is $5m^2$ then find its value in C.G.S unit??
(*a*) 5×10^4 cm^2 (*b*) 3×10^4 m^2
(*c*) 2×10^4 cm^2 (*d*) 1×10^4 m^2

9. Convert 25 m/s in C.G.S unit

10. If unit of length becomes double then value of area $5m^2$ in new unit will be :-
(*a*) $\frac{1}{4}$ (*b*) $\frac{3}{2}$ (*c*) $\frac{5}{4}$ (*d*) $\frac{5}{2}$

11. Convert 1 newton into Dyne.
(*a*) 10^4 (*b*) 10^5 (*c*) 10^3 (*d*) 10^7

12. Convert values of 10 joule in CGS unit?
(*a*) 10×10^7 (*b*) 1×10^7 (*c*) 1×10^5 (*d*) 3×10^5

13. In a new system of units, unit of mass is *x* kg, unit of length is *y* metre and unit of time is *z* second. Now if 1 newton = *F* new units then F =
(*a*) $\frac{z}{xy}$ (*b*) $\frac{z^2}{xy}$ (*c*) $\frac{z}{xy^2}$ (*d*) $\frac{z}{x^2y}$

14. In new system of unit, unit of length is 10 m , unit of time is 2s , unit of mass is 5 kg , then find unit of torque in new system of unit.
(*a*) 125 Nm (*b*) 0.125 Nm
(*c*) 8 Nm (*d*) 8×10^{-3} Nm

15. If unit of length 10 m and unit of mass is 5 kg and unit of time is 2 sec then, find value of 10 Joule energy in new system of unit.
(*a*) $\frac{2}{25}$ (*b*) $\frac{3}{8}$ (*c*) $\frac{1}{16}$ (*d*) $\frac{2}{3}$

16. If unit of mass becomes double, unit of length becomes half and unit of time becomes $\frac{1}{4}$ th then find value of 10 N force in new system of unit.

17. The density of a material in CGS system of units is 4 g cm^{-3} In a system of units in which unit of length is 10 cm and unit of mass is 100 g , the value of density of material will be
(*a*) 0.04 (*b*) 0.4 (*c*) 40 (*d*) 400

18. If unit of length 10 m and unit of mass is 5 kg and unit of time is 2 sec then, find unit of energy in new system.
(*a*) 25 $kg.m^2/s^2$ (*b*) 125 $kg.m^2/s^2$
(*c*) 1 $kg.m^2/s^2$ (*d*) 108 $kg.m^2/s^2$

19. If unit of mass becomes double, unit of length becomes half and unit of time becomes $\frac{1}{4}$ th then find unit of force.
(*a*) 10 $kg.m^2/s^2$ (*b*) 25 $kg.m^2/s^2$
(*c*) 1 $kg.m^2/s^2$ (*d*) 16 $kg.m^2/s^2$

20. In a new system of units, unit of mass is α kg unit of length is β m and unit of time is γ s. In this symstem, 10J will be represented as.
(*a*) $10\alpha^{-1}\beta^2\gamma^2$ (*b*) $10\alpha^{-2}\beta^{-1}\gamma^{-2}$
(*c*) $10\alpha^{-1}\beta^{-2}\gamma^2$ (*d*) $10\alpha\beta^2\gamma^{-2}$

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21. Given below are two statements:

Statement I: Two physical quantities having same dimensions, may have different units.

Statement II: Shake and light year, both measure time.

In the light of the above statements, choose the most appropriate answer from the options given below:

(*a*) Both statement I and statement II are correct.

(*b*) Statement I is correct and statement II is incorrect

(*c*) Statement I is incorrect and statement II is correct

(*d*) Both statements I and statements II are incorrect

22. Light year is used to measure :

(*a*) distance between stars

(*b*) distance between atoms

(*c*) revolution time of earth around sun

(*d*) none of these

23. The wrong unit conversion among the following is :

(*a*) 1 angstrom = 10^{-10} m

(*b*) 1 fermi = 10^{-15} m

(*c*) 1 light year = 9.46×10^{15} m

(*d*) 1 astronomical unit = 1.496×10^{-11} m

24. The unit for nuclear dose given to a patient is :

(*a*) fermi (*b*) rutherford

(*c*) curie (*d*) roentgen

25. Which of the following is not the unit of time ?

(*a*) microsecond (*b*) leap year

(*c*) lunar months (*d*) parallactic second

(*e*) Solar day

26. The unit of Stefan's constant σ is :

(If rate of heat radiation is given by σAT^4 where *A* is Area and T is temperature)

(*a*) $Wm^{-2}K^{-1}$ (*b*) $Wm^2 K^{-4}$

(*c*) $Wm^{-2}K^{-4}$ (*d*) $Wm^{-2} K^4$

27. Match Column-I with Column-II and select correct option.

Column-I		Column-II	
(A)	Mega	(P)	10^{-9}
(B)	Nano	(Q)	10^{-15}
(C)	Micro	(R)	10^{6}
(D)	Femto	(S)	10^{-6}
(E)	Pico	(T)	10^{-12}

	A	B	C	D	E
(*a*)	R	P	S	T	Q
(*b*)	S	P	R	Q	T
(*c*)	R	P	S	Q	T
(*d*)	S	P	R	T	Q

28. Two clocks are being tested against a standard clock located in a national laboratory. At 12 : 00 : 00 noon by the standard clock, the readings of the two clocks are :

Days	Clock 1	Clock 2
Monday	12:00:05	10:15:06
Tuesday	12:01:15	10:14:59
Wednesday	11:59:08	10:15:18
Thursday	12:01:50	10:15:07
Friday	11:59:15	10:14:53
Saturday	12:01:30	10:15:24
Sunday	12:01:19	10:15:11

If you are doing an experiment that requires precision time interval measurements, which of the two clocks will you prefer?

29. Which of the following ratios express pressure ?

(i) Force/Area

(ii) Energy/Volume

(iii) Energy/Area

(iv) Force/Volume

(*a*) Only (i) is correct. (*b*) Only (ii) is correct.

(*c*) Only (iii) is correct. (*d*) Both (i) and (ii) are correct.

30. The unit of thermal conductivity is :

(*a*) $Wm^{-1}K^{-1}$ (*b*) $Hm\ K^{-1}$

(*c*) $Jm^{-1}\ K^{-1}$ (*d*) $Wm\ K^{-1}$

Dimension

31. The dimension of mutual inductance is:

(*a*) $[ML^2T^{-2}\ A^{-1}]$ (*b*) $[ML^2T^{-3}\ A^{-1}]$

(*c*) $[ML^2T^{-2}\ A^{-2}]$ (*d*) $[ML^2T^{-3}\ A^{-2}]$

32. The SI unit of a physical quantity is pascal-second. The dimensional formula of this quantity will be

(*a*) $[ML^{-1}T^{-1}]$ (*b*) $[ML^{-1}T^{-2}]$

(*c*) $[ML^2T^{-1}]$ (*d*) $[ML^{-1}L^3\ T^0]$

33. Dimension of Stress

34. Dimension of electric resistance

35. Dimension of Self Induction

36. Dimension of Permeability

37. Dimension of Magnetic field and magnetic flux

38. Dimension of Coefficient of viscosity

39. Dimension of $\frac{1}{\mu_0 \epsilon_0}$ should be equal to

(*a*) T^2/L^2 (*b*) T/L

(*c*) L^2/T^2 (*d*) L/T

40. If the dimensions of a physical quantity are given by $M^aL^bT^c$, then the physical quantity will be

(*a*) Velocity if $a = 1, b = 0, c = -1$

(*b*) Acceleration if $a = 1, b = 0, c = -2$

(*c*) Force if $a = 0, b = -1, c = -2$

(*d*) Pressure if $a = 1, b = -1, c = -2$

41. If E, L, M and G denote the quantities as energy, angular momentum, mass and constant of gravitation respectively, then the dimensions of *P* in the formula $P = EL^2M^{-5}G^{-2}$ are:

(*a*) $[M^0L^0T^0]$ (*b*) $[M^1L^1T^{-2}]$

(*c*) $[M^0L^1T^0]$ (*d*) $[M^{-1}L^{-1}T^2]$

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42. A quantity f is given by $f = \sqrt{\frac{hc^5}{G}}$ where c is speed of light, G universal gravitational constant and h is the Planck's constant. Dimension of f is that of

(*a*) Energy (*b*) Momentum
(*c*) Area (*d*) Volume

43. Which two of the following five physical parameters have the same dimensions?

i. Energy density ii. Refractive index
iii. Dielectric constant iv. Young's modulus
v. Magnetic field

(*a*) 1 and 4 (*b*) 1 and 5
(*c*) 2 and 4 (*d*) 3 and 5

44. Which of the following pairs have same dimensional formula?

(*a*) Bulk modulus and energy density
(*b*) Latent heat and velocity
(*c*) Specific heat and latent heat
(*d*) Both (A) and (B)

45. Which pair do not have equal dimensions?

(*a*) Energy and torque
(*b*) force and impulse
(*c*) Angular momentum and Planck's constant
(*d*) Elastic modulus and pressure

46. The unit of electric flux is

(*a*) $\frac{Vm^2}{C}$ (*b*) volt-second
(*c*) $\frac{Nm^2}{C}$ (*d*) $\frac{N}{C^2\ m}$

47. Match List-I with List-II:

	List-I		List-II
A.	Surface tension	I.	$kg\ m^{-1}s^{-1}$
B.	Pressure	II.	$kg\ m^{-1}s^{-2}$
C.	Viscosity	III.	$kg\ m^{-1}s^{-2}$
D.	Impulse	IV.	$kg\ s^{-2}$

Choose the correct answer from the options given below:

(*a*) A-IV, B-III, C-II, D-I
(*b*) A-IV, B-III, C-I, D-II
(*c*) A-III, B-IV, C-I, D-II
(*d*) A-II, B-I, C-III, D-IV

48. Match List-I with List-II:

	List-I		List-II
A.	Torque	I.	$kg\ m^{-1}s^{-2}$
B.	Energy density	II.	$kg\ ms^{-1}$
C.	Pressure gradient	III.	$kg\ m^{-2}s^{-2}$
D.	Impulse	IV.	$kg\ m^2\ s^{-2}$

Choose the correct answer from the options given below:

(*a*) A-IV, B-III, C-I, D-II (*b*) A-I, B-IV, C-III, D-II
(*c*) A-IV, B-I, C-II, D-III (*d*) A-IV, B-I, C-III, D-II

49. Match List-I with List-II:

	List-I		List-II
A.	Torque	I.	Nms^{-1}
B.	Stress	II.	$J\ kg^{-1}$
C.	Latent Heat	III.	Nm
D.	Power	IV.	Nm^{-2}

Choose the correct answer from the options given below:

(*a*) A-III, B-II, C-I, D-IV (*b*) A-III, B-IV, C-II, D-I
(*c*) A-IV, B-I, C-III, D-II (*d*) A-II, B-III, C-I, D-IV

50. Match List-I with List-II:

	List-I		List-II
A.	Planck's constat (h)	I.	$[M^1L^2T^{-2}]$
B.	Stopping potential (Vs)	II.	$[M^1L^1T^{-1}]$
C.	Work function (ϕ)	III.	$[M^1L^2T^{-1}]$
D.	Momentum (p)	IV.	$[M^1L^2T^{-3}A^{-1}]$

(*a*) A-III, B-I, C-II, D-IV (*b*) A-III, B-IV, C-I, D-II
(*c*) A-II, B-IV, C-III, D-I (*d*) A-I, B-III, C-IV, D-II

51. Match List-I with List-II:

	List-I		List-II
A.	Young's Modulus (Y)	I.	$[M\,L^{-1}T^{-1}]$
B.	Co-efficient of Viscosity (η)	II.	$[M\,L^2T^{-1}]$
C.	Planck's Constant (h)	III.	$[M\,L^{-1}T^{-2}]$
D.	Work Function (ϕ)	IV.	$[M\,L^2T^{-2}]$

Choose the correct answer from the options given below:

(*a*) A-II, B-III, C-IV, D-I (*b*) A-III, B-I, C-II, D-IV
(*c*) A-I, B-III, C-IV, D-II (*d*) A-I, B-II, C-III, D-IV

52. Match List-I with List-II:

	List-I (Quantity)		List-II (Dimensional Formula)
A.	Pressure gradient	I.	$[M^0L^2\,T^{-2}]$
B.	Energy density	II.	$[ML^{-1}T^{-2}]$
C.	Electric field	III.	$[M^1\,L^{-2}T^{-2}]$
D.	Latent heat	IV.	$[M^1\,L^1\,T^{-3}\,A^{-1}]$

Choose the correct answer from the options given below:

(*a*) A-III, B-II, C-I, D-IV (*b*) A.-II, B-III, C-IV, D-I
(*c*) A-III, B-II, C-IV, D-I (*d*) A-II, B-III, C-I, D-IV

53. Match List-I with List-II:

	List-I		List-II
A.	Angular momentum	I.	$[M\,L^2\,T^{-2}]$
B.	Torque	II.	$[ML^{-2}T^{-2}]$
C.	Stress	III.	$[ML^2T^{-1}]$
D.	Pressure gradient	IV.	$[ML^{-1}\,T^{-2}]$

Choose the correct answer from the options given below:

(*a*) A-I, B-IV, C-III, D-II (*b*) A-III, B-I, C-IV, D-II
(*c*) A-II, B-III, C-IV, D-I (*d*) A-IV, B-II, C-I, D-III

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54. Match the List-I with List-II.

List-I		List-II	
A.	Coefficient of viscosity	I.	$M L^2 T^{-2}$
B.	Surface tension	II.	$ML^2 T^{-1}$
C.	Angular momentum	III.	$ML^{-1}T^{-1}$
D.	Rotational kinetic energy	IV.	$ML^0 T^{-2}$

Choose the correct answer from the options given below :

(*a*) (A)-(II), (B)-(I) , (C)-(IV), (D)-(III)
(*b*) (A)-(I), (B)-(II), (C)-(III), (D)-(IV)
(*c*) (A)-(IV), (B)-(III), (C)-(II), (D)-(I)
(*d*) (A)-(III), (B)-(IV), (C)-(II), (D)-(I)

55. If L, C and R are the self inductance, capacitance and resistance respectively, which of the following does not have the dimension of time?

(*a*) RC (*b*) L/R (*c*) $\sqrt{LC}$ (*d*) L/C

56. **Assertion:** The dimensional formula for product of resistance and conductance is same as for dielectric constant.

Reason: Both have dimensions of time constant

(*a*) If both Assertion & Reason are True & the Reason is a correct explanation of the Assertion.
(*b*) If both Assertion & Reason are True but Reason is not a correct explanation of the Assertion.
(*c*) If Assertion is True but the Reason is False. /
(*d*) If both Assertion & Reason are false.

57. A quantity *x* is given by (IF $v^{2/}$ WL^4) in terms of moment of inertia I, force *F*, velocity *v* , work *W* and length *L* . The dimensional formula for *x* is same as that of

(*a*) Coefficient of viscosity (*b*) Force constant
(*c*) Energy density (*d*) Planck's constant

58. The pair of quantities having same dimensions is

(*a*) Impulse and Surface Tension
(*b*) Angular momentum and Work
(*c*) Work and Torque
(*d*) Young's modulus and Energy

59. Which two of the following five physical parameters have the same dimensions ?

(A) energy density (B) refractive index
(C) dielectric constant (D) Young's modulus
(E) magnetic field

(*a*) a and d (*b*) a and e
(*c*) b and d (*d*) c and e

60. Choose the incorrect statement

(*a*) Solid angle has a unit but no dimensions
(*b*) Relative density has neither unit nor dimensions
(*c*) Universal gravitational constant (G) has a SI unit $Nm^2 kg^{-2}$
(*d*) Reynolds number is having a unit

61. If *y* = force and *x* = velocity then dimension of $\frac{dy}{dx}$

(*a*) $[MT^{-1}]$ (*b*) $[LT^{-2}]$
(*c*) $[ML^2T^2]$ (*d*) $[MLT^{-1}]$

62. **Assertion:** If *x* and *y* are the distances along *x* and *y* axes respectively then the dimensions of $\frac{d^3y}{dx^3}$ is $M^0 L^{-2} T^0$.

Reason: Dimensions of $\int_a^b y dx$ is $M^0 L^2 T^0$

(*a*) If both Assertion & Reason are True & the Reason is a correct explanation of the Assertion.
(*b*) If both Assertion & Reason are True but Reason is not a correct explanation of the Assertion.
(*c*) If Assertion is True but the Reason is False.
(*d*) If both Assertion & Reason are false.

63. Fill in the blanks with correct statement, according to given statement

Dimension	(1) _____	(2) _____	(c) A physical quantity have dimension	(d) A physical quantity does not have dimension
Unit	(a) A physical quantity have unit	(b) A physical quantity does not have unit	(3) _____	(4) _____

64. A unitless physical quantity may have dimension

(*a*) True (*b*) False

65. A dimensionless physical quantity may be unitless

(*a*) True (*b*) False

66. A physical quantity have unit must have dimension

(*a*) True (*b*) False

67. A physical quantity have dimension may have unit

(*a*) True (*b*) False

68. Select correct options

(*a*) Two physical quantities of different dimensions may have same unit
(*b*) Two physical quantities of different units may have same dimensions
(*c*) Unit less quantities must be dimensionless /
(*d*) Both (B) & (C)

69. **Assertion:** The unit vectors $\hat{i}, \hat{j}$ and $\hat{k}$ have units of distance and dimensions $[M^0L^1T^0]$

Reason: The product of a scalar and a vector is a new scalar.

(*a*) If both Assertion & Reason are True & the Reason is a correct explanation of the Assertion.
(*b*) If both Assertion & Reason are True but Reason is not a correct explanation of the Assertion.
(*c*) If Assertion is True but the Reason is False.
(*d*) If both Assertion & Reason are false.

70. Different physical quantity can have same dimension?

71. Two quantity have different dimension, can be same physical quantity.

72. Which of the following is a dimensional constant?

(*a*) Relative density (*b*) Gravitational constant
(*c*) Refractive inbox (*d*) Poisson's ratio

73. The relation between [E] and [B] is

(*a*) [E] = [B][L][T] (*b*) $[E] = [B][L]^{-1}[T]$
(*c*) $[E] = [B][L][T]^{-1}$ (*d*) $[E] = [B][L]^{-1}[T]^{-1}$

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74. In the expression $P = El^2m^{-5}G^{-2}$, where E, m, l and G denote energy, mass, angular momentum and gravitational constant, respectively.

The dimensions of P are

(*a*) $[MLT^0]$ (*b*) $[M^2LT^{-1}]$

(*c*) $[M^0L^0T^0]$ (*d*) $[M^0 LT^{-2}]$

75. The pairs of physical quantities that have the same dimensions is/are

I. Volumetric strain and coefficient of friction.

II. Disintegration constant of a radioactive substance and frequency of light wave.

III. Heat capacity and gravitational potential.

IV. Stefan's constant and Wien's constant.

(*a*) I, II and IV (*b*) I, III and IV

(*c*) I, II and III (*d*) I and II

76. Match the following columns.

Column-I		Column-II	
(A)	A physical quantity which has a unit but no dimensions	1.	Gravitational constant
(B)	A physical quantity which has neither unit nor dimensions	2.	Reynold number
(C)	A constant which has a unit	3.	Strain
(D)	A constant which has no unit	4.	Plane angle

(*a*) 4 3 1 2 (*b*) 3 4 2 1 (*c*) 1 2 3 4 (*d*) 1 4 2 3

77. Which of the following physical quantities have the same dimensions?

(*a*) Electric displacement ($\vec{D}$) and surface charge density

(*b*) Displacement current and electric field

(*c*) Current density and surface charge density

(*d*) Electric potential and energy

78. Which of the following is not a dimensionless quantity ?

(*a*) Relative magnetic permeability (μ_r)

(*b*) Power factor

(*c*) Quality factor

(*d*) Permeability of free space (μ_0)

Principle of Homogeneity

79. If P, Q, R are physical quantities having different dimensions. Which of following combinations can never be a meaningful quantity?

i. PQ – R ii. $PR–Q^2/R$

iii. (P–Q)/R iv. (R+Q)/P

(*a*) i, ii, iii, iv (*b*) both iii and iv

(*c*) both i and ii (*d*) i, iii, iv

80. $F = at + bt^2$, Find dimension of a and b

81. V = A sin(Bt) find dimension of A and B

82. $E = Ax + \dfrac{Bt}{(C-t^2)}$, Find dimension of A, B and C

83. $\left(P + \dfrac{q}{V^2}\right) \times (b - v^2) = \dfrac{nRT}{3}$ Find dimension of b?

84. The velocity v of a particle at time t is given by $v = at + \dfrac{b}{t+c}$, where a, b are constants. The dimensions of a,b and c are

(*a*) [L],[LT] and $[LT^{-2}]$ (*b*) $[LT^{-2}]$,[L] and [T]

(*c*) $[L^2]$,[T] and $[LT^{-2}]$ (*d*) $[LT^{-2}]$,[LT] and [L]

85. An equation is given here $\left(P + \dfrac{a}{v^2}\right) = b\dfrac{\theta}{V}$ where P= Pressure, V= Volume and θ= Absolute temperature. If a and b are constants, the dimensions of a will be

(*a*) $[MT^{-5}T^{-1}]$ (*b*) $[ML^5T^{-2}]$

(*c*) $[ML^5T^{-2}]$ (*d*) $[M^{-1}L^5T^2]$

86. Electric field in a certain region is given by $\vec{E} = \left(\dfrac{A}{x^2}\hat{i} + \dfrac{B}{y^3}\hat{j}\right)$. The SI unit of A and B are:

(*a*) $Nm^3 C^{-1}$; $N m^2C^{-1}$ (*b*) $Nm^2 C^{-1}$; $Nm^3 C^{-1}$

(*c*) $Nm^3 C$; $Nm^2 C$ (*d*) $Nm^3 C^{-1}$; $Nm^3 C$

87. In the equation $\left[x + \dfrac{a}{y^2}\right][y - b] = RT, x$ is pressure, y is volume, R is universal gas constant & T is temperature. The physical quantity equivalent to ratio $\dfrac{a}{b}$ is

(*a*) Impulse (*b*) Energy

(*c*) Pressure gradient (*b*) Coefficient of viscosity

88. The time dependence of a physical quantity p is given by $p = p_0 \exp(-at^2)$, where a is a constant and t is the time. The constant a

(*a*) is dimensionless (*b*) has dimensions $[T^{-2}]$

(*c*) has dimensions $[T^2]$ (*d*) has dimensions of p

89. **Assertion:** Force is not added with pressure

Reason: Quantities having different dimension are not added or subtracted.

(*a*) If both Assertion & Reason are True & the Reason is a correct explanation of the Assertion.

(*b*) If both Assertion & Reason are True but Reason is not a correct explanation of the Assertion.

(*c*) If Assertion is True but the Reason is False.

(*d*) If both Assertion & Reason are false.

90. If A and B are physical quantity having different dimension then which of the following expression is correct?

(*a*) A + B (*b*) A – B

(*c*) $A – B^2$ (*d*) AB + B

91. Y = A sin (ωt – kx + ϕ) find dim^n of A, ω, k ϕ and where y and x is position.

92. Velocity $V = \dfrac{\alpha}{\beta}e^{-\alpha t}$ then find dimension of α and β.

93. If velocity $v = \alpha t + \beta x - \gamma xt$, then find dimension of α, β and γ

94. A force is represented by $F = ax^2 + bt^{1/2}$ where x = distance and t = time. Then The dimensions of b^2/a are

(*a*) $M L^3 T^{-3}$ (*b*) $M L T^{-2}$

(*c*) $M L^{-1} T^{-1}$ (*d*) $M L^2 T^{-3}$

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95. On the basis of dimension, decide which of the following relation for displacement of a particle is not correct

(*a*) $y = a\sin\left(\frac{2\pi t}{T}\right)$

(*b*) $y = a\sin\left(\frac{vt}{\lambda}\right)$

(*c*) $y = \sqrt{2}a\sin\left(\frac{2\pi t}{T}\right)\cos\left(\frac{2\pi x}{\lambda}\right)$

(*d*) $y = \frac{x}{t}\sin(\lambda t)$

96. Velocity $V = A\sin\left(x\sqrt{\alpha t}\right)$, find dimension of α

97. Velocity $V = \frac{\alpha}{\beta + \sqrt{\text{density}}}$, find dimension of α and β.

98. $\int \frac{dx}{\sqrt{2ax - x^2}} = b$; find dimension of *a* and *b* of *x* is distance

99. Momentum of object is given as $P = \alpha t\,[1 - \beta^{\gamma x}]$ then, find dimension of α, β and γ. Where t is time *x* is position.

100. The equation of a circle is given by $x^2 + y^2 = a^2$, where *a* is the radius. If the equation is modified to change the origin other than (0, 0), then find out the correct dimensions of A and B in a new equation: $(x - At)^2 + \left(y - \frac{t}{B}\right)^2 = a^2$. The dimensions of ties given as $[T^{-1}]$

(*a*) $A = [L^{-1}T]$, $B = [LT^{-1}]$ (*b*) $A = [LT]$, $B = [L^{-1}T^{-1}]$

(*c*) $A = [L^{-1}T^{-1}]$, $B = [LT^{-1}]$ (*d*) $A = [L^{-1}L^{-1}]$, $B = [LT]$

101. Position of object Y is given $Y = A\sin(kx - \omega t)$ then, find dimension of $k; \omega$ and A.

102. If $Y = A\sin\left[\frac{2\pi}{\lambda}(ct - x)\right]$. Find dimension of *c*.

103. Equation of force $F = \frac{a - x}{bt^2}$ then find dimension of a and b

104. Consider two physical quantities *A* and *B* related to each other as $E = \frac{B - x^2}{At}$ where *Ex* and *t* have dimensions of energy, length and time respectively. The dimension of (AB)is

(*a*) $L^{-2}M^1T^0$ (*b*) $L^2M^{-1}T^1$ (*c*) $L^0M^{-1}T^{-1}$ (*d*) $L^{-2}M^{-1}T^1$

105. A force is represented by $F = ax^2 + bt^{1/2}$
where *x* = distance and *t* = time. Then The dimensions of b^2/a are

(*a*) $M L^3 T^3$ (*b*) $M L T^{-2}$ (*c*) $M L^{-1} T^{-2}$ (*d*) $ML^2 T^{-3}$

106. $Y = \log e^{\alpha t}$ then find dimension of α?

107. $F = 2V - 6t$. Find dimension of '2' & '6' Where F is force, V = velocity, t = time

(*a*) Both are dimensionless (*b*) MT^{-1}, MLT^{-3}

(*c*) $ML^{-1}T^{-2}$, MLT^{-3} (*d*) MTT^{-3}, MT^{-1}

108. Force (F) and density (*d*) are related as $F = \frac{\alpha}{\beta + \sqrt{d}}$ Then, the dimensions of α and β are

(*a*) $[M^{3/2} L^{-1/2} T^{-2}]$, $[ML^{-3} T^0]$

(*b*) $[M^{3/2} L^{-1/2} T^{-2}]$, $[M^{1/2} L^{-3/2}T^0]$

(*c*) $[M^2 L^2 T^{-1}]$, $[ML^{-1} T^{-3/2}]$

(*d*) $[MLT^{-2}]$, $[ML^{-2} T^{-2/3}]$

109. **Statement-1:** The displacement cannot be added with distance travelled.

Statement-2: Addition of scalar and vector of same dimensions is not a meaningful algebraic operation.

(*a*) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.

(*b*) Statement-1 is True, Statement-2 is True; Statement-2 is not a correct explanation for Statement-1.

(*c*) Statement-1 is True, Statement-2 is False.

(*d*) Statement-1 is False, Statement-2 is True

110. The force is given in terms of time *t* and displacement *x* by the equation $F = A\cos Bx + C\sin Dt$

The dimensional formula of $\frac{AD}{B}$ is

(*a*) $[M^2L^2T^{-3}]$ (*b*) $[M^1L^1T^{-2}]$ (*c*) $[ML^2T^{-3}]$ (*d*) $[M^0LT^{-1}]$

Dimensional Analysis

111. If force (F), acceleration (*a*) and time *t* is used as a fundamental P.Q. then find dimension of length in terms of them :-

(*a*) $F^0a^1T^2$ (*b*) Fa^2T^2 (*c*) $F a^2 T^0$ (*d*) $F^0 a T$

112. If time (*t*), energy (*E*) and momentum (*P*) taken as base quantities then dimension of mass (*m*), is

(*a*) $m = k t^0 P^2 E^{-1}$ (*b*) $m = k t^0 P^{-1} E^2$

(*c*) $m = k t P^2 E$ (*d*) $m = k t^0 P^2 E$

113. If mass (M), velocity (V) and time (T) are taken as fundamental units, then the dimensions of force (F) are

(*a*) [M V T] (*b*) $[M V T^{-1}]$

(*c*) $[M^2 V T]$ (*d*) $[M^{-1}V^{-1}T]$

114. If force (F), acceleration (*a*) and time *t* is used as a fundamental P.Q then find dimension of Area in terms of them :-

(*a*) $F^0 a^1 T^2$ (*b*) $F a^2 T^2$

(*c*) $F^0 a^2 T^4$ (*d*) $F^0 a T$

115. The frequency of vibrations *f* of a mass m suspended from a spring of spring constant K is given by a relation of type $f = cm^x K^y$, where *c* is a dimensionless constant. The values of *x* and *y* are

(*a*) $x = \frac{1}{2}, y = \frac{1}{2}$ (*b*) $x = \frac{-1}{2}, y = \frac{-1}{2}$

(*c*) $x = \frac{1}{2}, y = \frac{-1}{2}$ (*d*) $x = \frac{-1}{2}, y = \frac{1}{2}$

116. If mass is written as $m = k c^P G^{-1/2} h^{1/2}$ then the value of P will be : (Constants have their usual meaning with k a dimensionless constant)

(*a*) 1/2 (*b*) 1/3 (*c*) 2 (*d*) –1/3

117. If force acceleration and time are basic fundamental P.Q. then find dimension of energy

(*a*) $F^2A^{-1}T$ (*b*) $F A T^2$

(*c*) $F A T^{-2}$ (*d*) $F A^{-1}T$

118. If surface tension (S), moment of inertia (I) and Planck's constant (*h*), were to be taken as the fundamental units, the dimensional formula for linear momentum would be

(*a*) $S^{3/2}[I^{1/2}h^0]$ (*b*) $S^{1/2}[I^{1/2}h^0]$

(*c*) $S^{1/2}[I^{1/2}h^{-1}]$ (*d*) $S^{1/2}[I^{3/2}h^{-1}]$

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119. The frequency (v) of an oscillating liquid drop may depend upon radius (r) of the drop, density (ρ) of liquid and the surface tension (s) of the liquid as: $v = r^a \rho^b s^c$. The values of a,b and c respectively are

(*a*) $\left(-\frac{3}{2},-\frac{1}{2},\frac{1}{2}\right)$ (*b*) $\left(\frac{3}{2},-\frac{1}{2},\frac{1}{2}\right)$

(*c*) $\left(\frac{3}{2},\frac{1}{2},-\frac{1}{2}\right)$ (*d*) $\left(-\frac{3}{2},\frac{1}{2},\frac{1}{2}\right)$

120. The speed of a wave produced in H_2O is given by $v = \lambda^a g^b \rho^c$, where λ, g, ρ pare wavelength of wave, acceleration due to gravity & density of water respectively. The value of a, b & c respectively are :

(*a*) $\frac{1}{2},0,\frac{1}{2}$ (*b*) 1, 1, 0 (*c*) 1, –1, 0 (*d*) $\frac{1}{2},\frac{1}{2},0$

121. Young's modulus of elasticity Y is expressed in terms of three derived quantities, namely, the gravitational constant G. Planck's constant h and the speed of light c, as $Y = c^\alpha h^\beta G^\gamma$. Which of the following is the correct option?

(*a*) $\alpha = 7, \beta = -1, \gamma = -2$ (*b*) $\alpha = -7, \beta = -1, \gamma = -2$

(*c*) $\alpha = 7, \beta = -1, \gamma = 2$ (*d*) $\alpha = 7, \beta = 1, \gamma = -2$

122. If force F, area A and density D are taken as the fundamental units, the representation of Young's modulus 'Y' will be:

(*a*) $[F^{-1}A^{-1}D^{-1}]$ (*b*) $[FA^{-2}D^2]$

(*c*) $[FA^{-1}D]$ (*d*) $[FA^{-1}D^0]$

123. If maximum acceleration of oscillating particle is α and maximum velocity is β, then find time period

(*a*) $2\pi\frac{\alpha}{\beta}$ (*b*) $2\pi\alpha\beta$ (*c*) $2\pi\frac{\beta}{\alpha}$ (*d*) $\frac{2\pi\alpha^2}{\beta^2}$

124. Plank's constant (h), speed of light in vacuum (c) and Newton's gravitational constant (G) are three fundamental constants, Which of the following combinations of these has the dimension of length?

(*a*) $\frac{\sqrt{hG}}{c^{3/2}}$ (*b*) $\frac{\sqrt{hG}}{c^{5/2}}$ (*c*) $\sqrt{\frac{hc}{G}}$ (*d*) $\frac{\sqrt{Gc}}{h^{3/2}}$

125. If dimensions of critical velocity v_c of a liquid flowing through a tube are expressed as $\eta^x \rho^y r^z$ where η ρ r are the coefficient of viscosity of liquid, density of liquid and radius of the tube respectively, then the values of x,y and z are given by

(*a*) 1,1,1 (*b*) 1, –1,–1 (*c*) –1,–1,1 (*d*) –1,–1,–1

126. If momentum [P], area [A] and time [T] are taken as fundamental quantities, then the dimensional formula for coefficient of viscosity is:

(*a*) $[PA^{-1}T^0]$ (*b*) $[PAT^{-1}]$ (*c*) $[PA^{-1}T]$ (*d*) $[PA^{-1}T^{-1}]$

127. A spherical ball is moving through a viscous medium. If the viscous force acting on the ball is proportional to speed of the ball, then the dimensions of proportionality constant is

(*a*) $[M L^{-1} T^{-1}]$ (*b*) $[M L^{-2} T^{-1}]$

(*c*) $[M L T^{-2}]$ (*d*) $[M L^0 T^{-1}]$

128. Force acting on object is proportional to squre of velocity then find dimensions of proportional constant.

129. If energy E, velocity V and time T are taken as fundamental units, the dimensional formula for surface tension is

(*a*) $[E V^{-2} T^{-2}]$ (*b*) $[E^{-2} V T^{-2}]$

(*c*) $[E^{-2} V T^{-2}]$ (*d*) $[E^{-2} V^{-2} T^2]$

130. A physical quantity of the dimensions of length that can be formed out of c, G and $\frac{e^2}{4\pi\varepsilon_0}$ is c. is velocity of light, G is universal constant of gravitation and θ is charge]

(*a*) $\frac{1}{c^2}\left[G\frac{e^2}{4\pi\varepsilon_0}\right]^{1/2}$ (*b*) $c^2\left[G\frac{e^2}{4\pi\varepsilon_0}\right]^{1/2}$

(*c*) $\frac{1}{c^2}\left[\frac{e^2}{G4\pi\varepsilon_0}\right]^{1/2}$ (*d*) $\frac{1}{c}G\frac{e^2}{4\pi\varepsilon_0}$

131. Car is moving on rough inclined plane of inclination θ and coefficient of friction μ, then find maximum safe velocity of car?

132. The speed of light C gravitational constant G and plant constant h are taken as fundamental P.Q then the dimension of time in the new system of unit

(*a*) $G^{+1/2} h^{1/2} C^{-5/2}$ (*b*) $G^{-1/2} h^{1/2} C^{-1/2}$

(*c*) $G^{1/2} h^{1/2} C^{3/2}$ (*d*) $G^{-1/2} h^{-1/2} C^{-1/2}$

133. In a new system of units energy (E), density (d) and power (P) are taken as fundamental units, then the dimensional formula of universal gravitational constant G will be

(*a*) $[E^{-1}d^{-2}P^2]$ (*b*) $[E^{-1}d^{-1}P^2]$

(*c*) $[E^2 d^{-1} P^{-1}]$ (*d*) $[E^1 d^{-2} P^{-2}]$

134. A highly rigid cubical block A of small mass M and side L is fixed onto another cubical block B of the same dimensions and of low modulus of rigidity n such that the lower face of A completely covers the upper face of B. The lower face B is rigidly held on a horizontal surface. A small force F is applied perpendicular to one of the side faces of A. After the force is withdrawn, block A executes small oscillations. The time period of which is given by

(*a*) $2\pi\sqrt{\frac{M\eta}{L}}$ (*b*) $2\pi\sqrt{\frac{L}{M\eta}}$ (*c*) $2\pi\sqrt{\frac{ML}{\eta}}$ (*d*) $2\pi\sqrt{\frac{M}{\eta L}}$

135. Sometimes it is convenient to construct a system of units so that all quantities can be expressed in terms of only one physical quantity. In one such system, dimensions of different quantities are given in terms of a quantity x as follows: [position] = $[x^\alpha]$; speed = $[x^\beta]$; [acceleration] = $[x^p]$; [linear momentum] = $[x^q]$; force = $[x^r]$. Then

(*a*) $\alpha + p = 2\beta$ (*b*) $p + q - r = \beta$

(*c*) $p - q + r = \alpha$ (*d*) $p + q + r = \beta$

136. Let us consider a system of units in which mass and angular momentum are dimensionless. If length has dimension of L, which of the following statement (s) is/are correct?

(*a*) The dimension of force is L^{-3}

(*b*) The dimension of energy of L^{-2}

(*c*) The dimension of power is L^{-5}

(*d*) The dimension of linear momentum is L^{-1}

137. A length-scale (l) depends on the permittivity (ε) of a dielectric material, Boltzmann constant (k_B), the absolute temperature (T), the number per unit volume (n) of certain charged particles, and the charge (q) carried by each of the particles. Which of the following expressions for l is (are) dimensionally correct?

(*a*) $l = \sqrt{\left(\frac{nq^2}{\varepsilon k_B T}\right)}$ (*b*) $l = \sqrt{\left(\frac{\varepsilon k_B T}{nq^2}\right)}$

(*c*) $l = \sqrt{\left(\frac{q^2}{\varepsilon n^{2/3} k_B T}\right)}$ (*d*) $l = \sqrt{\left(\frac{q^2}{\varepsilon n^{1/3} k_B T}\right)}$

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138. Young's modulus of elasticity Y is expressed in terms of three derived quantities, namely, the gravitational constant G. Planck's constant h and the speed of light c, as $Y = c^{\alpha}h^{\beta}G^{\gamma}$ Which of the following is the correct option?

(*a*) $\alpha = 7, \beta = -1, \gamma = -2$ (*b*) $\alpha = -7, \beta = -1, \gamma = -2$
(*c*) $\alpha = 7, \beta = -1, \gamma = -2$ (*d*) $\alpha = -7, \beta = 1, \gamma = -2$

139. If momentum (p), area (A) and time (T) are taken to be fundamental quantities, then energy has the dimensional formula.

(*a*) $[pA^{-1}T^{1}]$ (*b*) $[p^{2}AT]$
(*c*) $[pA^{-1/2}T]$ (*d*) $[pA^{1/2}T^{-1}]$

140. If surface tension (S), Moment of inertia (I) and Planck's constant (h), were to be taken as the fundamental units, the dimensional formula for linear momentum would be.

(*a*) $S^{3/2}I^{1/2}h^{0}$ (*b*) $S^{1/2}I^{1/2}h^{0}$
(*c*) $S^{1/2}I^{1/2}h^{-1}$ (*d*) $S^{1/2}I^{3/2}h^{-1}$

141. If force (F), velocity (V) and time (T) are considered as fundamental physical quantity, then dimensional formula of density will be:

(*a*) $FV^{-2}T^{2}$ (*b*) $FV^{-4}T^{-2}$
(*c*) $FV^{4}T^{-6}$ (*d*) $F^{2}V^{2}T^{2}$

142. Velocity (v) and acceleration (a) in two systems of units 1 and 2 are related as respectively. Here m and n are constants. The relations for distance and time in two systems respectively are:

(*a*) $\frac{n^3}{m^3}L_1 = L_2$ and $\frac{n^2}{m}T_1 = T_2$ (*b*) $L_1 = \frac{n^4}{m^2}L_2$ and $T_1 = \frac{n^2}{m}T_2$

(*c*) $L_1 = \frac{n^2}{m}L_2$ and $T_1 = \frac{n^4}{m^2}T_2$ (*d*) $\frac{n^2}{m}L_1 = L_2$ and $\frac{n^4}{m^2}T_1 = T_2$

143. Consider the efficiency of Carnot's engine is given by $\eta = \frac{\alpha\beta}{\sin\theta}\log_e\frac{\beta x}{kT}$ where α and β are constants. If T is temperature, k is Boltzman constant, θ is angular displacement and x has the dimensions of length. Then, choose the incorrect option

(*a*) Dimensions of β is same as that of force
(*b*) Dimensions of $\alpha^{-1}x$ is same as that of energy
(*c*) Dimensions of $\eta^{-1}\sin\theta$ theta is same as that of αβ
(*d*) Dimensions of α is same as that of β

144. If E and H represents the intensity of electric field and magnetising field respectively, then the unit of E/H will be:

(*a*) Joule (*b*) Newton
(*c*) Ohm (*d*) Mho

145. A physical quantity $\vec{S}$ is defined as $\vec{S} = (\vec{E} \times \vec{B})/\mu_0$, where $\vec{E}$ is electric field, $\vec{B}$ is magnetic field and μ_0 is the permeability of free space. The dimensions of $\vec{S}$ are the same as the dimensions of which of the following quantity (ies)?

(*a*) $\frac{\text{Energy}}{\text{Charge} \times \text{Current}}$ (*b*) $\frac{\text{Force}}{\text{Length} \times \text{Time}}$

(*c*) $\frac{\text{Energy}}{\text{Volume}}$ (*d*) $\frac{\text{Power}}{\text{Area}}$

146. Identify the pair of physical quantities that have same dimensions:

(*a*) Velocity gradient and decay constant
(*b*) Wien's constant and Stefan constant
(*c*) Angular frequency and angular momentum
(*d*) Wave number and Avogadro number

147. Which of the following physical quantities have the same dimensions?

(*a*) Electric displacement ($\vec{D}$) and surface charge density
(*b*) Displacement current and electric field
(*c*) Current density and surface charge density
(*d*) Electric potential and energy

148. Which of the following is not a dimensionless quantity?

(*a*) Relative magnetic permeability (μr)
(*b*) Power factor
(*c*) Quality factor
(*d*) Permeability of free space (μ_0)

149. Which of the following combinations has the dimension of electrical resistance (Σ_0 is the permittivity of vacuum and μ_0 is the permeability of vacuum)?

(*a*) $\sqrt{\frac{\epsilon_0}{\mu_0}}$ (*b*) $\frac{\mu_0}{\epsilon_0}$ (*c*) $\frac{\epsilon_0}{\mu_0}$ (*d*) $\sqrt{\frac{\mu_0}{\epsilon_0}}$

150. In a typical combustion engine the work done by a gas molecule is given by $W = \alpha^2\beta e^{-\frac{\beta x^2}{kT}}$, where x is the displacement, k is the Boltzmann constant and T is the temperature. If a and b are constants, dimensions of a will be :

(*a*) $[MLT^{-1}]$ (*b*) $[M^0 L T^0]$
(*c*) $[M^2LT^{-2}]$ (*d*) $[MLT^{-2}]$

151. Dimensional formula for thermal conductivity is (here K denotes the temperature):

(*a*) $MLT^{-3} K^{-1}$ (*b*) $MLT^{-2} K^{-2}$
(*c*) MLT–2 K (*d*) $MLT^{-3} K$

152. Amount of solar energy received on the earth's surface per unit area per unit time is defined a solar constant. Dimension of solar constant is

(*a*) ML^2T^{-2} (*b*) MLT^{-2}
(*c*) $M^2L^0T^{-1}$ (*d*) ML^0T^{-3}

Limitation of Dimensional Analysis

153. Which of the following equation can be derived dimensionally??

(*a*) $s = vt - \frac{1}{2}at^2$ (*b*) $v^2 = u^2 \times 2as$

(*c*) $h = \frac{\omega^2 r^2}{2g}$ (*d*) $v = \frac{d}{t}$

154. The method of dimensions cannot be applied to derive the formula for physical quantity which depends on

(*a*) Two different physical quantities
(*b*) Three physical quantities in which two have same dimensions
(*c*) More than three physical quantities
(*d*) Both (b) & (c)

155. Which of the following equation can not be derived dimensionally

(*a*) $F = 6\pi r\eta$ (*b*) $\theta = \omega t$

(*c*) $\frac{d\theta}{dt} = \rho A v$ (*d*) $P = \rho gh$

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156. Fill in the blanks with correct statement, according to given statement

Physically correctness	(1) _____	(2) _____	(c) Equation is physically wrong	(d) Equation is physically correct
Dimensional correctness	(a) Equation is dimensional wrong	(b) Equation is dimensional correct	(3) _____	(4) _____

157. A student when discussing the properties of medium writes velocity of light in vacuum = velocity of light in medium. This formula is

(*a*) Dimensionally correct (*b*) Dimensionally incorrect
(*c*) Numerically incorrect (*d*) Both A and C

158. **Assertion:** Work = Torque is dimensionally correct but not physically.
Reason: Dimensional correctness of an equation ensures its physical correctness)

(*a*) If both Assertion & Reason are True & the Reason is a correct explanation of the Assertion.
(*b*) If both Assertion & Reason are True but Reason is not a correct explanation of the Assertion.
(*c*) If Assertion is True but the Reason is False.
(*d*) If both Assertion & Reason are false.

Significant Digits

159. Give the number of significant figures in each measurement.

1. 60.36.7 m 2. 0.006606 s
3. 61.2.002 kg 4. 306,490,000 people

160. The number of significant figures in 3.04×10^{23} is:

(*a*) 2 (*b*) 3 (*c*) 23 (*d*) 25

161. The number of significant figures in 0.01020 is:

(*a*) 1 (*b*) 2 (*c*) 3 (*d*) 4

162. Match the list -I with List-II

List-I		List-II	
(I)	1001	(A)	3
(II)	010.1	(B)	4
(III)	100.100	(C)	5
(IV)	0.0010010	(D)	6

163. Given $P = 0.0030\ m$, $Q = 2.40$ m and $R = 3000\ m$, the number of significant figures in P,Q,R are respectively :

(*a*) 1, 2, 1 (*b*) 2, 3, 1
(*c*) 4, 2, 1 (*d*) 4, 2, 4

164. How many significant figures should the answer to this calculation contain? $= \dfrac{1.014 + 0.07}{5.11}$

(*a*) 2 (*b*) 3 (*c*) 4 (*d*) 1

165. Add these three length : $l_1 = 0.307$m, 0.52 m and 0.4 m

(*a*) 1.22 m (*b*) 1.2 m
(*c*) 1.3 m (*d*) 1.7 m

166. Calculate the correct number of significant figures for the final solution:

(*i*) Round 4.7475 to 4 significant figures
(*ii*) Round 4.7465 to 4 significant figures

167. (i) 76.4 × 180.4 = ?
(ii) 934.9 ÷ 0.00455 = ?

168. Number of significant digit in the result of $\dfrac{4.327}{2.515}$ m .

(*a*) 2 (*b*) 4
(*c*) 3 (*d*) 5

169. Taking into account of significant digit. What is the value of 9.99 m – 0.0099 m.

(*a*) 9.98 m (*b*) 9.890 m
(*c*) 9.9 m (*d*) 9.9801 m

170. The area of rectangle of length 55.3 m and breadth 25 m .

(*a*) 1382 (*b*) 1382.5
(*c*) 14×10^2 (*d*) 138×10^1

171. If A = 2.413 and B = 1.2 then find A + B

172. If = 25.5 and B = 5 then find $\dfrac{A}{B}$

173. Express the final answer to the proper number of significant figures.

(i) 101.2 + 18.702 = ?
(ii) 202.88 – 1.013 = ?

174. $\dfrac{1.5}{1.5}$ is equal to

(*a*) 1 (*b*) 1.0 (*c*) 1.00 (*d*) 1.000

175. When 96.54 is divided by 2.40, the correct result is:

(*a*) 40.2250 (*b*) 4.0225
(*c*) 40.23 (*d*) 40.2

176. Find round off value of x = 16.351

(*a*) 16 (*b*) 16.33 (*c*) 16.3 (*d*) 16.4

177. Find round off value of x = 3.250

(*a*) 3.2 (*b*) 3.25 (*c*) 3.5 (*d*) 3

178. If true value of length is 6.57 m then which of the following reading is most accurate.

(*a*) 6.52 m (*b*) 6.61 m
(*c*) 6.513 m (*d*) 6.68 m

179. Which of the following reading is most accurate?

(*a*) 2.4 m (*b*) 2.41 m (*c*) 2 m (*d*) 2.413 m

180. For greater accuracy, the quantity with higher power should have least error.

(*a*) True (*b*) False

181. The mean length of an object is 5 cm. Which of the following measurements is most accurate?

(*a*) 4.9 cm (*b*) 4.805 cm
(*c*) 5.25 cm (*d*) 5.4 cm

182. The length, breadth and thickness of a rectangular sheet of metal are 4.234m, 1.005 m and 2.01 cm, respectively. Given the area and volume of the sheet to correct significant figures.

(*a*) 8.7 m^2, 0.092 m^3 (*b*) 8.4 m^2, 0.092 m^3
(*c*) 9.2 m^2, 0.001^3 (*d*) 8.72 m^2, 0.0855 m^3

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Error Analysis

183. Smaller the least count, higher is the accurate of measurement.

(*a*) True (*b*) False

184. Absolute error of the measurement is defined as

(*a*) The magnitude of the difference between individual and the true value of quantity

(*b*) The difference between individual and the true value

(*c*) Positive or negative value

(*d*) Both (b) and (c)

185. Absolute error is not dimensionless quantity.

(*a*) True (*b*) False

186. If absolute error and actual value of a number are 5, 15 respectively then relative error is

(*a*) $\frac{1}{3}$ (*b*) $\frac{3}{2}$ (*c*) 3 (*d*) $\frac{100}{3}$

187. In a series of successive measurements in an experiment, the readings of the period of oscillation of a simple pendulum were round to be 2.63s, 2.56s, 2.42s, 2.71s and 2.80s. Calculate

(i) The mean value of the period of oscillation

(ii) The absolute error in each measurement

(iii) The mean absolute error

(iv) The relative error

(v) The percentage error

188. **Assertion (A):** $T_1 = (104° \pm 0.3)°C$; $T_2 = (100 \pm 0.1)°C$. $T_1 - T_2 = (4 \pm 0.4)°C$; $T_1 + T_2 = (204 \pm 0.4)°C$

Reason (R): Mean absolute error is added always but not applicable for absolute value.

(*a*) Both A and R are true and R is the correct explanation of A.

(*b*) Both A and R are true but R is NOT the correct explanation of A.

(*c*) A is true but R is false.

(*d*) A is false but R is true.

189. Kallua measure mass of object as m = 4.95 kg.Where True mass is 5kg.

190. Measured a length of rod l1 = 5.02 cm l_2 = 5.0 4 cm rl_3 = 4.94 cm then find mean absolute and percentage error in measurment.

191. Relative error is a dimensionless quantity.

(*a*) True (*b*) False

192. Absolute error and actual value of P.Q are 5 and 15 then relative and % error.

193. A wire has a mass (0.3 ± 0.003) g, radius (0.5 ± 0.005) mm and length (6 ± 0.06) cm. The maximum percentage error in the measurement of its density is:

(*a*) 1 (*b*) 2 (*c*) 3 (*d*) 4

194. If $A = (6 \pm 1)$ and $B = (4 \pm 2)$ m then find $Z = 2A + B$ with absolute error.

195. In an experiment to measure the height of a bridge by dropping stone into water underneath, if the error in measurement of time is 0.1 s at the end of 2 s, then the error in estimation of height of bridge will be

(*a*) 0.49 m (*b*) 0.98 m

(*c*) 1.96 m (*d*) 2.12 m

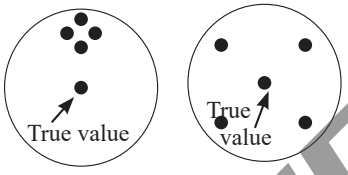
196. Value of $A = (10 \pm 0.1)$ m and $B = (20 \pm 0.5)$ m then find:

(i) $x = B + A$ (ii) $y = B - A$

(iii) $z = B.A$ (iv) $m = B/A$

197. In an experiment to find acceleration due to gravity (*g*) using simple pendulum, time period of 0.5 s is measured from time of 100 oscillation with a watch of 1s resolution. If measured value of length is 10 cm known to 1 mm accuracy. The accuracy in the determination of *g* is found to be *x*%. The value of x is

198.



Assertion: Instrument (i) is less accurate but more precise.

Reason : We will prefer instrument (i) for measurement.

(*a*) Both Assertion and Reason are correct and Reason is correct explanation of Assertion.

(*b*) Both Assertion and Reason are correct and Reason is not correct explanation of Assertion

(*c*) Assertion is correct but Reason is wrong

(*d*) Both Assertion and Reason are wrong.

Relative Error

199. Value of $A = (10 \pm 0.1)$ m and $B = (20 \pm 0.5)$ m then find:

(i) $x = B + A$ (ii) $y = B - A$

(iii) $z = B.A$ (iii) $m = B/A$

200. A public park, in the form of a square, has an area of (100 ± 0.2) m^2. The side of park is

(*a*) (10 ± 0.01) m (*b*) (10 ± 0.1) m

(*c*) (10 ± 0.02) m (*d*) (10 ± 0.2) m

201. If temprature T_1 = (340 K ± 5K) and T_2 = (300K ± 10 K) find error in temprature difference.

(*a*) 50K (*b*) 40K (*c*) 15K (*d*) 5K

202. If Z = A + B, find % error in Z.

203. If $Z = \frac{A}{B}$, Find absolute error in Z.

204. The external and internal diameters of a hollow cylinder are measured to be (4.23 ± 0.01) cm and (3.89 ± 0.01) cm. The thickness of the wall of the cylinder is:

(*a*) (0.34 ± 0.02) cm (*b*) (0.17 ± 0.02) cm

(*c*) (0.17 ± 0.01) cm (*d*) (0.34 ± 0.01) cm

205. The temprature of two bodies measured are $\theta_1 = 10°C \pm 0.4°C$ and $\theta_2 = 40°C \pm 0.3°C$. Find the sum and difference in temprature with error limit.

206. Percentage error in measuring the radius and mass of a solid sphere are 2% & 1% respectively. Then error in measurement of moment of inertia with respect to its diameter is :-

(*a*) 3% (*b*) 6% (*c*) 5% (*d*) 4%

207. $Z = \frac{4A^{\frac{1}{2}}\sqrt{B}}{C^{\frac{1}{3}}D}$, Find % error in Z

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208. In an experiment four quantities a, b, c and d are measured with percentage error 1%, 2%, 3% and 4%, respectively. Quantity P is calculate as follows: $P = \frac{a^3b^2}{cd}$, % error in P is

(*a*) 10% (*b*) 7% (*c*) 4% (*d*) 14%

209. If the error in the measurement of radius of a sphere is 2%, then the error in the determination of volume of the sphere will be:

(*a*) 2% (*b*) 4% (*c*) 6% (*d*) 8%

210. The error in measuring the mass and radius of a solid sphere are ±1% and ±0.5% respectively. The error in calculation of the moment of inertia of the solid sphere will be about:

(*a*) ±1.5% (*b*) +2.5% (*c*) ±3% (*d*) ±2

211. If error in measuring diameter of a circle is 4%, the error in circumference of the circle would be:

(*a*) 2% (*b*) 8% (*c*) 4% (*d*) 1%

212. A force F is applied on a square area of side L. If the percentage error in the measurement of L is 2% and that in F is 4%, what is the maximum percentage error in pressure?

(*a*) 2% (*b*) 4% (*c*) 6% (*d*) 8%

213. If the percentage error in the measurement of momentum and mass of an object are 2% and 3% respectively, then maximum percentage error in the calculate value of its kinetic energy is

(*a*) 2% (*b*) 1% (*c*) 5% (*d*) 7%

214. A rectangular plate has length (2 + 0.02) cm and width (1 ± 0.01) cm. The maximum percentage error in the measurement of its area is

(*a*) 1% (*b*) 2% (*c*) 3% (*d*) 5%

215. The radius of a spherical body is (10 ± 0.5) cm. Then correct option is/are

(*a*) The percentage error in radius is 5%

(*b*) The percentage error in volume is 10%

(*c*) The percentage error in volume is 15%

(*d*) Both (A) & (C)

216. The least count of a stop watch is 1/5 second. The time of 20 oscillations of a pendulum is measured to be 25 seconds. The maximum percentage error in the measurement of time will be

(*a*) 0.1% (*b*) 0.8% (*c*) 1.8% (*d*) 8%

217. A physical quantity is represented by $X = [M^a L^b T^{-c}]$. If percentage error in the measurement of M, L and T are α%, β% and γ% respectively, then maximum percentage error in measurement of X should be (Given that α, β and γ are very small)

(*a*) $(\alpha a - \beta b + \gamma c)\%$ (*b*) $(\alpha a + \beta b + \gamma c)\%$

(*c*) $(\alpha a - \beta b - \gamma c)\%$ (*d*) $(\alpha a + \beta b - \gamma c)\%$

218. The acceleration due to gravity is measured on the surface of earth by using a simple pendulum. If α and β are relative errors in the measurement of length and time period respectively, then percentage error in the measurement of acceleration due to gravity is

(*a*) $\left(\alpha + \frac{1}{2}\beta\right)$ (*b*) $(\alpha - 2\beta)$

(*c*) $(2\alpha + \beta) \times 100$ (*d*) $(\alpha + 2\beta) \times 100$

219. Time period of simple pendulum $T = 2\pi\sqrt{\frac{l}{g}}, l$ is about 100 cm and is known to have 1 mm accuracy. Time period is 2s. The time of 100 oscillation measured by stop watch of L.C. 0.1.S. percentage error in g.

220. The resistance of a conductor R = V/I where V = (50 ± 2) volt and I = (9 ± 0.3) Amp, find percentage error in R. also find absoule error in R.

221. The radius of a sphere is (5.3 ± 0.1) cm. The percentage error in its volume is

(*a*) $\frac{0.1}{5.3} \times 100$ (*b*) $3 \times \frac{0.1}{5.3} \times 100$

(*c*) $\frac{3}{2} \times \frac{0.1}{5.3} \times 100$ (*d*) $6 \times \frac{0.1}{0.3} \times 100$

222. The length of a cylinder is measured with a meter rod having least count 0.1 cm. Its diameter is measured with Vernier caliper's having least count 0.01 cm. Given that length is 5 cm and radius is 2 cm. The percentage error in the calculated value of volume will be

(*a*) 1% (*b*) 2% (*c*) 3% (*d*) 4%

223. The relative error in the determination of the surface area of sphere is a. Then the relative error in the determination of its volume is:

(*a*) $\frac{3}{2}\alpha$ (*b*) $\frac{2}{3}\alpha$ (*c*) $\frac{5}{2}\alpha$ (*d*) α

224. $y = \sin\theta$ find percentage error in y if percentage error in θ is 2% at $\theta = \pi/6$ rad.

225. If y = m tanθ, where m is constant then find angle at which % error in 'y' will be minimum.

226. If percetange error in speed and mass are 1% and 2% then find % error in K.E.

227. Find percentage error in length of simple pendulum if % error in time is 4% and acceleration due to gravity is 2%

228. If error in measurment of speed is 50% then find % error in kinetic energy.

229. Two wire of resistance $R_1 = (50 \pm 2)\ \Omega$ and $R_2 = (100 \pm 4)\ \Omega$, find equivalent capacitance in (I) series (II) parallel with absolute error.

Types of Instruments & Least Count

230. If measured length of Rod is 1.56 cm then instrument used is

(*a*) metre scale (*b*) Vernier caliper

(*c*) screw gauge

231. Write down name of measuring instrument for given measurement:

(1) 87.3 mm (5) 8.53 cm

(2) 0.831 cm (6) 8.96 mm

(3) 6.7 cm (7) 9.812 cm

(4) 6.7 mm

232. A student measured the length of a rod and wrote it as 3.50 cm. Which instrument did he use to measure it?

(*a*) A screw gauge having 100 divisions in the circular scale and pitch as 1 mm.

(*b*) A screw gauge having 50 divisions in the circular scale and pitch as 1 mm.

(*c*) A meter scale.

(*d*) A Vernier caliper where the 10 divisions in Vernier scale matches with 9 division in main scale and main scale has 10 divisions in 1 cm.

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233. Given below are two statements:

Statement I: Least count of a screw gauge is directly proportional to the number of divisions on circular scale.

Statement II: A screw gauge having a smaller value of pitch has greater accuracy.

In the light of the above statements, choose the most appropriate answer from the options given below:

(*a*) Both statement I and statement II are correct
(*b*) Statement I is correct and statement II is incorrect
(*c*) Statement I is incorrect and statement II is correct.
(*d*) Both statements I and statements II are incorrect

234. Match the quantities in column –I to dimensions in column-II. R is resistance, L is inductance, C is capacitance, H is latent heat and S is specific heat.

Column-I		Column-II	
(A)	LC	(p)	L^2T^{-2}
(B)	LR	(q)	$L^2T^{-2}K^{-1}$
(C)	H	(r)	T^2
(D)	S	(s)	$M^2L^4T^{-5}A^{-4}$

(*a*) A→r, B→s, C→p, D→q (*b*) A→s, B→p ,C→r, D→q
(*c*) A→p, B→s,C→r, D→q (*d*) A→q, B→s,C→r, D→q

Vernier Caliper

235. In Vernier calipers 8 M.S.D. coincides with 10 Vernier scale division then find least count.

236. Least count of main scale of Vernier caliper is 1 cm and 4 main scale division coincide with 6 Vernier scale division then L.C. of Vernier scale.

237. 10 divisions on the main scale of Vernier caliper coincide with x divisions on Vernier scale. If Each division on main scale is of 5 units and Vernier constant of given scale is 5/11, find the value of x.

(*a*) 11 (*b*) 12 (*c*) 9 (*d*) 13

238. In certain vernier callipers, 25 divisions on the vernier scale have the same length as 24 divisions on the main scale. One division on the main scale is 1 mm long. The least count of the instrument is

(*a*) 0.04 mm (*b*) 0.01 mm (*c*) 0.02 mm (*d*) 0.08 mm

239. In a Vernier calliper, one main scale division is x cm and n division of Vernier scale coincide with $(n - 1)$ division of the main scale. The least count of the Vernier caliper in cm is:

(*a*) $\left(\frac{n-1}{n}\right)x$ (*b*) $\frac{nx}{(n-1)}$ (*c*) $\frac{x}{n}$ (*d*) $\frac{x}{n-1}$

240. The main scale of a Vernier callipers has n divisions/cm. n divisions of the Vernier scale coincide with $(n - 1)$ divisions of main scale. The least count of the Vernier callipers is

(*a*) $\frac{1}{(n+1)(n-1)}$ cm (*b*) $\frac{1}{n}$ cm

(*c*) $\frac{1}{n^2}$ cm (*d*) $\frac{1}{n(n+1)}$ cm

241. One cm on the main scale of vernier callipers is divided into ten equal parts. If 20 divisions of vernier scale coincide with 8 small divisions of the main scale. What will be the least count of callipers?

242. A hypothetical Vernier scale of a travelling microscope has 40 divisions which is equal to 38 main scale divisions. If each main scale division is 1.2 mm, then minimum error in the measurement of length is

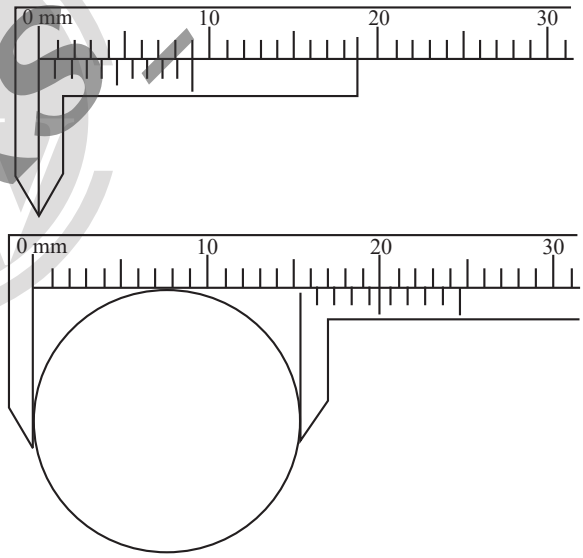
(*a*) 0.6 mm (*b*) 1.2 mm
(*c*) 0.06 mm (*d*) 0.1 mm

243. One centimeter on the main scale of Vernier calliper is divided into ten equal parts. If 10 divisions of Vernier scale coincide with 8 small divisions of the main scale, the least count of the callipers is:

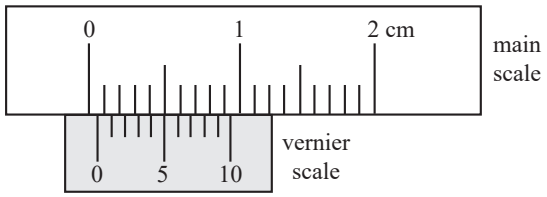
(*a*) 0.01 cm (*b*) 0.02 cm
(*c*) 0.05 cm (*d*) 0.07 cm

Reading on vernier Calliper

244. In the given Vernier scale, 10 divisions of the vernier scale is matching with 9 divisions of the main scale as shown in the first figure. Find the diameter of the object in the second figure. Assume the edge of the vernier as '0' of the verrnier.



245. Find the zero correction in the given figure.



(*a*) 0.4 mm (*b*) 0.5 mm
(*c*) –0.5 mm (*d*) –0.4 mm

246. The diameter of a cylinder is measured using a vernier calipers with no zero error. It is found that the zero of the vernier scale lies between 5.10 cm and 5.15 cm of the main scale. The vernier scale has 50 divisions equivalent to 2.45 cm. The 24th division of the vernier scale exactly coincides with one of the main scale divisions. The diameter of the cylinder is

(*a*) 5.112 cm (*b*) 5.124 cm
(*c*) 5.136 cm (*d*) 5.148 cm

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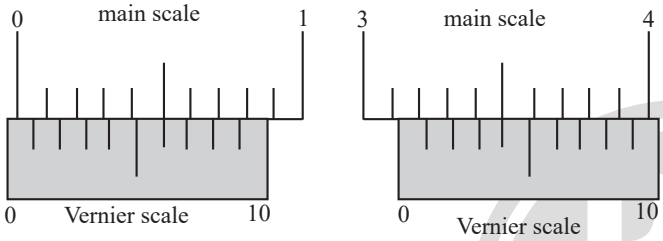
247. The least count of the main scale of a vernier calipers is 1 mm. Its vernier scale is divided into 10 divisions and coincide with 9 divisions of the main scale. When jaws are touching each other, the 7th division of vernier scale coincides with a division of main scale and the zero of vernier scale is lying right side of the zero of main scale. When this vernier is used to measure length of cylinder the zero of the vernier scale between 3.1 cm and 3.2 cm and 4th VSD coincides with a main scale division. The length of the cylinder is (VSD is vernier scale division)

(*a*) 2.99 cm (*b*) 3.07 cm (*c*) 3.21 cm (*d*) 3.2 cm

248. The smallest division on the main scale of a Vernier callipers is 0.1 cm. Ten divisions of the Vernier scale correspond to nine divisions of the main scale. The figure below on the left shows the reading of this calliper with no gap between its two jaws. The figure on the right shows the reading with a solid sphere held between the jaws. The correct diameter of the sphere is



(*a*) 3.07 cm (*b*) 3.11 cm (*c*) 3.15 cm (*d*) 3.17 cm

Screw Gauge

249. A screw gauge has least count of 0.01 mm and there arc 50 divisions in its circular scale. The pitch of the screw gauge is

(*a*) 0.01 mm (*b*) 0.25 mm (*c*) 0.5 mm (*d*) 1.0 mm

250. Using screw gauge of pitch 0.1 cm and 50 divisions on its circular scale, the thickness of an object is measured. It should correctly be recorded as

(*a*) 2,123 cm (*b*) 2.124 cm
(*c*) 2.125 cm (*d*) 2.121 cm

251. A screw gauge has 50 divisions on its circular scale. The circular scale is 4 units ahead of the pitch scale marking, prior to use. Upon one complete rotation of the circular scale, a displacement of 0.5 mm is noticed on the pitch scale. The nature of zero error involved and the least count of the screw gauge, are respectively:

(*a*) Positive, 0.1 mm (*b*) Positive, 0.1 μm
(*c*) Positive, 10 μm (*d*) Negative, 2 μm

252. **Assertion (A):** If in five complete rotations of the circular scale, the distance travelled on main scale of the screw gauge is 5 mm and there are 50 total divisions on circular scale, then least count is 0.001 cm.

Reason (R): Least Count = $\dfrac{\text{Pitch}}{\text{Total divisions on circular sclae}}$

In the light of the above statements, choose the most appropriate answer from the options given below :

(*a*) A is not correct but R is correct.
(*b*) Both A and R are correct and R is the correct explanation of A.
(*c*) A is correct but R is not correct.
(*d*) Both A and R are correct and R is NOT the correct explanation of A

Reading on Screw Guage

253. A student measured the diameter of a small steel ball using a screw gauge of least count 0.001 cm. The main scale reading is 5 mm and zero of circular scale division coincides with 25 divisions above the reference level. If screw gauge has a zero error of –0.004 cm, the correct diameter of the ball is

(*a*) 0.521 cm (*b*) 0.525 cm (*c*) 0.053 cm (*d*) 0.529 cm

254. Two full turns of the circular scale of gauge cover a distance of 1 mm on scale. The total number of divisions on circular scale is 50. Further, it is found that screw gauge has a zero error of -0.03 mm. While measuring the diameter of a thin wire a student notes the main scale reading of 3 mm and the number of circular scale division in line, with the main scale as 35. The diameter of the wire is

(*a*) 3.32 mm (*b*) 3.73 mm (*c*) 3.67 mm (*d*) 3.38 mm

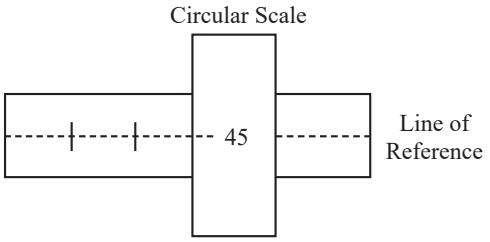
255. The pitch of a screw gauge is 1 mm and there are 100 division on its circular scale. When nothing is put in between its jaws, the zero of the circular scale lies 4 divisions below the reference line, When a steel wire is placed between the jaws, two main scale divisions are clearly visible and 67 divisions on the circular scale are observed. The diameter of the wire is

(*a*) 2.71 mm (*b*) 2.67 mm (*c*) 2.63 mm (*d*) 2.65 mm

256. A screw gauge with a pitch of 0.5 mm and a circular scale with 50 divisions is used to measure the thickness of a thin sheet of Aluminium. Before starting the measurement, it is found that when the two jaws of the screw gauge are brought in contact, the 45th division coincides with the main scale line and that the zero of the main scale is barely visible. What is the thickness of the sheet if the main scale reading is 0.5 mm and the 25th division coincides the main scale line?

(*a*) 0.75 mm (*b*) 0.80 mm (*c*) 0.70 mm (*d*) 0.50 mm

257. Consider a screw gauge without any zero error. What will be the final reading corresponding to the final state as shown? It is given that the circular head translates P MSD in N rotations. One MSD is equal to 1 mm.



The circular scale has 100 divisions

(*a*) $\left(\dfrac{P}{N}\right)\left(2+\dfrac{45}{100}\right)$ mm (*b*) $\left(\dfrac{N}{P}\right)\left(2+\dfrac{45}{N}\right)$ mm

(*c*) $P\left(\dfrac{2}{N}+\dfrac{45}{100}\right)$ mm (*d*) $\left(2+\dfrac{45}{100}\times\dfrac{P}{N}\right)$ mm

258. There are 100 divisions on the circular scale of a screw gauge of pitch 1 mm. With no measuring quantity in between the jaws, the zero of the circular scale lies 5 divisions below the reference line. The diameter of a wire is then measured using this screw gauge. It is found the 4 linear scale divisions are clearly visible while 60 divisions on circular scale coincide with the reference line. The diameter of the wire is:

(*a*) 4.65 mm (*b*) 4.55 mm (*c*) 4.60 mm (*d*) 3.35 mm

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Types of error

259. Zero error of an instrument introduces:

(*a*) Systematic errors (*b*) Random errors

(*c*) Both (*d*) None

260. **Assertion (A):** In Vernier caliper, if positive zero error exists, then while taking measurements the reading taken will be more than actual Reading.

Reason (R): The Zero error in Vernier caliper might have happened due to manufacturing defect or due to rough handling.

(*a*) Both A and R are true and R is the correct explanation of A.

(*b*) Both A and R are true but R is NOT the correct explanation of A.

(*c*) A is true but R is false.

(*d*) A is false but R is true.

261. In 5 number of observation systematic error is 12% then find error in 20 observation?

262. In 5 number of observation random error is 12% then find error in 20 observation?

263. Given below are two statements:

Statement I: Absolute error is unitless and dimensionless.

Statement II: All types of errors are unitless and dimensionless.

In the light of the above statements, choose the most appropriate answer from the options given below:

(*a*) Both statement I and statement II are correct

(*b*) Statement I is correct and statement II is incorrect.

(*c*) Statement I is incorrect and statement II is correct

(*d*) Both statements I and statements II are incorrect.

264. Given below are two statements: one is labelled as Assertion A and the other is labelled as Reason R

Assertion A: A spherical body of radius (5 ± 0.1) mm having a particular density is falling through a liquid of constant density. The percentage error in the calculation of its terminal velocity is 4%.

Reason R: The terminal velocity of the spherical body falling through the liquid is inversely proportional to its radius.

In the light of the above statements, choose the correct answer from the options given below

(*a*) If both assertion and reason are true and the reason is the correct explanation of the assertion.

(*b*) If both assertion and reason are true, but reason is not the correct explanation of the assertion.

(*c*) If assertion is true, but reason is false

(*d*) If assertion is false, but reason is true.

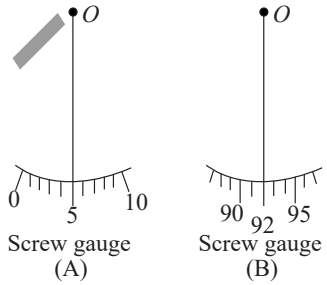
(e) If both assertion and reason are false.

265. The diameter and height of a cylinder are measured by a meter scale to be 12.6 ± 0.1 cm and 34.2 ± 0.1 cm respectively. What will be the value of its volume in appropriate significant figures?

(*a*) $4264 \pm 81\ cm^3$ (*b*) $4264 \pm 81.0\ cm^3$

(*c*) $4260 \pm 80\ cm^3$ (*d*) $4300 \pm 80\ cm^3$

266. Student *A* and Student *B* used two screw gauges of equal pitch and 100 equal circular divisions to measure the radius of a given wire. The actual value of the radius of the wire is 0.322 cm . The absolute value of the difference between the final circular scale readings observed by the students *A* and *B* is.....



[Figure shows position of reference '*O*' when jaws of screw gauge are closed]

Given pitch = 0.1 cm.

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1. **Assertion:** Force can be added to pressure.

   Reason: Force and pressure have same dimensions.

   (*a*) If both A and R are true and reason is the correct explanation of assertion.

   (*b*) If both A and R are true but reason is not the correct explanation of assertion.

   (*c*) If assertion is true but reason is false.

   (*d*) If both assertion and reason are false.

2. **Assertion :** Pressure cannot be subtracted from pressure gradient.

   Reason: Pressure and pressure gradient have different dimensions.

   (*a*) If both A and R are true and reason is the correct explanation of assertion.

   (*b*) If both A and R are true but reason is not the correct explanation of assertion.

   (*c*) If assertion is true but reason is false.

   (*d*) If both assertion and reason are false.

3. Assertion : Both velocity and speed have same dimensions.

   Reason: Velocity cannot be added to speed.

   (*a*) If both A and R are true and reason is the correct explanation of assertion.

   (*b*) If both A and R are true but reason is not the correct explanation of assertion.

   (*c*) If assertion is true but reason is false.

   (*d*) If both assertion and reason are false.

4. **Assertion:** The dimensional formula of surface energy is $[M^1L^2T^{-2}]$.

   Reason: Surface energy has same dimensions as that of potential energy.

   (*a*) If both A and R are true and reason is the correct explanation of assertion.

   (*b*) If both A and R are true but reason is not the correct explanation of assertion.

   (*c*) If assertion is true but reason is false.

   (*d*) If both assertion and reason are false.

5. **Assertion:** The given equation $x = x_0 + u_0t + 1/2\ at^2$ is dimensionally correct, where x is the distance travelled by a particle in time t, initial position x_0 initial velocity u_0 and uniform acceleration a is along the direction of motion.

   Reason: Dimensional analysis can be used for checking the dimensional consistency or homogeneity of the equation.

   (*a*) If both A and R are true and reason is the correct explanation of assertion.

   (*b*) If both A and R are true but reason is not the correct explanation of assertion.

   (*c*) If assertion is true but reason is false.

   (*d*) If both assertion and reason are false.

6. **Assertion:** Force cannot be added to pressure.

   Reason: Because their dimensions are different.

   (*a*) If both A and R are true and reason is the correct explanation of assertion.

   (*b*) If both A and R are true but reason is not the correct explanation of assertion.

   (*c*) If assertion is true but reason is false.

   (*d*) If both assertion and reason are false.

7. **Assertion:** Mass, length and time are fundamental physical quantities.

   Reason: They are independent of each other.

   (*a*) If both A and R are true and reason is the correct explanation of assertion.

   (*b*) If both A and R are true but reason is not the correct explanation of assertion.

   (*c*) If assertion is true but reason is false.

   (*d*) If both assertion and reason are false.

8. **Assertion:** Density is a derived physical quantity.

   Reason: Density cannot be derived from the fundamental physical quantities.

   (*a*) If both A and R are true and reason is the correct explanation of assertion.

   (*b*) If both A and R are true but reason is not the correct explanation of assertion.

   (*c*) If assertion is true but reason is false.

   (*d*) If both assertion and reason are false.

9. **Assertion:** When we change the unit of measurement of a quantity, its numerical value changes.

   Reason: Smaller the unit of measurement, smaller is its numerical value.

   (*a*) If both A and R are true and reason is the correct explanation of assertion.

   (*b*) If both A and R are true but reason is not the correct explanation of assertion.

   (*c*) If assertion is true but reason is false.

   (*d*) If both assertion and reason are false.

10. **Assertion:** The time period of a pendulum is given by the formula, $T = 2\pi\sqrt{l/g}$.

    Reason: According to the principle of homogeneity of dimensions, only that formula is correct in which the dimensions of LHS is equal to dimensions of RHS.

    (*a*) If both A and R are true and reason is the correct explanation of assertion.

    (*b*) If both A and R are true but reason is not the correct explanation of assertion.

    (*c*) If assertion is true but reason is false.

    (*d*) If both assertion and reason are false.

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11. Assertion: L/R and CR both have the same dimensions.

Reason: L/R and CR both have the dimension of time.

(*a*) If both A and R are true and reason is the correct explanation of assertion.

(*b*) If both A and R are true but reason is not the correct explanation of assertion.

(*c*) If assertion is true but reason is false.

(*d*) If both assertion and reason are false.

12. Assertion: The quantity $(1/\sqrt{\mu_0\varepsilon_0})$ is dimensionally equal to velocity and numerically equal to velocity of light.

Reason: μ_0 is permeability of free space and ε_0 is the permittivity of free space.

(*a*) If both A and R are true and reason is the correct explanation of assertion.

(*b*) If both A and R are true but reason is not the correct explanation of assertion.

(*c*) If assertion is true but reason is false.

(*d*) If both assertion and reason are false.

13. Assertion: Dimensional constants are quantities whose values are constant.

Reason: Dimensional constants are dimensionless.

(*a*) If both A and R are true and reason is the correct explanation of assertion.

(*b*) If both A and R are true but reason is not the correct explanation of assertion.

(*c*) If assertion is true but reason is false.

(*d*) If both assertion and reason are false.

14. Assertion: A screw gauge having a smaller value of pitch has greater accuracy.

Reason: The least count of screw gauge is directly propor- tional to the number of divisions on circular scale.

(*a*) If both A and R are true and reason is the correct explanation of assertion.

(*b*) If both A and R are true but reason is not the correct explanation of assertion.

(*c*) If assertion is true but reason is false.

(*d*) If both assertion and reason are false.

15. Assertion: Heat can be added to work done.

Reason: Heat and work have the same dimensions.

(*a*) If both A and R are true and reason is the correct explanation of assertion.

(*b*) If both A and R are true but reason is not the correct explanation of assertion.

(*c*) If assertion is true but reason is false.

(*d*) If both assertion and reason are false.

16. Assertion: All unitless quantities are dimensionless.

Reason: Dimensions are exponent raised to fundamental units in derived units.

(*a*) If both A and R are true and reason is the correct explanation of assertion.

(*b*) If both A and R are true but reason is not the correct explanation of assertion.

(*c*) If assertion is true but reason is false.

(*d*) If both assertion and reason are false.

17. Assertion: All dimensionless quantities are unitless.

Reason: All unitless quantities are not dimensionless.

(*a*) If both A and R are true and reason is the correct explanation of assertion.

(*b*) If both A and R are true but reason is not the correct explanation of assertion.

(*c*) If assertion is true but reason is false.

(*d*) If both assertion and reason are false.

18. Assertion: Universal gravitation constant is a dimensional constant. **Reason:** $G = 6.67\times10^{-11}\ Nm^2\ kg^{-2}$.

(*a*) If both A and R are true and reason is the correct explanation of assertion.

(*b*) If both A and R are true but reason is not the correct explanation of assertion.

(*c*) If assertion is true but reason is false.

(*d*) If both assertion and reason are false.

19. Assertion: Power of an engine depends on mass, angular speed, torque and angular momentum, so the formula of power is not derived with the help of dimensional method.

Reason: In mechanics, if a particular quantity depends on more than three quantities, then we cannot derive the formula of the quantity by the help of dimensional method.

(*a*) If both A and R are true and reason is the correct explanation of assertion.

(*b*) If both A and R are true but reason is not the correct explanation of assertion.

(*c*) If assertion is true but reason is false.

(*d*) If both assertion and reason are false.

20. Assertion: Angular momentum and Planck's constant have the same dimensional formula.

Reason: Angular momentum and Planck's constant are dimensional constants.

(*a*) If both A and R are true and reason is the correct explanation of assertion.

(*b*) If both A and R are true but reason is not the correct explanation of assertion.

(*c*) If assertion is true but reason is false.

(*d*) If both assertion and reason are false.

21. Assertion: All dimensionally correct formula must be numerically correct.

Reason: All numerically correct formula may be dimensionally incorrect.

(*a*) If both A and R are true and reason is the correct explanation of assertion.

(*b*) If both A and R are true but reason is not the correct explanation of assertion.

(*c*) If assertion is true but reason is false.

(*d*) If both assertion and reason are false.

22. Assertion: The magnitude of any physical quantity does not depend on the method of measurement.

Reason: The magnitude of any physical quantity is more in SI system than in CGS system.

(*a*) If both A and R are true and reason is the correct explanation of assertion.

(*b*) If both A and R are true but reason is not the correct explanation of assertion.

(*c*) If assertion is true but reason is false.

(*d*) If both assertion and reason are false.

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23. **Assertion:** Temperature cannot be expressed as a derived quantity in terms of length and mass.

Reason: Temperature is a fundamental quantity.

(*a*) If both A and R are true and reason is the correct explanation of assertion.

(*b*) If both A and R are true but reason is not the correct explanation of assertion.

(*c*) If assertion is true but reason is false.

(*d*) If both assertion and reason are false.

24. **Assertion:** Quality factor is dimensionless.

Reason: Quality factor depends on resistance, inductance and capacitance of LCR series circuit.

(*a*) If both A and R are true and reason is the correct explanation of assertion.

(*b*) If both A and R are true but reason is not the correct explanation of assertion.

(*c*) If assertion is true but reason is false.

(*d*) If both assertion and reason are false.

25. **Assertion:** Kilowatt-hour is a unit of energy.

Reason: Kilowatt is the unit of energy.

(*a*) If both A and R are true and reason is the correct explanation of assertion.

(*b*) If both A and R are true but reason is not the correct explanation of assertion.

(*c*) If assertion is true but reason is false.

(*d*) If both assertion and reason are false.

26. **Assertion:** The unit of EMF is Joule/Coulomb.

Reason: EMF is an electromagnetic force.

(*a*) If both A and R are true and reason is the correct explanation of assertion.

(*b*) If both A and R are true but reason is not the correct explanation of assertion.

(*c*) If assertion is true but reason is false.

(*d*) If both assertion and reason are false.

27. **Assertion:** A physical quantity is measured and its value is always found to be *nu*; where *n* is the numerical value and *u* is the unit.

Reason: $n \propto \frac{1}{u}$

(*a*) If both A and R are true and reason is the correct explanation of assertion.

(*b*) If both A and R are true but reason is not the correct explanation of assertion.

(*c*) If assertion is true but reason is false.

(*d*) If both assertion and reason are false.

28. **Assertion:** Unit of surface tension is newton per metre.

Reason: Surface tension is the force on the surface of a liquid.

(*a*) If both A and R are true and reason is the correct explanation of assertion.

(*b*) If both A and R are true but reason is not the correct explanation of assertion.

(*c*) If assertion is true but reason is false.

(*d*) If both assertion and reason are false.

29. **Assertion:** Dimensional formula for latent heat is [M0L2T–2]

Reason: Latent heat is the heat required to change the state of any system per unit mass.

(*a*) If both A and R are true and reason is the correct explanation of assertion.

(*b*) If both A and R are true but reason is not the correct explanation of assertion.

(*c*) If assertion is true but reason is false.

(*d*) If both assertion and reason are false.

30. **Assertion:** The frequency of vibration of a mass *m* suspended from a spring of spring constant K is given by a relation of the type, $f = C\, m^x\, K^y$; where C is a dimensionless quantity.

Reason: $x = 1/2$, $y = -1/2$

(*a*) If both A and R are true and reason is the correct explanation of assertion.

(*b*) If both A and R are true but reason is not the correct explanation of assertion.

(*c*) If assertion is true but reason is false.

(*d*) If both assertion and reason are false.

31. **Assertion:** Accuracy of measurement is determined by absolute error and percentage error both.

Reason: Absolute error is the difference in actual and measured values of physical quantities.

(*a*) If both A and R are true and reason is the correct explanation of assertion.

(*b*) If both A and R are true but reason is not the correct explanation of assertion.

(*c*) If assertion is true but reason is false.

(*d*) If both assertion and reason are false.

32. **Assertion:** The unit of specific resistance is Ohm.

Reason: Specific resistance is another name for specific conductance.

(*a*) If both A and R are true and reason is the correct explanation of assertion.

(*b*) If both A and R are true but reason is not the correct explanation of assertion.

(*c*) If assertion is true but reason is false.

(*d*) If both assertion and reason are false.

33. **Assertion:** The random error in the arithmetic mean of 100 observations is *x*; then random error in the arithmetic mean of 400 observations would be *x*/4.

Reason: Arithmetic mean of the magnitudes of absolute errors in *n* measurements of the quantity is represented by

$$\overline{\Delta a} = \frac{|\Delta a_1| + |\Delta a_2| + ... + |\Delta a_n|}{n}$$

(*a*) If both A and R are true and reason is the correct explanation of assertion.

(*b*) If both A and R are true but reason is not the correct explanation of assertion.

(*c*) If assertion is true but reason is false.

(*d*) If both assertion and reason are false.

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34. Assertion: The quantity percentage error is unitless.

Reason: Percentage error

$$= \frac{\text{Mean absolute error}}{\text{Mean value}} \times 100\% = \frac{\overline{\Delta a}}{a_m} \times 100\%;$$

(*a*) If both A and R are true and reason is the correct explanation of assertion.

(*b*) If both A and R are true but reason is not the correct explanation of assertion.

(*c*) If assertion is true but reason is false.

(*d*) If both assertion and reason are false.

35. Assertion: Out of the two measurements 50.14 cm and 0.00025 A, the first one has greater accuracy.

Reason: Since for 50.14 cm, significant number is 4 and for 0.00025, significant number is 2.

(*a*) If both A and R are true and reason is the correct explanation of assertion.

(*b*) If both A and R are true but reason is not the correct explanation of assertion.

(*c*) If assertion is true but reason is false.

(*d*) If both assertion and reason are false.

36. Assertion: Formation. and evolution of stars and galaxies are due to gravitational forces.

Reason: Gravitational force is always attractive.

(*a*) If both A and R are true and reason is the correct explanation of assertion.

(*b*) If both A and R are true but reason is not the correct explanation of assertion.

(*c*) If assertion is true but reason is false.

(*d*) If both assertion and reason are false.

37. Assertion: Velocity gradient has unit of velocity.

Reason: Velocity gradient is change in velocity per unit time.

(*a*) If both A and R are true and reason is the correct explanation of assertion.

(*b*) If both A and R are true but reason is not the correct explanation of assertion.

(*c*) If assertion is true but reason is false.

(*d*) If both assertion and reason are false.

38. Assertion: Systematic error can be minimised.

Reason: Systematic error can be calculated.

(*a*) If both A and R are true and reason is the correct explanation of assertion.

(*b*) If both A and R are true but reason is not the correct explanation of assertion.

(*c*) If assertion is true but reason is false.

(*d*) If both assertion and reason are false.

39. Assertion: In random error, we take n as the number of observations.

Reason: Taking n as number of observations, random error reduces to 1/n.

(*a*) If both A and R are true and reason is the correct explanation of assertion.

(*b*) If both A and R are true but reason is not the correct explanation of assertion.

(*c*) If assertion is true but reason is false.

(*d*) If both assertion and reason are false.

40. Assertion: The period of oscillation of a simple pendulum in the experiment is recorded as 2.63 s, 2.56 s, 2.42 s, 2.71 s and 2.80 s, respectively. The average absolute error is 0.11 s.

Reason: Mean absolute error $= \dfrac{\text{Sum of absolute errors}}{\text{Numbers of observations}}$

(*a*) If both A and R are true and reason is the correct explanation of assertion.

(*b*) If both A and R are true but reason is not the correct explanation of assertion.

(*c*) If assertion is true but reason is false.

(*d*) If both assertion and reason are false.

41. Assertion: In one-dimensional motion distance in t^{th} sec is given by $S_t = u + \frac{1}{2}a\,(2t-1)$; where u is the initial velocity and a is constant acceleration.

Reason: Given equation is both numerically and dimensionally correct.

(*a*) If both A and R are true and reason is the correct explanation of assertion.

(*b*) If both A and R are true but reason is not the correct explanation of assertion.

(*c*) If assertion is true but reason is false.

(*d*) If both assertion and reason are false.

42. Assertion: Measurement's precision is determined by least count of measuring instrument.

Reason: Smaller the least count, more is the precision

(*a*) If both A and R are true and reason is the correct explanation of assertion.

(*b*) If both A and R are true but reason is not the correct explanation of assertion.

(*c*) If assertion is true but reason is false.

(*d*) If both assertion and reason are false.

43. Assertion: Work done is dimensionally same as torque.

Reason: Work done and torque both are scalar quantities.

(*a*) If both A and R are true and reason is the correct explanation of assertion.

(*b*) If both A and R are true but reason is not the correct explanation of assertion.

(*c*) If assertion is true but reason is false.

(*d*) If both assertion and reason are false.

44. Assertion: Specific gravity of liquid is dimensionless.

Reason: It is the ratio of density of liquid to density of water.

(*a*) If both A and R are true and reason is the correct explanation of assertion.

(*b*) If both A and R are true but reason is not the correct explanation of assertion.

(*c*) If assertion is true but reason is false.

(*d*) If both assertion and reason are false

45. Assertion: Methods of dimensions cannot be used for deriving formula containing trigonometric ratios.

Reason: Trigonometric ratios have no dimensions.

(*a*) If both A and R are true and reason is the correct explanation of assertion.

(*b*) If both A and R are true but reason is not the correct explanation of assertion.

(*c*) If assertion is true but reason is false.

(*d*) If both assertion and reason are false.

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46. **Assertion:** Both plane and solid angles are fundamental units.

Reason: Both have the same units.

(*a*) If both A and R are true and reason is the correct explanation of assertion.

(*b*) If both A and R are true but reason is not the correct explanation of assertion.

(*c*) If assertion is true but reason is false.

(*d*) If both assertion and reason are false.

47. **Assertion:** Parallax method is used for measuring distances of nearby star only.

Reason: With increase of distance of star parallactic angle becomes too small to be measured accurately.

(*a*) If both A and R are true and reason is the correct explanation of assertion.

(*b*) If both A and R are true but reason is not the correct explanation of assertion.

(*c*) If assertion is true but reason is false.

(*d*) If both assertion and reason are false.

48. **Assertion:** Parallactic second is a unit of distance.

Reason: Second is the SI unit of time.

(*a*) If both A and R are true and reason is the correct explanation of assertion.

(*b*) If both A and R are true but reason is not the correct explanation of assertion.

(*c*) If assertion is true but reason is false.

(*d*) If both assertion and reason are false.

49. **Assertion:** Distance cannot be added with speed.

Reason: Only same units of quantities could be added.

(*a*) If both A and R are true and reason is the correct explanation of assertion.

(*b*) If both A and R are true but reason is not the correct explanation of assertion.

(*c*) If assertion is true but reason is false.

(*d*) If both assertion and reason are false.

50. **Assertion:** Permittivity and permeability have the same value for a given medium.

Reason: Permittivity is a property of magnetic field and permeability is a property of electric field.

(*a*) If both A and R are true and reason is the correct explanation of assertion.

(*b*) If both A and R are true but reason is not the correct explanation of assertion.

(*c*) If assertion is true but reason is false.

(*d*) If both assertion and reason are false.

51. **Assertion:** Astronomical unit is a unit for measuring large distances.

Reason: It is the distance covered by light in one year.

(*a*) If both A and R are true and reason is the correct explanation of assertion.

(*b*) If both A and R are true but reason is not the correct explanation of assertion.

(*c*) If assertion is true but reason is false.

(*d*) If both assertion and reason are false.

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Answer Key

1. (*a*) **2.** (*d*) **3.** (*e*) **4.** (*a*) **5.** (*d*) **6.** (*b*) **7.** (*b*) **8.** (*a*) **9.** 2500 m/s

10. (*c*) **11.** (*b*) **12.** (*a*) **13.** (*b*) **14.** (*a*) **15.** (*a*) **16.** 5/8 **17.** (*c*) **18.** (*b*) **19.** (*d*)

20. (*c*) **21.** (*b*) **22.** (*a*) **23.** (*d*) **24.** (*d*) **25.** (*d*) **26.** (*c*) **27.** (*c*)

28. Clock 2 (Presision is more) **29.** (*d*) **30.** (*a*) **31.** (*c*) **32.** (*a*) **33.** $ML^{-1}T^{-2}$ **34.** $ML^2T^{-3}A^{-2}$

35. $ML^2T^{-2}A^{-2}$ **36.** $MLT^{-2}A^{-2}$ **37.** $MT^{-2}A^{-1}$, $ML^2T^{-2}A^{-1}$ **38.** $ML^{-1}T^{-1}$ **39.** (*c*) **40.** (*d*) **41.** (*a*)

42. (*a*) **43.** (*a*) **44.** (*a*) **45.** (*b*) **46.** (*c*) **47.** (*a*) **48.** (*d*) **49.** (*b*) **50.** (*b*) **51.** (*b*)

52. (*c*) **53.** (*b*) **54.** (*d*) **55.** (*d*) **56.** (*c*) **57.** (*c*) **58.** (*c*) **59.** (*a*) **60.** (*d*) **61.** (*a*)

62. (*b*) **63.** (1) May have dimension/may be dimensionless, (2) Must be dimensionless/does not have dimension, (3) Must have unit, (4) May or may not have unit **64.** (*b*) **65.** (*a*) **66.** (*b*) **67.** (*b*) **68.** (*d*) **69.** (*d*) **70.** Yes

71. No **72.** (*b*) **73.** (*c*) **74.** (*c*) **75.** (*d*) **76.** (*a*) **77.** (*a*) **78.** (*d*) **79.** (*b*)

80. $a = MLT^{-3}$, $b = MLT^{-4}$ **81.** $A = LT^{-1}$, $B = T^{-1}$ **82.** $A = MLT^{-2}$, $B = ML^2T^{-1}$, $C = t^2 = M^0L^0T^2$ **3.** L^6 **84.** (*b*)

85. (*c*) **86.** (*b*) **87.** (*b*) **88.** (*b*) **89.** (*a*) **90.** (c), (*d*) **91.** $A = L^1$, $\omega = T^{-1}$, $K = L^{-1}$, $\phi = M^0L^0T^0$

92. $\beta = L^{-1}$, $\alpha = T^{-1}$ **93.** $\alpha = LT^{-2}$, $\beta = T^{-1}$, $\gamma = T^{-2}$ **94.** (*a*) **95.** (*d*) **96.** $[L^{-2}T^{-1}]$

97. $\alpha = \left[M^{\frac{1}{2}}L^{-\frac{1}{2}}T^{-1}\right]$, $\beta = \left[M^{\frac{1}{2}}L^{-\frac{3}{2}}\right]$ **98.** $a = [L^1] \cdot b = [M^0L^0T^0]$ **99.** $\alpha = [MLT^{-2}]$, $\beta = [M^0L^0T^0]$, $\gamma = [L^{-1}]$ **100.** (*b*)

101. $A = L^1$, $k = L^{-1}$, $\omega = T^{-1}$ **102.** $[LT^{-1}]$ **103.** $b = M^{-1}$ **104.** (*b*) **105.** (*a*) **106.** $\alpha = T^{-1}$

107. (*b*) **108.** (*b*) **109.** (*a*) **110.** (*c*) **111.** (*a*) **112.** (*a*) **113.** (*b*) **114.** (*c*) **115.** (*d*) **116.** (*a*)

117. (*b*) **118.** (*b*) **119.** (*a*) **120.** (*d*) **121.** (*a*) **122.** (*d*) **123.** (*c*) **124.** (*a*) **125.** (*b*) **126.** (*a*)

127. (*d*) **128.** (*d*) **129.** (*a*) **130.** (*a*) **131.** $v = \sqrt{Rg\left[\frac{\tan\theta + \mu}{1 - \mu\tan\theta}\right]}$ **132.** (*a*) **133.** (*b*)

134. (*d*) **135.** (*a* & *b*) **136.** (*a,b,d*) **137.** (*b* & *d*) **138.** (*a*) **139.** (*d*) **140.** (*b*) **141.** (*b*) **142.** (*a*) **143.** (*d*)

144. (*c*) **145.** (*b, d*) **146.** (*a*) **147.** (*a*) **148.** (*d*) **149.** (*d*) **150.** (*b*) **151.** (*a*) **152.** (*d*) **153.** (*d*)

154. (*d*) **155.** (*a*)

156. (1) Must be physically wrong, (2) May or amy not physically correct, (3) May or may be dimensionally correct (4) Must be dimensionally correct $S_n = u + \frac{a}{2}(2n-1)$ (S_nth → dimensionally correct becouse it is displacement in one sec.) **157.** (*d*)

158. (*c*) **159.** 3, 4, 4, infinite. **160.** (*b*) **161.** (*d*) **162.** I-B, II-A, III-D, IV-C **163.** (*b*) **164.** (*b*) **165.** (*b*)

166. (i) 4.75, (ii) 4.75 **167.** 13700, 205000 **168.** (*b*) **169.** (*a*) **170.** (*c*) **171.** 3.6 **172.** 5

173. (i) 119.9 (ii) 201.87 **174.** (*b*) **175.** (*d*) **176.** (*d*) **177.** (*a*) **178.** (*b*) **179.** (*d*) **180.** (*a*) **181.** (*a*)

182. (*d*) **183.** (*a*) **184.** (*a*) **185.** (*a*) **186.** (*a*)

187. (i) 2.62, (ii) 0.01, 0.06, 0.2, 0.09, 0.18, (iii) 0.11, (iv) 0.042, (iv) 4.2% **188.** (*a*) **189.** 1% **190.** 0.53% **191.** (*a*)

192. 33.3% **193.** (*d*) **194.** [16 ± 4] **195.** (*c*)

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196. (i) $\Delta x = 0.6$, (ii) $\Delta y = 0.6$, (iii) $\Delta z = 200\left(\frac{0.5}{20}+\frac{0.1}{10}\right)$, (iv) $\Delta m = 0.7$ **197.** 5% **198.** (*b*)

199. (i) $\frac{\Delta x}{x}=\frac{0.6}{30}$, (ii) $\frac{\Delta y}{y}=\frac{0.6}{10}$, (iii) $\frac{\Delta z}{z}=\left(\frac{0.5}{20}+\frac{0.1}{10}\right)$, (iv) $\frac{\Delta m}{m}=\frac{7}{200}$ **200.** (*a*) **201.** (c)

202. $\frac{\Delta Z}{Z}\times 100=\left(\frac{\Delta A+\Delta B}{A+B}\times 100\right)$ **203.** $(\Delta Z)=\frac{A}{B}\left(\frac{\Delta A}{A}+\frac{\Delta B}{B}\right)$ **204.** (*a*)

205. sum = (50 ± 0.7)°C, Difference = (30 ± 0.7)°C **206.** (*c*) **207.** $100\times\frac{\Delta Z}{Z}=\left[\frac{1}{2}\frac{\Delta A}{A}+\frac{1}{2}\frac{\Delta B}{B}+\frac{1}{3}\frac{\Delta C}{C}+\frac{\Delta D}{D}\right]\times 100$ **208.** (*d*)

209. (*c*) **210.** (*d*) **211.** (*c*) **212.** (*d*) **213.** (*d*) **214.** (*b*) **215.** (*d*) **216.** (*b*) **217.** (*b*) **218.** (*d*)

219. 10.1% **220.** 7.3%, $\frac{11}{27}$ **221.** (*b*) **222.** (*c*) **223.** (*a*) **224.** $\frac{\pi}{\sqrt{3}}\%$ **225.** 45° **226.** 4% **227.** 10%

228. 125% **229.** (I) (150 ± 6) Ω, (II) (33.1 ± 3.1) Ω **230.** (*b*)

231. (1) Vernier Calliper, (2) screw gauge, (3) metre scale, (4) Vernier Calliper, (5) Vernier Calliper, (6) screw gauge, (7) screw gauge 14

232. (*d*) **233.** (*c*) **234.** (*a*) **235.** [0.2 mm] **236.** 0.33 cm **237.** (*a*) **238.** (*a*) **239.** (c)

240. (*c*) **241.** 12/20 **242.** (*c*) **243.** (*b*) **244.** 15.6 mm **245.** (*b*) **246.** (*b*) **247.** (*b*) **248.** (*d*)

249. (*c*) **250.** (*b*) **251.** (*c*) **252.** (*a*) **253.** (*d*) **254.** (*d*) **255.** (*c*) **256.** (*b*) **257.** (*d*) **258.** (*b*)

259. (*a*) **260.** (*b*) **261.** 12% **262.** 3% **263.** (*d*) **264.** (*c*) **265.** (*c*) **266.** 0.013

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1. (*d*)	**2.** (*a*)	**3.** (*b*)	**4.** (*a*)	**5.** (*a*)	**6.** (*a*)	**7.** (*a*)	**8.** (*c*)	**9.** (*c*)	**10.** (*a*)
11. (*a*)	**12.** (*a*)	**13.** (*c*)	**14.** (*c*)	**15.** (*a*)	**16.** (*b*)	**17.** (*d*)	**18.** (*a*)	**19.** (*a*)	**20.** (*c*)
21. (*d*)	**22.** (*d*)	**23.** (*a*)	**24.** (*b*)	**25.** (*c*)	**26.** (*b*)	**27.** (*a*)	**28.** (*a*)	**29.** (*a*)	**30.** (*a*)
31. (*d*)	**32.** (*d*)	**33.** (*b*)	**34.** (*a*)	**35.** (*a*)	**36.** (*b*)	**37.** (*d*)	**38.** (*d*)	**39.** (*a*)	**40.** (*a*)
41. (*b*)	**42.** (*a*)	**43.** (*c*)	**44.** (*a*)	**45.** (*a*)	**46.** (*d*)	**47.** (*b*)	**48.** (*c*)	**49.** (*b*)	**50.** (*a*)
51. (*d*)									

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Thermodynamics & KTG

(Practice Questions)

Degree of Freedom

1. The degrees of freedom of a triatomic gas is

(*a*) 6 (*b*) 4 (*c*) 2 (*d*) 8

2. The number of translational degrees of freedom for a diatomic gas is

(*a*) 2 (*b*) 3 (*c*) 5 (*d*) 6

3. Match List-I with List-II

List-I		List-II	
A.	3 Translational degrees of freedom	I.	Monoatomic gases
B.	3 Translational, 2 rotational degrees of freedoms	II.	Polyatomic gases
C.	3 Translational, 2 rotational and 1 vibrational degrees of freedom	III.	Rigid diatomic gases
D.	3 Translational, 3 rotational and more than one vibrational degrees of freedom	IV.	Non rigid diatomic gases

4. A vessel contains a nonlinear triatomic gas. If 50% of gas dissociate into individual atom, then find new value of degree of freedom by ignoring the vibrational mode and any further dissociation.

(*a*) 2.15 (*c*) 5.25 (*b*) 3.75 (*d*) 6.35

Adiabatic Exponent

5. The ratio of the specific heats of a gas is $\frac{C_P}{C_V} = 1.66$, then the gas may be

(*a*) CO_2 (*b*) He (*c*) NO_2 (*d*) H_2

6. The molar specific heat at constant pressure of an ideal gas is (7/2) *R*. The ratio of specific heat at constant pressure to that at constant volume is

(*a*) $\frac{9}{7}$ (*b*) $\frac{7}{5}$ (*c*) $\frac{8}{7}$ (*d*) $\frac{5}{7}$

7. For a certain gas the ratio of specific heats is given to be $\gamma = 1.5$ For this gas

(*a*) $C_v = 3R/J$ (*b*) $C_P = 3R/J$

(*c*) $C_P = 5R/J$ (*d*) $C_v = 5R/J$

8. During an adiabatic process, the pressure of a gas is found to be proportional to the cube of its temperature. The ratio of C_P/C_V for the gas is:

(*a*) $\frac{3}{2}$ (*b*) $\frac{4}{3}$ (*c*) 2 (*d*) $\frac{5}{3}$

9. Match the C_p/C_v ratio for ideal gases with different type of molecules:

Column-I Molecule Type		Column-II C_p/C_v	
A.	Monatomic	I.	$\frac{7}{5}$
B.	Diatomic rigid molecules	II.	$\frac{9}{7}$
C.	Diatomic non-rigid molecules	III.	$\frac{4}{3}$
D.	Triatomic rigid molecule	IV.	$\frac{5}{3}$

(*a*) (A)-(IV),(B)-(II),(C)-(I),(D)-(III)

(*b*) (A)-(III),(B)-(IV),(C)-(II),(D)-(1)

(*c*) (A)-(IV), (B)-(I), (C)-(II), (D)-(III)

(*d*) (A)-(II), (B)-(III), (C)-(I), (D)-(IV)

10. When one mole of monatomic gas is mixed with one mole of a diatomic gas, then the equivalent value of γ for the mixture will be (vibration mode neglected)

(*a*) 1.33 (*b*) 1.40 (*c*) 1.50 (*d*) 1.6

Mayer's Formula

11. For hydrogen gas $C_P - C_V = a$ and for oxygen gas $C_P - C_V = b$, so the relation between *a* and *b* is given by

(*a*) $a = 16b$ (*b*) $16b = a$ (*c*) $a = 4b$ (*d*) $a = b$

12. If C_P and C_v denote the specific heats of nitrogen per unit mass at constant pressure and constant volume respectively, then

(*a*) $C_p - C_v = \frac{R}{28}$ (*b*) $C_p - C_v = \frac{R}{14}$

(*c*) $C_p - C_v = R$ (*d*) $C_p - C_v = 28\,R$

13. If *R* is a gas constant and C_P and C_V are specific heats for a solid per mole, then for the solid.

(*a*) $C_p - C_v = R$ (*b*) $C_p - C_v < R$

(*c*) $C_p - C_v = 0$ (*d*) $C_p - C_v$ is negative

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Internal Energy

14. A polyatomic gas with n degrees of freedom has a mean energy per molecule given by

(*a*) $\frac{nkT}{N}$ (*b*) $\frac{nkT}{2N}$ (*b*) $\frac{nkT}{2}$ (*d*) $\frac{3kT}{2}$

15. A gas mixture consists of 2 moles of O_2 and 4 moles of Ar at temperature T. Neglecting all vibrational modes, the total internal energy of the system is

(*a*) 15 RT (*b*) 9 RT (*c*) 11 RT (*d*) 4 RT

16. The amount of heat energy required to raise the temperature of 1g of Helium at NTP, from T_1K to T_2K is

(*a*) $\frac{3}{4}N_a k_B(T_2 - T_1)$ (*b*) $\frac{3}{4}N_a k_B\left(\frac{T_2}{T_1}\right)$

(*c*) $\frac{3}{8}N_a k_B(T_2 - T_1)$ (*d*) $\frac{3}{2}N_a k_B(T_2 - T_1)$

17. Find ratio of internal energy of diatomic and monoatomic gas both at Temperature T, for Translational degree of freedom.

(*a*) $\frac{3}{5}$ (*b*) $\frac{5}{3}$ (*c*) $\frac{2}{3}$ (*d*) $\frac{1}{1}$

18. Find ratio of internal energy per *d.o.f.* of diatomic and monoatomic gas both at Temperature T.

(*a*) $\frac{3}{5}$ (*b*) $\frac{5}{3}$ (*c*) $\frac{2}{3}$ (*d*) $\frac{1}{1}$

19. If the ratio of specific heat of a gas at constant pressure to that at constant volume is γ, the change in internal energy of a mass of gas, when the volume changes from V to 2V at constant pressure P, is

(*a*) $\frac{PV}{(\gamma-1)}$ (*b*) PV (*c*) $\frac{R}{(\gamma-1)}$ (*d*) $\frac{\gamma PV}{(\gamma-1)}$

Kinetic Energy of Molecules

20. The mean rotational kinetic energy of (diatomic molecule at temperature T is

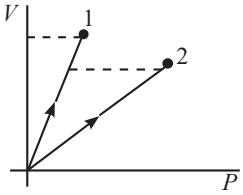
(*a*) $\frac{1}{2}kT$ (*b*) $\frac{5}{2}kT$ (*c*) kT (*d*) $\frac{3}{4}kT$

21. A jar has a mixture of hydrogen and oxygen gases in the ratio 1 :5, the ratio of mean kinetic energy of hydrogen and oxygen molecule is

(*a*) 1 : 16 (*b*) 1 : 4 (*c*) 1 : 5 (*d*) 1 : 1

Work Done in P-V Graph

22. Consider the pressure-volume diagram shown below, where two processes are represented as lines 1 and 2.

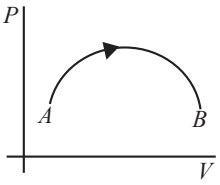


Which of the following is correct

(*a*) $W_1 = W_2$ (*b*) $W_1 > W_2$

(*c*) $W_1 < W_2$ (*d*) non of these

23. In the pressure-volume (P-V) diagram shown below, a system undergoes a process from point A to point B along the curved path. Based on this curve, how does the work done by the system change during the process?



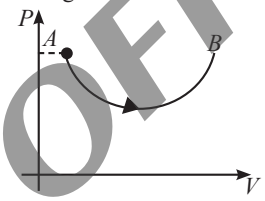
(*a*) Continuously increasing

(*b*) Continuously decreasing

(*c*) First increasing, then decreasing

(*d*) First decreasing, then increasing

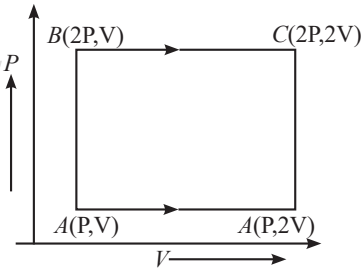
24. which of the following correct for work ?



(*a*) Continuously Increasing (*b*) Continuously decreasing

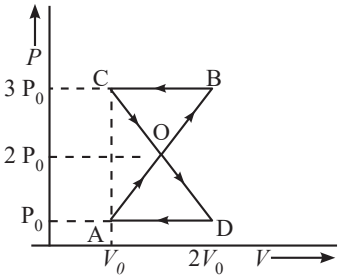
(*c*) 1st ↑then↓ (*d*) 1st ↓then↑

25. An ideal gas undergoes a thermodynamic process ABCDA as shown in the diagram. Total work done during the cycle ABCDA is



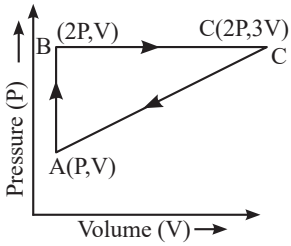
(*a*) 4 PV (*b*) Zero (*c*) PV (*d*) 0.5 PV

26. A thermodynamics system undergoes cyclic process ABCDA as shown in fig. The work done by the system in the cycle is



(*a*) P_oV_o (*b*) $2P_oV_o$ (*c*) $P_oV_o/2$ (*d*) Zero

27. An ideal gas is taken through a cycle ABCA as shown below in P-V diagram. What is the work done during the cycle?



(*a*) $\frac{PV}{2}$ (*b*) PV (*c*) 2 PV (*d*) Zero

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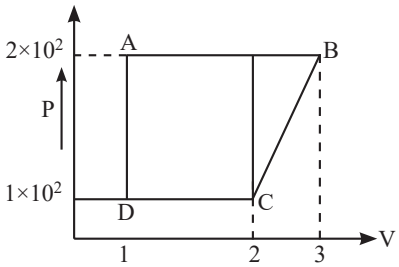
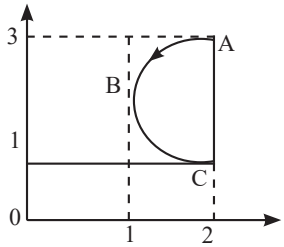
28. A cyclic process is shown in the figure. Work done during the cyclic process ABCDA



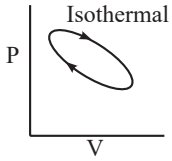
(*a*) 150 J (*b*) 163 J (*c*) 145 J (*d*) 166 J

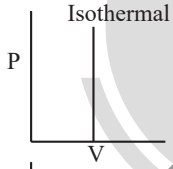
29. In P-V diagram shown in figure ABC is a semicircle. The work done in the process ABC is

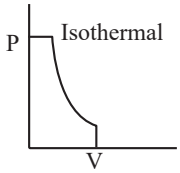


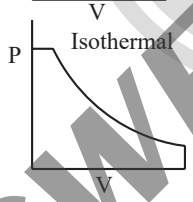
(*a*) 4 J (*b*) $\frac{-\pi}{2}$ J (*c*) $\frac{\pi}{2}$ J (*d*) Zero

30. Which of the following *p-V* curve represents maximum work done?

(*a*)


(*b*)


(*c*)


(*d*)


Thermodynamic Process

31. Identify the wrong statement

(*a*) For isothermal process $\Delta T = 0$

(*b*) For isochoric process $\Delta P = 0$

(*c*) For adiabatic process $\Delta Q = 0$

(*d*) For cyclic process $\Delta W = 0$

32. In which of the following processes, heat is neither absorbed nor released by a system?

(*a*) isochoric (*b*) isothermal (*c*) adiabatic (*d*) isobaric

33. Which of the following relations does not give the equation of an adiabatic process, where terms have their usual meaning?

(*a*) $P^{1-\gamma}\, T^{\gamma}$ = constant (*b*) PV^{γ} = constant

(*c*) $TV^{\gamma-1}$ = constant (*d*) $P^{\gamma}\, T^{1-\gamma}$ = constant

34. In thermodynamic processes which of the following statement is not true

(*a*) In an adiabatic process PV^{γ} = constant

(*b*) In an adiabatic process the system is insulated from the surrounding

(*c*) In an isochoric process pressure remains constant

(*d*) In an isothermal process the temperature remains constant

35. Two cylinders *A* and *B* of equal capacity are connected to each other via a stopcock. *A* contains an ideal gas at standard temperature and pressure. *B* is completely evacuated. The entire system is thermally insulated. The stopcock is suddenly opened. The process is

(*a*) isothermal (*b*) adiabatic (*c*) isochoric (*d*) isobaric

36. Argon gas is at initial temperature 20ºC. If gas is expanded adiabatically 8 times to its initial volume then find final temperature of Argon gas?

(*a*) –100ºC (*b*) –50ºC (*c*) –200ºC (*d*) 0

37. A mass of diatomic gas (γ = 1.4) at a pressure of 2 atmospheres is compressed adiabatically so that its temperature rises from 270ºC to 927ºC. The pressure of the gas in the final state is

(*a*) 8 atm (*b*) 28 atm (*c*) 68.7 atm (*d*) 256 atm

38. A gas is found to obey the law P^2V = constant. The initial temperature and volume are T_0 and V_0. If the gas expands to a volume $2V_0$, its final temperature becomes:

(*a*) $\sqrt{2}\,T_0$ (*b*) $T_0/2$ (*c*) $2T_0$ (*d*) $T_0/\sqrt{2}$

39. When an ideal diatomic gas is heated at constant pressure then what fraction of heat given is used to increase internal energy of gas?

(*a*) $\frac{5}{7}$ (*b*) $\frac{3}{7}$ (*c*) $\frac{3}{5}$ (*d*) $\frac{2}{5}$

40. If *R* is universal gas constant, the amount of heat needed to raise the temperature of 2 moles of an ideal monoatomic gas from 273 *K* to 373 K , when no work is done, is

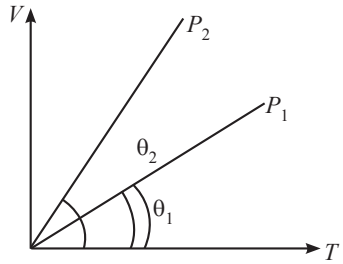
(*a*) 100 R (*b*) 150 R (*c*) 300 R (*d*) 500 R

41. During an adiabatic compression, 830 J of work is done on 2 moles of a diatomic ideal gas to reduce its volume by 50%. The change in its temperature is nearly:

(*a*) 40 K (*b*) 33 K (*c*) 20 K (*d*) 14 K

Graph Based Questions

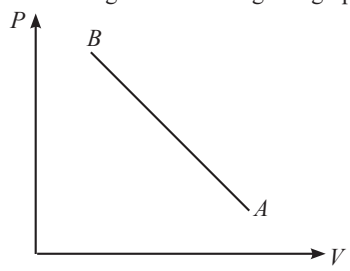
42. In the given (*V – T*) diagram, what is the relation between pressures P_1 and P_2?



(*a*) $P_2 < P_1$ (*b*) Cannot be predicted

(*c*) $P_2 = P_1$ (*d*) $P_2 > P_1$

43. Which of the following is correct for given graph



(*a*) Constant temperature (*b*) Increasing temperature

(*c*) Decreasing temperature (*d*) Non of these

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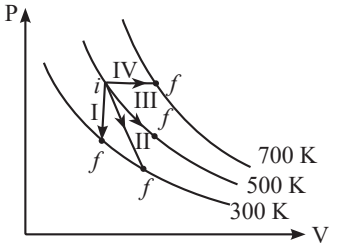
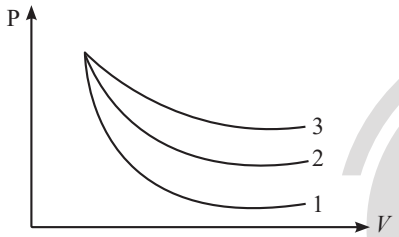
44. Thermodynamic processes are indicated in the following diagram.

Column-I		Column-II	
P.	Process I	A.	Adiabatic
Q.	Process II	B.	Isobaric
R.	Process III	C.	Isochoric
S.	Process IV	D.	Isothermal



(*a*) P→C,Q→A,R→D,S→B (*b*) P→C,Q→D,R→B,S→A
(*c*) P→D,Q→B,R→A,S→C (*d*) P→A,Q→C,R→D,S→B

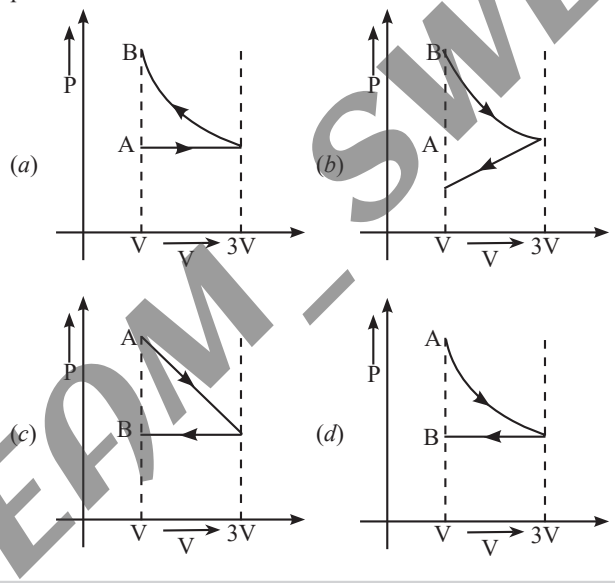
45. Choose the appropriate gas for given waves of adiabatic expansion.



46. The ratio of the slopes of adiabatic and isotherm is-

(*a*) 1 : γ (*b*) 1 : 1 (*c*) γ : 1 (*d*) 1 : 4

47. One mole of an ideal gas goes from an initial state A to final state B via two processes. It first undergoes isothermal expansion from volume V to 3V and then its volume is reduced from 3V to V at constant pressure. The correct P-V diagram representing the two processes is



Work done in Thermodynamic Processes

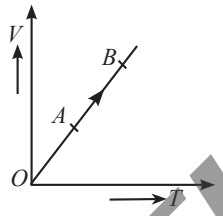
48. A monatomic gas at a pressure *P*, having a volume *V* expands isothermally to a volume 2*V* and then adiabatically to a volume 16 V . The final pressure of the gas is (Take γ = 5/3)

(*a*) 64 P (*b*) 32 P (*c*) P/64 (*d*) 16 P

49. An ideal gas has volume V_0 at 27ºC. It is heated at constant pressure so that its volume becomes $2V_0$ The final temperature is

(*a*) 54ºC (*b*) 32.6ºC (*c*) 327ºC (*d*) 150 *k*

50. The volume (V) of a monatomic gas varies with its temperature (T), as shown in the graph. The ratio of work done by the gas, to the heat absorbed by it, when it undergoes a change from state *A* to state *B*, is



(*a*) $\frac{2}{5}$ (*b*) $\frac{2}{3}$ (*c*) $\frac{1}{3}$ (*d*) $\frac{2}{7}$

51. Given below are two statements:

Statement I: If heat is added to a system, its temperature must increase.

Statement II: If positive work is done by a system in a thermodynamic process, its volume must increase.

In the light of the above statements, choose the correct answer from the options given below:

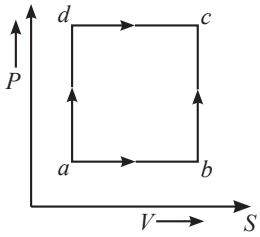
(*a*) Statement I is true but Statement II is false
(*b*) Both Statement I and Statement II are true
(*c*) Both Statement I and Statement II are false
(*d*) Statement I is false but Statement II is true

52. During an isothermal expansion, a confined ideal gas does +150 J of work against its surroundings. This implies that

(*a*) 150 J of heat has been removed from the gas
(*b*) 300 J of heat has been added to the gas
(*c*) No heat is transferred because the process is isothermal
(*d*) 150 J of heat has been added to the gas

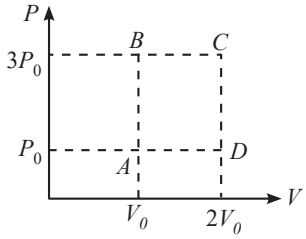
First Law of Thermodynamics

53. When a system is taken through the process *abc*, 80 cal of heat is absorbed by the system and 60 cal of work is done by it if the system is taken through the process adc, 30 cal of heat is absorbed, then work done by the system is



(*a*) 10 cal (*b*) 20 cal (*c*) 30 cal (*d*) 4 cal

54. An ideal monatomic gas is carried along the cycle ABCDA as shown in the figure. The total heat absorbed during this process is



(*a*) $10.5\, p_0V_0$ (*b*) $7.5\, p_0V_0$ (*c*) $2\, p_0V_0$ (*d*) $1.5\, p_0V_0$

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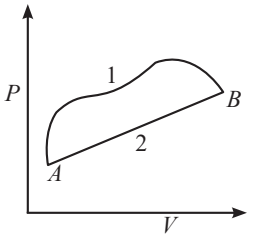
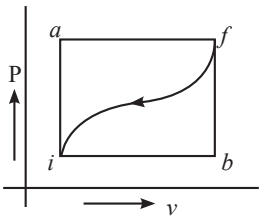
55. A system is taken from state A to state B along two different paths 1 and 2. The heat absorbed and work done by the system along these two paths are Q_1, Q_2 and W_1, W_2 respectively then



(*a*) $Q_1 - W_1 = Q_2 - W_2$ (*b*) $Q_1 = Q_2$
(*c*) $W_1 = W_2$ (*d*) None

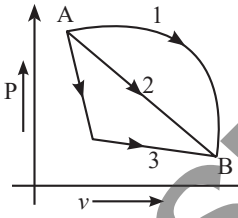
56. When a system is taken from state i to state f along the path if, it is found that $Q = 50$ cal and $W = 20$ cal Along the path ibf. $Q = 36$ cal. W along path ibf is



(*a*) 30 cal (*b*) 16 cal
(*c*) 6 cal (*d*) 14 cal

57. An ideal gas goes from state A to state B via three different processes as indicated in the P-V diagram

If Q_1, Q_2, Q_3 indicate the heat absorbed by the gas along the three processes and U_1, U_2, U_3 indicate the change in internal energy along the three processes respectively, then



(*a*) $Q_3 > Q_2 > Q_1$ and $\Delta U_1 = \Delta U_2 = \Delta U_3$
(*b*) $Q_1 = Q_2 = Q_3$ and $\Delta U_1 > \Delta U_2 > \Delta U_3$
(*c*) $Q_3 > Q_2 > Q_1$ and $\Delta U_1 > \Delta U_2 > \Delta U_3$
(*d*) $Q_1 > Q_2 > Q_3$ and $\Delta U_1 = \Delta U_2 = \Delta U_3$

58. An ideal gas is taken through a cycle thermodynamic process through four steps. The amounts of heat involved in these steps arc $Q_1 = 5960$ J $Q_2 = -5585$ J, $Q_3 = -2980$ J $Q_4 = 3645$ J, respectively. The corresponding works involved are $W_1 = 2200$ J $W_2 = -825$ J $W_3 = -1100$ J and W_4 respectively, the value of W_4 is:

(*a*) 780 (*b*) 775 (*c*) 765 (*d*) 760

59. If 110 J of heat are added to a gaseous system, whose internal energy 40J , then the amount of/external work done is -

(*a*) 40 J (*b*) 70 J (*c*) 110 J (*d*) 150 J

60. If 150 J of heat is added to a system and the work done by the system is 110 J , then change in internal energy will be

(*a*) 40 J (*b*) 110 J (*c*) 150 J (*d*) 260 J

61. A gas is compressed at a constant pressure of 50 N/m^2 from a volume of 10 m^3 to volume of 4m^3. Energy of 100 joule is thus added to gas by heating. Its internal energy is:

(*a*) 450 (*b*) 400 (*c*) 350 (*d*) 410

62. Consider the following two statements and choose the correct answer.

(I) If heat is added to a system, its temperature must always increase.

(II) If positive work is done by a system in thermodynamic process, its volume must increase

(*a*) I (*b*) II (*c*) Both (*d*) None

63. A system is provided with 200 cal of heat and the work done by the system on the surrounding is 40 J. Then its internal energy

(*a*) Increases by 600 J (*b*) Decreases by 800 J
(*c*) Increases by 800 J (*d*) Decreases by 50 J

64. In a thermodynamic process, pressure of a fixed mass of a gas is changed in such a manner that the gas molecules gives out 20 J of heat and 10 J of work is done on the gas. If the initial internal energy of the gas was 40 J , then the final internal energy will be

(*a*) 30 J (*b*) 20 J (*c*) 60 J (*d*) 40 J

65. One mole of an ideal gas at 300 K is expanded isothermally from 1 L to 10 L volume. ΔU for this process is: (Use R = 9.314 J k^{-1} mol^{-})

(*a*) 0 J (*b*) 1260 J (*c*) 2520 J (*d*) 5040 J

Polytropic Process

66. If $P \propto V^2$ then find molar heat capacity for monoatomic gas ?

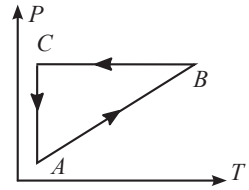
67. If T^2V is constant then find molar heat capacity of 2 mole of diatomic gas and heat require to increase temperature by 20ºC .

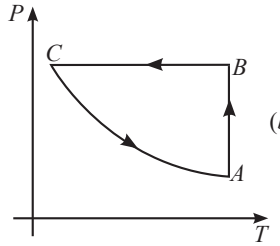
68. One mole of an ideal monatomic gas undergoes a process described by the equation $PV^3 =$ constant. The heat capacity of the gas during this process is

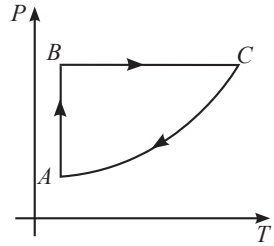
(*a*) $\frac{3}{2}R$ (*b*) $\frac{5}{2}R$ (*c*) $2R$ (*d*) R

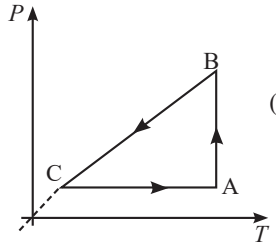
Graph Conversion

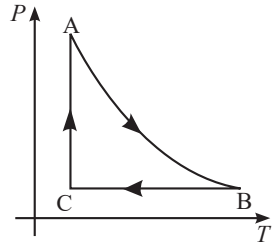
69. Convert P - T graph to PV



(*a*)


(*b*)


(*c*)


(*d*)


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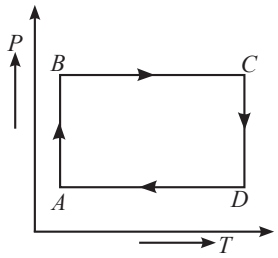
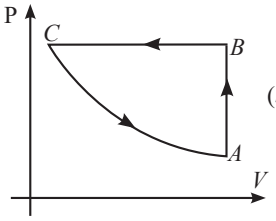
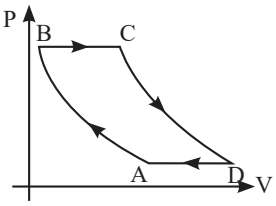
70. Convert P – T graph into P – V



(*a*)


(*b*)


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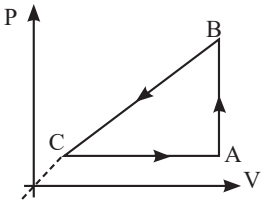
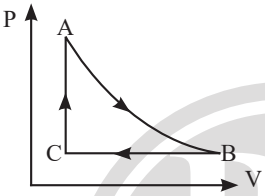
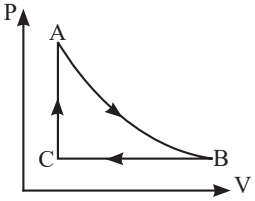
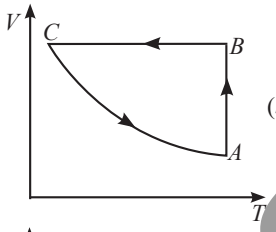
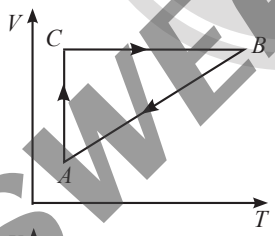


(*d*)


71. Convert P/V to V/T



(*a*)


(*b*)


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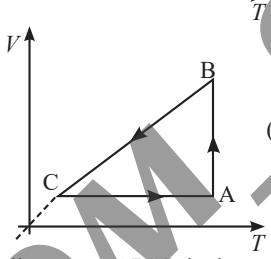
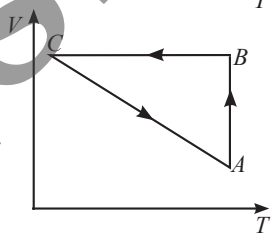
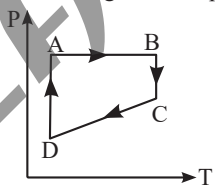
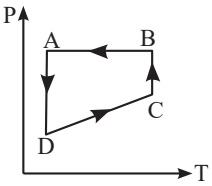
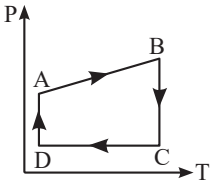


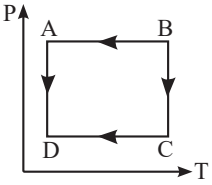
(*d*)


72. A cyclic process ABCD is shown in the figure P-T diagram. Which of the following curves represent the same process

(*a*)


(*b*)


(*c*)


(*d*)


Carnot Engine

73. A Carnot engine has same efficiency between (i) 100*K* and 500*K* and (ii) Tk and 900*K* . The value of T is

74. A Carnot engine has an efficiency of 40% when the sink temperature is 27ºC. The source temperature will be

Refrigerator

75. The temperature inside a refrigerator is t_2 ºC and the room temperature is t_1 ºC. The amount of heat delivered to the room for each joule of electrical energy consumed ideally will be :

(*a*) $\frac{t_1}{t_1 - t_2}$ (*b*) $\frac{t_1 + 273}{t_1 - t_2}$ (*c*) $\frac{t_2 + 273}{t_1 - t_2}$ (*d*) $\frac{t_1 + t_2}{t_1 + 273}$

76. A Carnot engine works as a refrigerator in between 250*K* and 300 *K*. If it acquires 750 calories from heat source at low temperature, then the heat generated at higher temperature, (in calories) will be.

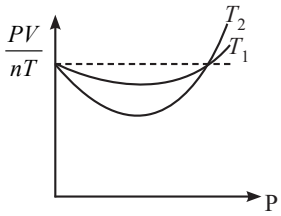
Absolute Zero Temperature

77. Absolute zero temperature is one at which

(*a*) All liquids convert into solid
(*b*) All gases convert to solid
(*c*) All matter is in solid state
(*d*) The K.E. of all molecules becomes zero

Real Gas & Ideal Gas

78. The figure shows the plot of $\frac{PV}{nT}$ *vs P*, for oxygen gas at two different temperatures then



(*a*) $T_1 > T_2$ (*b*) $T_2 > T_1$
(*c*) $T_1 = T_2$ (*d*) May be (*a*) and (*b*)

79. A real gas behaves as an ideal gas at

(*a*) Very low pressure and high temperature
(*b*) High pressure and low temperature
(*c*) High pressure and high temperature
(*d*) Low pressure and low temperature

80. Relation $PV = RT$ is given for following condition for real gas

(*a*) High temperature and high density
(*b*) Low temperature and low density
(*c*) High temperature and low density
(*d*) Low temperature and high density

81. Select the appropriate property of an ideal gas

(*a*) Its molecules are infinitesimally small
(*b*) There are no forces of interaction between i molecules
(*c*) It strictly obeys the ideal gas laws
(*d*) All of these

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82. The equation of state for 5g of oxygen at a pressure P and temperature T, when occupying a volume V, will be :- (where R is the gas constant.)

(*a*) $PV = 5\,RT$ (*b*) $PV = (5/2)\,RT$
(*c*) $PV = (5/16)\,RT$ (*d*) $PV = (5/32)\,RT$

83. A given sample of an ideal gas occupies a volume V at a pressure P and absolute temperature T. The mass of each molecule of the gas is m. Which of the following gives the density of the gas?

(*a*) $\frac{P}{(kT)}$ (*b*) $\frac{Pm}{(kT)}$ (*c*) $\frac{P}{(kTV)}$ (*d*) mKT

84. A cylinder contains hydrogen gas at pressure of 249 *kPa* and temperature 27°C. Its density is ($R = 8.3\ J\ mol^{-1}\ K^{-1}$)

(*a*) 0.5 kg/m^3 (*b*) 0.2 kg/m^3
(*c*) 0.1 kg/m^3 (*d*) 0.02 kg/m^3

85. Boyle's law is obeyed by

(*a*) Real gas of constant mass and temperature
(*b*) Ideal gas of constant mass and temperature
(*c*) Both ideal and real gases at constant temperature and variable mass
(*d*) Both ideal and real gases of constant mass and variable temperature

86. The pressure (P) and temperature (T) relationship of an ideal gas obeys the equation PT^2 = constant. The volume expansion coefficient of the gas will be:

(*a*) $3T^2$ (*b*) $3/T^2$ (*c*) $3/T^3$ (*d*) $3/T$

Average Speed, RMS Speed & Most Probable Speed

87. Four molecules of a gas have speeds 1, 2, 3 and 4 *km/s*. The value of the *r.m.s* speed of the gas molecules is

(*a*) $\frac{1}{2}\sqrt{15}$ *km/s* (*b*) $\frac{1}{2}\sqrt{10}$ *km/s*
(*c*) 2.5 *km/s* (*d*) $\sqrt{\frac{15}{2}}$ *km/s*

88. Which of the following is correct for R.M.S velocity

(*a*) $V_{rms} = \sqrt{\frac{3RT}{M}}$ (*b*) $V_{rms} = \sqrt{\frac{8RT}{\pi M}}$
(*c*) $V_{rms} = \sqrt{\frac{2RT}{M}}$ (*d*) Zero

89. The average velocity of gas molecules is

(*a*) Proportional to $\sqrt{T}$ (*b*) Proportional to T
(*c*) Zero (*d*) Not possible to determine

90. The *r.m.s.* speed of the molecules of enclosed gas is V. What will be the *r.m.s* speed if pressure is doubled keeping the temperature same?

(*a*) $\frac{v}{2}$ (*b*) V (*c*) $2V$ (*d*) $4V$

91. At constant pressure the *r.m.s.* velocity c is related to density d as

(*a*) $c \propto d$ (*b*) $c \propto \frac{1}{d}$ (*c*) $c \propto d$ (*d*) $\left\{c \propto \frac{1}{\sqrt{d}}\right\}$

92. If density is constant & pressure become double then *r.m.s* speed will be

93. Temperature of ideal gas is increased from 27ºC to 927ºC, the rms speed of molecule will become

(*a*) Twice (*b*) Half
(*c*) Four times (*d*) One fourth

94. The temperature of an ideal gas is increased from 27ºC to 127º C then percentage increase in V_{rms} is

(*a*) 37% (*b*) 11% (*c*) 33% (*d*) 15.5%

95. The molecules of a given mass of a gas have *r.m.s.* velocity of 200 ms^{-1} at 27ºC and $1.0 \times 10^5\ Nm^{-2}$ pressure. When the temperature and pressure of the gas are respectively, 127ºC and $0.05 \times 10^5\ Nm^{-2}$, the r.m.s. velocity of its molecules in ms^{-1} is

(*a*) $\frac{100}{3}$ (*b*) $100\sqrt{2}$ (*c*) $\frac{400}{\sqrt{3}}$ (*d*) $\frac{100\sqrt{2}}{3}$

96. Which of the following gas possesses maximum *rms* velocity? All being at same temperature

(*a*) Oxygen (*b*) Carbon dioxide
(*c*) Hydrogen (*d*) Helium

97. If the pressure remains constant; find the temperature at which root mean square speed of a gas is half of its value at 27ºC.

98. V_{rms}, V_{av} and V_{mp} are root means square, average and most probable speeds of molecules of a gas obeying Maxwell velocity distribution. Which of the following statements is correct?

(*a*) $V_{rms} < V_{av} < V_{mp}$ (*b*) $V_{rms} > V_{av} > V_{mp}$
(*c*) $V_{mp} < V_{rms} < V_{av}$ (*d*) $V_{mp} > V_{rms} > V_{av}$

99. If $V_{rms} : V_{avg} : V_{mps} = \sqrt{12} : \sqrt{\frac{x}{\pi}} : \sqrt{8}$, Find x

Maxwell Velocity Distribution Curve

100. In the maxwell Boltzmann curve for distribution of energy.

(*a*) Area under curve must not change with an increases in temperature
(*b*) Area under the curve increases with increase in temperature
(*c*) Area under curve decrease with increase in temperature
(*d*) With increase in temperature, curve gets narrowed and shifts to the right-hand side.

Pressure & Energy of Gas

101. A jar has a mixture of hydrogen and oxygen gases in the ratio 1:5, the ratio of mean kinetic energy of hydrogen and oxygen molecule is

(*a*) 1 : 16 (*b*) 1 : 4 (*c*) 1 : 5 (*d*) 1 : 1

102. The ratio of average translator kinetic energy) of He gas molecules to O_2 gas molecules is

(*a*) $\frac{25}{21}$ (*b*) $\frac{21}{25}$ (*c*) $\frac{3}{2}$ (*d*) 1

103. If is the energy density in an ideal gas, then the pressure of the ideal gas is

(*a*) $P = \frac{2}{3}E$ (*b*) $P = \frac{3}{2}E$ (*c*) $P = \frac{5}{2}E$ (*d*) $P = \frac{2}{5}E$

104. The pressure P of an ideal gas and its mean *K.E.* per unit volume are related as

(*a*) $P = E/2$ (*b*) $P = E$ (*c*) $P = 3E/2$ (*d*) $P = 2E/3$

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105. Match List-I and List-II and choose the correct match from the given choices.

List-I		List-II	
A.	Root mean square speed of gas molecules	P	$\frac{1}{3}nm\bar{v}^2$
B.	Pressure exerted by ideal gas	Q	$\sqrt{\frac{3RT}{M}}$
C.	Average kinetic energy of a molecule	R	$\frac{5}{2}RT$
D.	Total internal energy of 1 mole of a diatomic gas	S	$\frac{3}{2}k_BT$

(*a*) (A) - (Q), (B) - (P), (C) - (S), (D) - (R)
(*b*) (A) - (R), (D) - (P), (B) - (S), (E) - (R)
(*c*) (A) - (Q), (B) - (P), (C) - (R), (D) - (S)
(*d*) (A) - (S), (B) - (P), (C) - (R), (D) - (Q)

106. The percentage change in the pressure of a given mass of a gas filled in a container at constant temperature is 100%. Calculate the percentage change in its volume.

107. A gas is filled in a vessel at a certain temperature and at a pressure of 80 cm of mercury. At the same temperature, more gas is filled in the vessel so that its mass increases 60%. Determine the resultant pressure in the vessel.

108. A gas at a pressure P_0 is contained in a vessel. If the masses of all the molecules are halved and their velocities doubled, then the resulting pressure P will be

(*a*) $4P_0$ (*b*) $2P_0$ (*c*) P_0 (*d*) $P_0/2$

109. A fixed mass of gas at constant pressure occupies a volume. The gas undergoes a rise in temperature so that the root mean square velocity of its molecules is doubled. The new volume will be.

(*a*) $\frac{V}{2}$ (*b*) $\frac{V}{\sqrt{2}}$ (*c*) $2V$ (*d*) $4V$

110. A sample of gas in a box is at pressure P_0 and temperature T_0. If number of molecules is doubled and total kinetic energy of the gas is kept constant, then final temperature and pressure will be

(*a*) T_0, P_0 (*b*) $T_0, 2P_0$ (*c*) $\frac{T_0}{2}, 2P_0$ (*d*) $\frac{T_0}{2}, P_0$

111. Pressure of an ideal gas is increased by keeping temperature constant. The kinetic energy of molecules

(*a*) decrease
(*b*) increase
(*c*) remains same
(*d*) Increases or decreases depending on the nature of gas

112. For an ideal gas the fractional change in its volume per degree rise in temperature at constant pressure is equal to [T is absolute temperature of gas]

(*a*) T^0 (*b*) T (*c*) T^{-1} (*d*) T^2

113. The raise in the temperature of a given mass of an ideal gas at constant pressure and at temperature 27° to double its volume is

(*a*) 327°C (*b*) 54°C (*c*) 300 K (*d*) 600 K

Open Vessel Concept

114. A gas is filled in a vessel at 27°C To what temperature should it be heated in order that $\frac{1}{3}$ rd of the gas may escape out of the vessel?

Mean Free Path

115. The mean free path of molecules of a gas, (radius r) is inversely proportional to

(*a*) r^3 (*b*) r^2 (*c*) r (*d*) $\sqrt{2}$

116. In a gas sample, the time between two successive collisions of a gas molecule is 0.2 μs, and the average speed of the molecule is 4 m/s. Calculate the mean free path of the molecule.

117. For a molecule of an ideal gas $n = 3 \times 10^8$ cm^{-3} and mean free path is 10^{-2} Calculate the diameter of the molecule.

Mixture of Gases

118. Two thermally insulated vessels 1 and 2 are filled with air at temperatures (T_1, T_2), volume (V_1, V_2) and pressure (P_1, P_2) respectively. If the valve joining the two vessels is opened, the temperature inside the vessel at equilibrium will be

(*a*) $T_1 + T_2$ (*b*) $\frac{(T_1 + T_2)}{2}$

(*c*) $\frac{(T_1T_2)(P_1V_1 + P_2V_2)}{P_1V_1T_2 + P_2V_2T_1}$ (*d*) $\frac{T_1T_2(P_1V_1 + P_2V_2)}{P_1V_1T_1 + P_2V_2T_2)}$

119. 14 g of CO at 27°C is mixed with 16g of O_2 at 47°C. The temperature of mixture is (vibration mode neglected)

(*a*) –5°C (*b*) 32°C (*c*) 37°C (*d*) 27°C

120. Two container A and B are partly filled with water and closed. The volume of A is twice that of B and it contains half the amount of water in B. If both are at same temperature, the water vapour in the container will have pressure in the ratio of

(*a*) 1 : 2 (*b*) 1 : 1 (*c*) 2 : 1 (*d*) 4 :1

121. Two vessels separately contain two ideal gases A and B at the same temperature, the pressure of A being twice that of B. Under such conditions, the density of A is found to be 1.5 times the density of A The ratio of molecular weight of A and B is

(*a*) $\frac{1}{2}$ (*b*) $\frac{2}{3}$

(*c*) $\frac{3}{4}$ (*d*) 2

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1. **Statement I:** Speed is the same for molecules of all gases at a given temperature

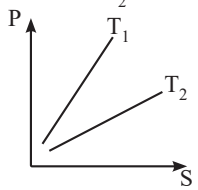
   Statement II: A gas behaves more closely as an ideal gas at high temperature & low pressure.

2. **Statement I:** The energy of a given sample of an ideal gas depends only on its temperature.

   Statement II: The pressure of on ideal gas is written as $p = \frac{2E}{3v}$ where E represents the total kinetic energy.

3. **Statement I:** Hydrogen gas will posses maximum r.m.s speed at a given temperature among nitrogen, hydrogen, oxygen & carbon dioxide.

   Statement II: Given graph shows graph of pressure versus density for an ideal gas at two temperatures T_1 and T_2. From graph, we can decode that T_1 is greater than T_2



4. **Statement I:** The mean square speed of the molecules of a gas at absolute temperature T will be proportional to $\sqrt{T}$

   Statement II: Suppose a container is evacuated to leave just one molecule of a gas in it. Let V_a and $V_{r.m.s}$ represent the average & RMS speed of the gas then $V_{r.m.s} > V_a$

5. **Statement I:** The rms speed of oxygen at room temperature is about 500m/s the rms speed of hydrogen at Same temperature will be about 2000m/s.

   Statement II: The rms speed of oxygen molecules in gas is v. If the temperature is doubled & oxygen molecules dissociate into oxygen atoms, the r.m.s speed will become double [$2v$].

6. **Statement I:** The quantity $\frac{PV}{K_B T}$ represents number of molecules in the gas

   Statement II: Momentum is zero on an average for the molecules of an ideal gas in equilibrium.

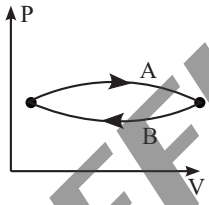
7. **Statement I:** Considering a collision between and oxygen molecule and a hydrogen molecule in a mixture of O_2 and H_2 kept at room temperature, It is possible that kinetic energy of O_2 molecule increases and that of the hydrogen molecule decreases.

   Statement II: Consider a mixture of oxygen and hydrogen kept at room temperature. As compared to hydrogen molecule an oxygen molecule hits the wall with smaller average kinetic energy.

8. **Statement I:** The first law of thermodynamics is a statement of conservation of energy.

   Statement II: If heat is supplied to an ideal gas in an isothermal process, the gas will do positive work.

9. **Statement I:** For figure given below. Let Q_A and Q_B be the heat given in processes A and B respectively. Then $Q_A = Q_B$

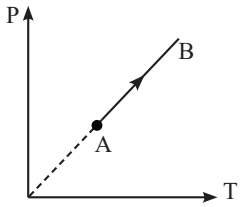


   Statement II: For figure given above, Let ΔU_A and ΔU_B be the changes in internal energy of system in process A and B. Then $\Delta U_A = \Delta U_B$

10. **Statement I:** If positive work is done by a system in thermodynamic process, It's volume must increase.

    Statement II: If heat is added to a system its temperature must increase.

11. **Statement I:** An ideal gas goes from the state A to the state B as shown in figure. The work done by the gas during the process is negative.

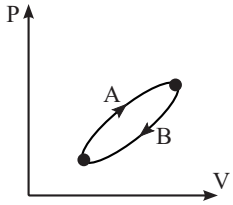


    Statement II: It is not possible that the pressure P and volume V of an ideal gas both increase in a process.

12. **Statement I:** In a process on a system, the initial pressure and volume are equal to the final pressure and volume, then the initial internal energy must be equal to the final internal energy

    Statement II: The net work done by the system in the process given above in statement I must be zero.

13. **Statement I:** If the internal energy of an ideal gas decreases by the same amount as the work done by the system, then the process must be adiabatic.



    Statement II: Refer to the given figure, Let ΔU_1, and ΔU_2 be the change in internal energy in processes A and B respectively, then $\Delta U_1 - \Delta U_2$ will be equal to zero

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Answer Key

1. (*a*) **2.** (*b*) **3.** A – I, B – III, C–IV, D – II **4.** (*b*) **5.** (*b*) **6.** (*b*) **7.** (*b*) **8.** (*a*)

9. (*c*) **10.** (*c*) **11.** (*d*) **12.** (*a*) **13.** (*a*) **14.** (*c*) **15.** (*c*) **16.** (*c*) **17.** (*d*) **18.** (*d*)

19. (*a*) **20.** (*c*) **21.** (*d*) **22.** (*c*) **23.** (*a*) **24.** (*a*) **25.** (*c*) **26.** (*d*) **27.** (*b*) **28.** (*a*)

29. (*c*) **30.** (*d*) **31.** (*b*) **32.** (*c*) **33.** (*d*) **34.** (*c*) **35.** (*b*) **36.** (*c*) **37.** (*d*) **38.** (*a*)

39. (*a*) **40.** (*c*) **41.** (*c*) **42.** (*a*) **43.** (*d*) **44.** (*a*) **45.** 1- Monoatonic, 2 - Diatomic, 3- Triatomic

46. (*c*) **47.** (*d*) **48.** (*c*) **49.** (*c*) **50.** (*b*) **51.** (*d*) **52.** (*d*) **53.** (*a*) **54.** (*c*) **55.** (*a*)

56. (*c*) **57.** (*d*) **58.** (*c*) **59.** (*d*) **60.** (*a*) **61.** (*b*) **62.** (*b*) **63.** (*c*) **64.** (*a*) **65.** (*a*)

66. $\frac{11R}{6}$ **67.** R/2 and 20R **68.** (*d*) **69.** (*a*) **70.** (*b*) **71.** (*c*) **72.** (*a*) **73.** T = 180*K*

74. T = 500*K* **75.** (*b*) **76.** 900 cal **77.** (*d*) **78.** (*a*) **79.** (*a*) **80.** (*c*) **81.** (*d*) **82.** (*d*)

83. (*b*) **84.** (*b*) **85.** (*b*) **86.** (*d*) **87.** (*d*) **88.** (*d*) **89.** (*c*) **90.** (*b*) **91.** (*d*)

92. $\sqrt{2}$ times **93.** (*a*) **94.** (*d*) **95.** (*c*) **96.** (*c*) **97.** –198°C **98.** (*b*) **99.** 32 **100.** (*a*) **101.** (*d*)

102. (*d*) **103.** (*a*) **104.** (*d*) **105.** (*a*) **106.** 50% decreased **107.** 128 cm Hg **108.** (*b*) **109.** (*d*)

110. (*d*) **111.** (*c*) **112.** (*c*) **113.** (*c*) **114.** 450 kelvin **115.** (*b*) **116.** 0.8 μm **117.** $d = 2.7 \times 10^{-4}$ cm

118. (*c*) **119.** (*c*) **120.** (*b*) **121.** (*c*)

MR* CORNER

1. I. Fasle, II. True **2.** I. True, II. False **3.** Both are True **4.** Both are False **5.** Both are True
6. Both are True **7.** I. True, II. False **8.** Both are True **9.** I. False, II. True **10.** I. True, II. False
11. Both False **12.** I. True, II. False **13.** I. True, II. False

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MR PHYSICS for questions practice

Motion in a Plane

(Practice Questions)

General Motion in 2D

1. If initial velocity of object $\vec{u} = 3\hat{i} + 4\hat{j}$ and after some time its velocity $v = 4\hat{i} + 3\hat{j}$ then find

(i) magnitude of change in velocity

(ii) change in magnitude of velocity.

2. Position of object $\vec{r} = 3t^2\hat{i} + (6t - t^2)\hat{j}$, then find velocity and acceleration at t = 1 sec.

3. x and y -coordinates of the particle at any time are $x = 5t - 2t^2$ and $y = 10t$, where x and y. Acceleration of the particle at t = 2s.

4. A particle has initial velocity $2\hat{i} + 3\hat{j}$ and acceleration $(0.3\hat{i} + 0.2\hat{j})$. Magnitude of velocity after 10 sec.

5. A position vector of a particle $r = 15t^2\hat{i} + \left(4 - 20t^2\right)\hat{j}\Big)$ Find acceleration at t = 1 sec

(*a*) 25 (*b*) 40

(*c*) 100 (*d*) 50

6. A particle moving in plane such that $y = \frac{x^2}{4}$ and $x = \frac{t}{2}$ then find speed at t = 2 sec.

7. A particle starting from origin moves in straight line and reach at a point $(\sqrt{3}, 3)$ then path makes an angle.

8. Object starts from the point $(2\hat{i}, 4\hat{j})$m at t = 0 with velocity $(5\hat{i} + 4\hat{j})$ with constant acceleration $(4\hat{i} + 4\hat{j})$m/s^2. What is distance of particle from origin at t = 2 sec.

9. Potion of object $\vec{r} = (t^2 - 38t)\hat{i} + 2t^3\hat{j}$ find instant when velocity and acceleration are perpendicular.

10. A car starts from rest and acceleration 5m/s^2 at t = 4 s. A ball is dropped out of a window by a person sitting in the car. What is the velocity and acceleration of the ball at t = 6s?

(*a*) $20\sqrt{2}$ m / s, 10 m / s^2, $t = 0$ (*b*) 20 m/s, 5 m/s^2

(*c*) 20 m/s,0 (*d*) $20\sqrt{2}$m/s, 0

11. A particle starts from origin with velocity $3\hat{i}$ m / s and acceleration $(6\hat{i} + 4\hat{j})$. Then find x-coordinates of particle when y -coordinates is 32 .

12. Object is moving with velocity $V = 3\sin(\omega t)\hat{i} + 3\cos(\omega t)\hat{j}$ then find distance moved by object in 2 sec.

13. At time t = 0 a particle starts travelling from a height $7\hat{z}$ cm in a plane keeping z coordinate constant. At any instant of time it's position along the $\hat{x}$ and $\hat{y}$ directions are defined as $3t$ and $5t^3$ respectively. At t = 1s acceleration of the particle will be

(*a*) $-30\hat{y}$ (*b*) $30\hat{y}$

(*c*) $3\hat{x} + 15\hat{y}$ (*d*) $3\hat{x} + 15\hat{y} + 7\hat{z}$

14. Initial velocity of object is 5m/s in east and acceleration of object is 2.5 ms^2 north then find speed of object at t = 2 sec.

15. Acceleration of object $a = 2\hat{i} + 3t^2\hat{j}$, then find velocity at t = 1 sec it initial velocity of object is zero.

16. Initial velocity of object $(4\hat{i} + 8\hat{j})$m/s and acceleration $a = -4$ m / s$^2\hat{j}$, then find velocity after t = 2sec and displacement in 3 sec.

17. Match column-I with Column-II:

Column-I (Condition)		Column-II (Result)	
		(*i*)	Velocity constant
(A)	$\vec{v} \cdot \vec{a} = +ve$	(*ii*)	Speed constant
(B)	$\vec{v} \cdot \vec{a} = -ve$	(*iii*)	Speed increases
(C)	$\vec{v} \cdot \vec{a} = 0$	(*iv*)	Speed decrease

18. **Assertion (A):** If acceleration is present, it will surely change the speed of the object.

Reason (R): Acceleration is rate of change in velocity.

(*a*) A is false but R is true

(*b*) Both A and R are true but R is NOT the correct explanation of A

(*c*) A is true but R is false

(*d*) Both A and R are true and R is the correct explanation of A

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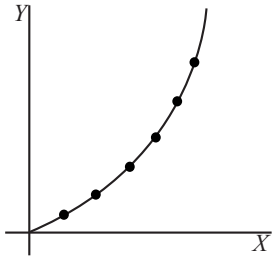
19. For initial velocity $(\vec{v}_i) = 3\hat{i} - 4\hat{j}$ and find velocity $(\vec{v}_f) = 3\hat{i} - 4\hat{j}$

(A)	$\lvert \Delta\vec{v} \rvert$	(i)	$8\hat{j}$
(B)	$\Delta \lvert \vec{v} \rvert$	(ii)	$6\hat{i}$
(C)	$\vec{v}_f - \vec{v}_i$	(iii)	0
(D)	$\vec{v}_f + \vec{v}_i$	(iv)	8

(*a*) (A)-(iii); (B)-(iv); (C)-(ii); (D)-(i)
(*b*) (A)-(iii); (B)-(iv); (C)-(i); (D)-(ii)
(*c*) (A)-(iv); (B)-(iii); (C)-(ii); (D)-(i)
(*d*) (A)-(iv); (B)-(ii); (C)-(i); (D)-(ii)

Equation of Trajectory

20. Position of object at time $'t', \vec{r} = 2t\hat{i} + 4t^2\hat{j}$, then find equation of trajectory.



21. If position of object $\vec{r} = 3\sin(\omega t)\hat{i} + 3\cos(\omega t)\hat{j}$, then object is moving on.

22. If position of object $\vec{r} = 4\sin(\omega t)i + 3\cos(\omega t)\hat{j}$, then object is moving on

23. If position of object $\vec{r} = 4\sin(\omega t)\hat{i} + 3\sin(\omega t)\hat{j}$, then object is moving on

(*a*) ellipse (*b*) circle
(*c*) parallel (*d*) straight line

24. Velocity of object $\vec{V} = 2\hat{i} + x\hat{j}$ then equation of trajectory.

25. A particle moving with velocity $V = y\hat{i} + x\hat{j}$ then find equation of trajectory.

Ground to Ground Projectile Motion

26. A bullet is fired from a gun at the speed of 280 ms^{-1} in the direction 30° above the horizontal. The maximum height attained by the bullet is... (g = 10 m/s^2, sin 30° = 0.5)

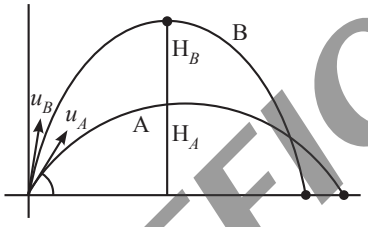
(*a*) 2000 m (*b*) 1000 m
(*c*) 3000 m (*d*) 2800 m

27. Velocity of projection $\vec{u} = 40\hat{i} + 30\hat{j}$ then find H, T, R and angle of project.

28. The horizontal range and the maximum height of a projectile are equal. The angle of projection of the projectile

(*a*) $\theta = \tan^{-1}$ (*b*) $\theta = 45^o$
(*c*) $\theta = \tan^{-1}\left(\frac{1}{4}\right)$ (*d*) $\theta = \tan^{-1}(4)$

29. Find the relation between time of flight from a given path as shown in fig.



(*a*) $T_A = T_B$ (*b*) $T_A > T_B$
(*c*) $T_A < T_B$ (*d*) Can't Say

30. The range of a projectile when fired at with the horizontal 75° is 1km what will be it's range when fired at 15° with same speed :-

(*a*) 0.5 km (*b*) 1.0 km
(*c*) 1.5 km (*d*) 2.0 km

31. An arrow is shot into the air. Its range is 200 metres and its time of flight is 5 s. If the value of *g* is assumed to be $10ms^{-2}$ then the horizontal component of the velocity of arrow is :-

(*a*) 25 m /s (*b*) 40 m /s
(*c*) 31.25 m/s (*d*) 12.5 m/s

32. Two projectiles of same mass and with same velocity are thrown at an angle 60° & 30° with the horizontal, then which quantity will remain same:

(*a*) Time of flight
(*b*) Horizontal range of projectile
(*c*) Max height acquired
(*d*) All of them

33. For angles of projection of a projectile at angles (45° – θ) and (45° + θ), the horizontal ranges described by the projectile are in the ratio of :

(*a*) 1 : 1 (*b*) 2 : 3
(*c*) 1 : 2 (*d*) 2 : 1

34. A projectile is thrown into space so as to have the maximum possible horizontal range equal to 400m . Taking the point of projection as the origin, the coordinates of the point where the velocity of the projectile is minimum are :-

(*a*) (400, 100) (*b*) (200, 100)
(*c*) (400, 200) (*d*) (200, 200)

35. Two stones are projected with the same speed but making different angles with the horizontal. Their ranges are equal. If the angle of projection of one is π/3 and its maximum height is y_1 then the maximum height of the other will be :

(*a*) $3y_1$ (*b*) $2y_1$
(*c*) $y_1/2$ (*d*) $y_1/3$

36. A projectile has same range at two different angle if time of flight are t_1 and t_2 then range of the projectile will be?

37. The horizontal range of a projectile is $4\sqrt{3}$ times its maximum height. Its angle of projectile will be:

(*a*) 45° (*b*) 60°
(*c*) 90° (*d*) 30°

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38. Two bodies are thrown up at angles of 45° and 60° respectively, with the horizontal. If both bodies attain same vertical height, then the ratio of velocities with which these are thrown is :

(*a*) $\sqrt{\frac{2}{3}}$ (*b*) $\frac{2}{\sqrt{3}}$

(*c*) $\sqrt{\frac{3}{2}}$ (*d*) $4\frac{\sqrt{3}}{2}$

39. A projectile is fired from the surface of the earth with a velocity of 5 ms^{-1} and angle θ with the horizontal. Another projectile fired from another planet with a velocity of 3ms^{-1} at the same angle follows a trajectory which is identical with the trajectory of the projectile fired from the earth. The value of the acceleration due to gravity on the planet is (in ms^{-2}) is: (given g = 9.8 $m.s^2$)

(*a*) 3.5 (*b*) 5.9

(*c*) 16.3 (*d*) 110.8

40. The equation of projectile is $y = \sqrt{3}x - \frac{gx^2}{2}$ the angle of projection is :

(*a*) 30° (*b*) 60°

(*c*) 45° (*d*) none

41. The equation of projectile is $y = 16x - \frac{x^2}{4}$ the horizontal range is

(*a*) 16 m (*b*) 8 m

(*c*) 64 m (*d*) 12.8 m

42. The equation of trajectory of a projectile thrown from a level ground near the surface of earth is given by $y = ax - bx^2$ with *y*-axis in vertical direction and *x*-axis in horizontal direction, *a* and *b* are constants. Then,

(*i*) The range of the projectile is *a* / *b*.

(*ii*) At $x - a/2b$, the velocity of projectile becomes zero.

(*iii*) The maximum height attained by projectile is $a^2/4b$.

(*iv*) The angle of projectile is $\tan^{-1}(a)$

(*a*) (i) and (ii) (*b*) (ii) and (iii)

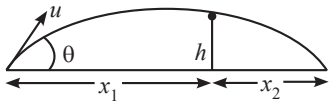
(*c*) (i), (iii) and (iv) (*d*) All above

43. Position of projected object at time *t* is $\vec{s} = 30t\hat{i} + (40t - 5t)\hat{j}$ then find (i) Angle of Projection (ii) H_{max} (iii) *R* & T_f

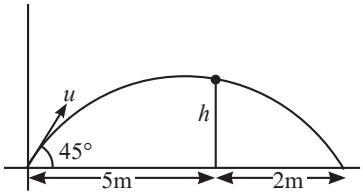
44. Particle is projected and its velocity at time 't' is $\vec{v} = \alpha\hat{i} + (\beta - rt)\hat{j}$ then find H,R,T angle of projection.

45. Particle is projected at other planets & its position at time 't' is $\vec{r} = 3t\hat{i} + (4t - 2t^2)\hat{j}$ find t_f(Time of flight), H (maximum height) and R (range)

46. Find relation between x_1, x_2 and *h*; if the ball is projected with speed *u* at angle θ.



47. A projectile is launched at an angle of 45° with an initial velocity u from the ground. The horizontal distance traveled by the projectile is 7 meters (5 meters to the highest point and 2 meters from the highest point to the landing point). Find the maximum height *h* attained by the projectile.



48. Ball is projected, with speed u at angle θ then find time after which ball will be moving perpendicular to the initial direction of projection.

49. A ball is thrown vertically upwards from the top of a cliff. Take starting position of motion as origin and upward direction as positive. Column-I specifies the position, velocity and for acceleration of the particle at any instant column-II gives their sign (+) or (–) at that moment.

Column –1		Column –II	
i.	When the ball is above point of projection, its displacement is	A	Always (+)
ii.	When the ball is above point of projection, its velocity is	B.	Always (–)
iii.	When the ball is above point of projection, its acceleration is	C.	May be (+)
iv.	When the ball is below point of projection, its acceleration is	D.	May be zero

(*a*) (i)–A; (ii)–C, D; (iii) –B; (iv)–B

(*b*) (i)–B; (ii)–A, (iii) –D; (iv)–C

(*c*) (i)–C; (ii)–B, (iii) –C, D; (iv)–B

(*d*) (i)–A; (ii)–C, (iii) –C; (iv)–B

50. The path of projectile is represented by $y = Px - Qx^2$.

Column –1		Column –II	
i.	Range	A	P/Q
ii.	Maximum height	B.	P
iii.	Time of flight	C.	$P^2/4Q$
iv.	Tangent of angle of projection is	D.	$\sqrt{\frac{2P}{Qg}}$

(*a*) (i)–D, (ii)–A, (iii) –B, (iv)–C

(*b*) (i)–C, (ii)–A, (iii) –D; (iv)–B

(*c*) (i)–A, (ii)–C, (iii) –D, (iv)–B

(*d*) (i)–B; (ii)–C, (iii) –A; (iv)–C

51. At maximum height of projectile motion velocity is minimum and perpendicular to acceleration.

(*a*) True (*b*) False

52. Tangential acceleration in projectile motion 1st decreases then increases during motion.

(*a*) True (*b*) False

53. The rate of change in velocity is constant in projectile motion.

(*a*) True (*b*) False

54. Speed, velocity and acceleration are variable in projectile motion.

(*a*) True (*b*) False

55. If air friction is not ignored in projectile motion angle of projection is less than angle of collision.

(*a*) True (*b*) False

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56. Ball is projected at angle θ then total angular displacement of ball is 2θ in time of flight of Projectile motion.

(*a*) True (*b*) False

57. Projectile motion is non-uniform motion with non-uniform acceleration.

(*a*) True (*b*) False

58. At point of projectile centripetal acceleration of object is g cos θ.

(*a*) True (*b*) False

59. Total change in momentum(2 mu sin θ) in projectile motion.

(*a*) True (*b*) False

60. Average velocity in projectile motion between any two point is u cosθ.

(*a*) True (*b*) False

61. Horizontal component of projectile motion is uniform and y^{th} component is nonuniform motion

(*a*) True (*b*) False

62. Path of on projectile with respect to another projectile is always straight line.

(*a*) True (*b*) False

63. The maximum vertical height to which a man can throw a ball is 136 m The maximum horizontal distance unto which he can throw the same ball is

(*a*) 136 m (*b*) 272 m

(*c*) 68 m (*d*) 192 m

64. A projectile is projected at 60° from vertical with initial velocity $40 ms^{-1}$. The velocity of projectile at $t = 2s$ from the start will be :

(*a*) Zero (*b*) $20\sqrt{3}$ m / s

(*c*) 20 m/s (*d*) $40\sqrt{3}$m/s

65. The trajectory of projectile, projected from the ground is given by $y = x - \frac{x^2}{20}$, where *x* and *y* are measured in meter. The maximum height attained by the projectile will be :

(*a*) 10 m (*b*) 5 m

(*c*) 200 m (*d*) $10\sqrt{2}$m

66. **Assertion (A):** When a body is projected at an angle 45°, it's range is maximum.

Reason (R): For maximum range, the value of sin (2θ) should be equal to one.

(*a*) A is false but *R* is true

(*b*) Both A and R are true but R is NOT the correct explanation of A

(*c*) A is true but *R* is false

(*d*) Both A and R are true and R is the correct explanation of A

67. A ball is projected from the ground with a speed 15 m /s at an angle θ with horizontal so that its range and maximum height are equal, then 'sin θ' 'will be equal to :

(*a*) 1/4 (*b*) 4

(*c*) $4/\sqrt{17}$ (*d*) 1/2

68. A projectile is projected with velocity of 25 m/s at an angle θ with the horizontal. After *t* seconds its inclination with horizontal becomes zero. If R represent horizontal range of projectile, the value of θ will be :

(*a*) $\frac{1}{2}\sin^{-1}\left(\frac{5t^2}{4R}\right)$ (*b*) $\tan^{-1}\left(\frac{4t^2}{5R}\right)$

(*c*) $\frac{1}{2}\sin^{-1}\left(\frac{4R}{5t^2}\right)$ (*d*) $\cot^{-1}\left(\frac{R}{20t^2}\right)$

69. The ranges and heights for two projectiles projected with the same initial velocity at angles 42° and 48° with horizontal are R_1, R_2 and H_1, H_2 respectively. Choose the correct option :

(*a*) $R_1 > R_2$ and $H_1 = H_2$ (*b*) $R_1 = R_2$ and $H_1 < H_2$

(*c*) $R_1 < R_2$ and $H_1 < H_2$ (*d*) $R_1 = R_2$ and $H_1 = H_2$

70. **Assertion (A):** If a body of mass *m* is projected upwards with a speed *v* making an angle θ with horizontal, then the change in momentum of body along *x* -axis will be zero.

Reason (R): Mass of body remains constant along *x*-axis.

(*a*) A is false but R is true

(*b*) Both A and R are true but R is NOT the correct explanation of A

(*c*) A is true but R is false

(*d*) Both A and R are true and R is the correct explanation of A

71. Average velocity of a particle in projectile motion between its starting point and the highest point of its trajectory is (projection speed = *u* , angle projection from horizontal = θ)

(*a*) $\frac{u}{2}\sqrt{1+2\cos^2\theta}$ (*b*) $\frac{u}{2}\sqrt{1-2\cos^2\theta}$

(*c*) $\frac{u}{2}\sqrt{1+3\cos^2\theta}$ (*d*) $u \cos\theta$

72. A particle is projected vertically upward from ground with initial velocity u such that it clears the top of a pole of height *h* after time t_1 in its path. It takes further time t_2 to reach the ground

(A)	*u*	(i)	$\frac{(t_1+t_2)^2}{8}g$
(B)	*h*	(ii)	$(t_{1+}t_2)$
(C)	Time of flight	(iii)	$\frac{1}{2}g(t_1+t_2)$
(D)	Maximum height	(iv)	$\frac{1}{2}gt_1t_2$

(*a*) (A)-(ii); (B)-(i); (C)-(iii); (D)-(iv)

(*b*) (A)-(i); (B)-(ii); (C)-(iii) (D)-(iv)

(*c*) (A)-(iii); (B)-(iv);(C)-(ii) (D)-(i)

(*d*) (A)-(iv); (B)-(iii); (C)-(ii); (D)-(1)

73. For ground to ground projectile motion with intitial velocity *u* at angle θ from horizontal

(A)	Change in speed from initial to final point	(i)	u-u cos θ
(B)	Magnitude of change in velocity from initial to final point	(ii)	u sin θ
(C)	Change in speed from initial to top	(iii)	2u sin θ
(D)	Magnitude of change in velocity from initial to top	(iv)	zero

(*a*) (A)-(i); (B)-(ii); (C)-(iii); (D)-(iv)

(*b*) (A)-(iv); (B)-(ii); (C)-(i); (D)-(iii)

(*c*) (A)-(iv); (B)-(iii); (C)-(1); (D)-(ii)

(*d*) (A)-(iv); (B)-(iii); (C)-(ii); (D)-(i)

74. A projectile is fired at an angle of θ with the horizontal. What will be the elevation angle α of the projectile at its heighest point as seen form the point of projection?

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Horizontal Projectile Motion

75. When a particle is thrown horizontally, with initial velocity 'u' the resultant velocity of the projectile at any time t is given by:

(*a*) gt (*b*) $\frac{1}{2}gt^2$

(*c*) $\sqrt{u^2+g^2t^2}$ (*d*) $4\sqrt{u^2-g^2t^2}$

76. A bomber is flying horizontally with a constant speed of 15 m/s at a height of 78.4 m . The pilot has to drop a bomb at the enemy target. At what horizontal distance from the target should he release the bomb:

(*a*) Zero (*b*) 30 m

(*c*) 60 m (*d*) 75 m

77. A body is thrown horizontally from the top of a tower of height 5 m. It touches the ground at a distance of 10 m from the foot of the tower. The initial velocity of the body is ($g = 10\ m/s^2$)

(*a*) $2.5\ ms^{-1}$ (*b*) $5\ ms^{-1}$

(*c*) $10\ ms^{-1}$ (*d*) $20\ ms^{-1}$

78. A body is thrown horizontally with a velocity $\sqrt{2gh}$ from the top of a tower of height h. It strikes the level ground through the foot of the tower at a distance x from the tower. The value of x is:

(*a*) h (*b*) $h/2$

(*c*) $2h$ (*d*) $2h/3$

79. Ball is projected with 30 m/s in horizontal direction from some height. Find time when it is 45° from horizontal.

80. A bullet is fired in a horizontal direction from a tower while a stone is simultaneously dropped from the same point then:

(*a*) The bullet and the stone will reach the ground simultaneously.

(*b*) The stone will reach earlier.

(*c*) The bullet will reach earlier.

(*d*) Nothing can be predicted.

81. A ball is projected upwards from the top of the tower with a velocity $50\ ms^{-1}$ making an angle 30° with the horizontal. The height of tower is 70 m. After how many seconds the ball will strike the ground?

(*a*) 3 s (*b*) 5 s

(*c*) 7 s (*d*) 9 s

Direction for questions from 82-85

A body x is dropped from the top of a tower. At the same time, another body y is thrown horizontally from the same position with a velocity U.

82. Both bodies will reach the ground at same time.

(*a*) True (*b*) False

83. A particle is projected from height h with horizontal velocity u, then range of particle is $u\sqrt{\frac{2H}{g}}$

(*a*) True (*b*) False

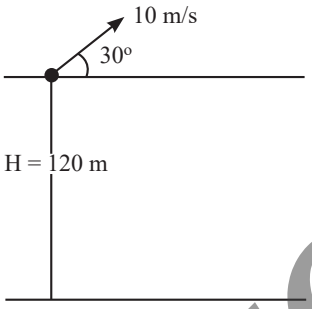
84. At the highest point of the path of projectile speed is zero.

(*a*) True (*b*) False

85. Horizontal velocity in projectile motion is zero at the highest point

(*a*) True (*b*) False

86. Find time of flight.



(*a*) 3 sec (*b*) 6 sec

(*c*) 4 sec (*d*) 7 sec

87. **Assertion :** Two bodies of different masses are projected horizontally with different speeds, they reach the ground simultaneously.

Reason : For both bodies, the vertical component of initial velocity is zero.

(*a*) Both the assertion and reason are correct, and the reason is the correct explanation of the assertion.

(*b*) Both the assertion and reason are correct, but the reason is not the correct explanation of the assertion.

(*c*) The assertion is correct, but the reason is incorrect.

(*d*) The assertion is incorrect, but the reason is correct.

88. **Assertion :** Mass of the projectile does not affect the maximum height

Reason: Heavier the body, greater is the force required project it.

(*a*) Both the assertion and reason are correct, and the reason is the correct explanation of the assertion.

(*b*) Both the assertion and reason are correct, but the reason is not the correct explanation of the assertion.

(*c*) The assertion is correct, but the reason is incorrect.

(*d*) The assertion is incorrect, but the reason is correct

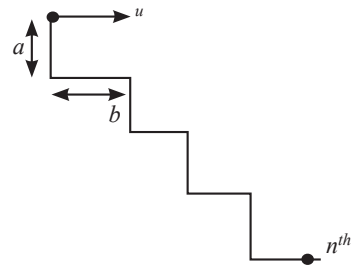
89. A bomber plane moves horizontally with a speed of 500 m/s and a bomb released from it, strikes the ground in 10 sec . Angle at which it strikes the ground will be ($g = 10\ m/s^2$)

(*a*) $\tan^{-1}\left(\frac{1}{5}\right)$ (*b*) $\tan\left(\frac{1}{5}\right)$

(*c*) $\tan^{-1}(1)$ (*d*) $\tan^{-1}(5)$

90. Ball is Projected in Horizontal direction with speed u then find its speed when it is at a point where horizontal and vertical displacement is same.

91. Find velocity so that ball will fall on n^{th} step



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Relative Motion in a Plane

92. Velocity of Ramlal $\vec{V}_R = -3\hat{i} + 4\hat{j}$ and velocity of Pinky $\vec{V}_P = 4\hat{i} + 3\hat{j}$ then find velocity of Ramlal with respect to Pinky.

93. Suppose you are riding a bike with a speed of 10 m /s due east relative to a person A who is walking on ground towards east. If your friend B walking on the ground due west measures your speed as 15m/ s , find the relative velocity between two reference frames A and B.

(*a*) Velocity of A w.r.t. B will be 5m /s due west.
(*b*) Velocity of B w.r.t. A will be 5m /s due east.
(*c*) Velocity of A w.r.t. B will be 25m /s due west.
(*d*) Velocity of A w.r.t. B will be 5m /s due east.

94. Ship is travelling due east at 10km/h. A ship heading 30° east of north is always due north from the first ship. The speed of the second ship in km / h is -

(*a*) $20\sqrt{2}$ (*b*) $20\sqrt{3/2}$
(*c*) 20 (*d*) $20/\sqrt{2}$

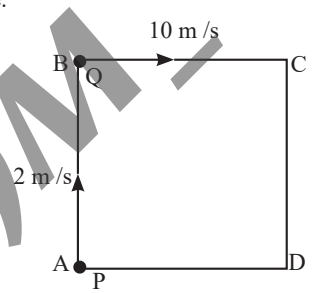
95. Car is moving with 30 m/s along east and truck is moving with speed 40 m/s at 30° north of east w.r.t. car then find velocity of truck.

96. A man 'A' moves in the north direction with a speed 10 m/s and another man B moves in E-30° – N with 10 m/s find the relative velocity of B w.r.t. A.

97. A bird is flying with a speed of 40km / hr. in the north direction. A train is moving with a speed of 40km / hr. in the west direction. A passenger sitting in the train will see the bird moving with velocity

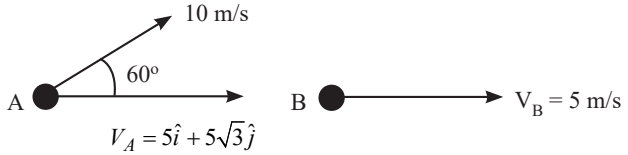
(*a*) 40 km/ hr in NE direction
(*b*) $40\sqrt{2}$ km / hr in NE direction
(*c*) 40 km/ hr in NW direction
(*d*) $40\sqrt{2}$ km / hr in NW direction

98. Two men P & Q are standing at corners A & B of square $ABCD$ of side 8 m . They start moving along the track with constant speed 2 m/s and 10m/s respectively. Find the time when they will meet for the first time.

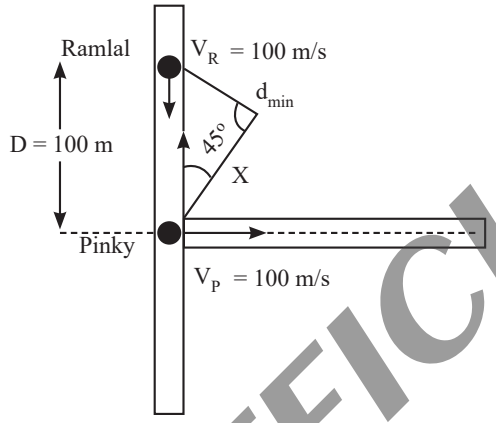


(*a*) 2 *s* (*b*) 3 *s*
(*c*) 1 *s* (*d*) 6 *s*

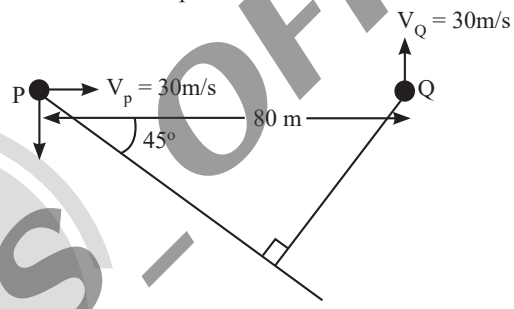
99. Find velocity of A with respect to B.



100. Find minimum separation between Ramlal and Pinky.



101. Find minimum separation between them.



102. Two particles A and B moving in $x - y$ plane are at origin at $t = 0$ sec. The initial velocity vectors of A and B are $\vec{u}_A = 8\hat{i}\,\text{m/s}$ and $\vec{u}_B = 8\hat{j}\,\text{m/s}$. The acceleration of A and B are constant and are $\vec{a}_A = -2\hat{i}\,\text{m/s}^2$ and $\vec{a}_B = -2\hat{i}\,\text{m/s}^2$. Column-I gives certain statements regarding particle A and B Column-I gives corresponding results. Match the statements in Column-I with corresponding results in Column-II.

Column-I		Column-II	
i	The time (in sec.) at which velocity of A relative to B is zero	A.	$16\sqrt{2}$
ii	The distance (in metres) between A and B when their relative velocity is zero	B.	$8\sqrt{2}$
iii	The time (in sec.) after $t = 0$ sec, at which A and B are at same position	C.	8
iv	The magnitude of relative velocity of A and B at instant when they are at same position	D.	4 sec

River Swimmer Problem

103. A river is flowing from east to west at a speed of 5m/min. A man on south bank of river, capable of swimming 10m/min. in still water, wants to swim across the river in shortest time should swim

(*a*) Due north
(*b*) Due north-east
(*c*) Due north-east with double the speed of river
(*d*) None of the above

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104. A boat is sailing at a velocity $\left(3\hat{i}+4\hat{j}\right)$ with respect to ground and water in river is flowing with a velocity $\left(-3\hat{i}-4\hat{j}\right)$ Relative velocity of the boat with respect to water is

(*a*) $8\hat{j}$ (*b*) $5\sqrt{2}$

(*c*) $6\hat{i}+8\hat{j}$ (*d*) $-6\hat{i}-8\hat{j}$

105. A boat takes 2 hours to go 8 km and come back in still water lake. With water velocity of 4 km / hr, the time taken for going upstream of 8 km and coming back is :-

(*a*) 140 min (*b*) 150 min

(*c*) 160 min (*d*) 60 min

106. A boat, which has a speed of 5 km/h in still water, crosses a river of width 1 km along the shortest possible path in 15 minutes. The velocity of the river water in km/h is

(*a*) 1 (*b*) 3

(*c*) 4 (*d*) $\sqrt{41}$

107. A man wishes to swim across a river 0.5 km . wide. If he can swim at the rate of 2 km /h. in still water and the river flows at the rate of 1 km /h . The angle (w.r.t. the flow of the river) along which he should swim so as to reach a point exactly opposite his starting point, should be

(*a*) 60º (*b*) 120º

(*c*) 145º (*d*) 90º

108. A man is crossing a river flowing with velocity of 5 m/s. He reaches a point directly across at distance of 60 m in 5 s . His velocity in still water should be:

(*a*) 12 m/s (*b*) 13 m/s

(*c*) 5 m/s (*d*) 10 m/s

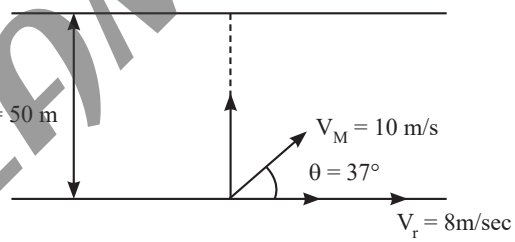
109. A person, reaches a point directly opposite on the other bank of a flowing river, while swimming at a speed of 5 m/s at an angle of 120º with the flow. The speed of the flow must be

(*a*) 2.5 m/s (*b*) 3 m/s

(*c*) 4 m/s (*d*) 1.5 m/s

110. River is flowing with speed 20 m/s a man can swim in flowing river with speed 10 m/s then find drift in a case of minimum time while the width of river is 60 m.

111. Find drift and time taken to cross the river.



112. Flow of rives is 20 m/s and Man can swim in rives with speed 10 m/s, then find angle at Which man have to swim to counter the river's flow and reach the exact opposite point with zero drift, following the minimum path?

(*a*) 30º (*b*) 60°

(*c*) 120° (*d*) None of these

113. Flow of river is 200 m/s and man can swim in river with speed 10m/s then find angle at which man have to swin for minimum time

(*a*) 30º (*b*) 90°

(*c*) 120° (*d*) None of these

114. A boat moving towards east with velocity 4m/s with respect to still water and river is flowing towards north with velocity 2 m/s and the wind is blowing towards north with velocity 6 m/s. The direction of the flag blown over by the wind hoisted on the boat is

(*a*) North - west (*b*) south-east

(*c*) $\tan^{-1}(1/2)$ with east (*d*) North

115. A man swims from a point A on one bank of a river of width 100 m . When he swims perpendicular to water current, he reaches the other bank 50 m downstream. The angle to the bank at which he should swim, to reach the directly opposite point B on other bank is

(*a*) 10º upstream (*b*) 20º upstream

(*c*) 30º upstream (*d*) 60º upstream

116. A river flows with a speed more than the maximum speed with which a person can swim in still water. He intends to cross the river by the shortest possible path [*i.e.* he wants to reach the point on the opposite bank which directly opposite to starting point). Which of the following is correct?

(*a*) He should start normal to river bank.

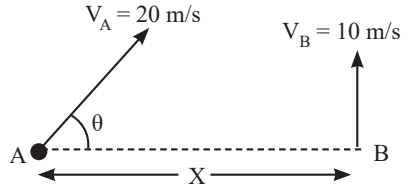
(*b*) He should start in such away that he moves normal to bank, relative to bank.

(*c*) He should start in particular calculated direction making an obtuse angle with downstream.

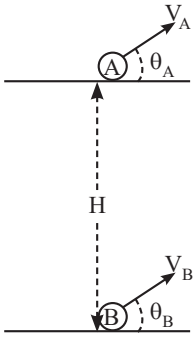
(*d*) The man cannot cross the river in that way.

Condition of Collision

117. Two particles A and B are projected from the ground simultaneously in the directions shown in the figure with initial velocities V_A = 20 m /s and V_B = 10 m/s respectively. They collide after 0.5 s . Find out the angle θ and the distance *x*.



118. Two balls are projected as shown in figure, find time of collision and condition of collision?



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119. Two particles having position vectors $\vec{r}_1 = \left(3\hat{i} + 5\hat{j}\right)$ meters and $\vec{r}_2 = \left(-5\hat{i} - 3\hat{j}\right)$ meres are moving with velocities $\vec{v}_1 = \left(2\hat{i} + 3\hat{j}\right)$ m/s and $v_2 = \left(\alpha\hat{i} + 7\hat{j}\right)$ m/s. If they collide after 2 seconds, the value of 'α' is:

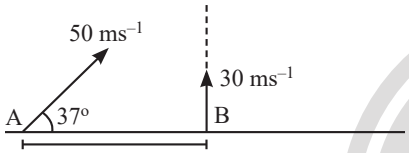
(*a*) 2 (*b*) 4
(*c*) 6 (*d*) 8

120. Two boys are standing at the ends A and B of a ground where AB = *a*. The boy at B starts running in a direction perpendicular to AB with velocity v_1. The boy at A starts running simultaneously with velocity *v* and catches the other boy in a time *t*, where *t* is-

(*a*) $\dfrac{a}{\sqrt{v^2 + v_1^2}}$ (*b*) $\dfrac{a}{\sqrt{v^2 - v_1^2}}$

(*c*) $\dfrac{a}{(v - v_1)}$ (*d*) $\dfrac{a}{(v + v_1)}$

121. Balls A and B are thrown from two points lying on the same horizontal plane separated by a distance of 120 m. Which of the following statements is correct?



(*a*) The balls can never meet
(*b*) The balls can meet if the ball B is thrown 1 s later
(*c*) The two balls meet at a height of 45 m
(*d*) None of the above

122. Four persons P, Q, R and S are initially at the four corners of a square of side *d*. Each person now moves with a constant speed *v* in such a way that P always moves directly towards Q, Q towards R, R towards S, and S towards P. The four persons will meet after time

(*a*) $\dfrac{d}{2v}$ (*b*) $\dfrac{d}{v}$

(*c*) $\dfrac{3d}{2v}$ (*d*) The will never meet

123. A 2m wide truck is moving with a uniform speed V_o = 8 ms^{-1} along a straight horizontal road. A man starts to cross the road with a uniform speed *v*, when the truck is 4 m away from him. The minimum value of *v* so that he can cross the road safely is

(*a*) 2.62 ms^{-1} (*b*) 4.6 m^{-1}
(*c*) 3.57 ms^{-1} (*d*) 1.414 ms^{-1}

Rain Man Problem

124. Rain is falling vertically with a speed of 30 ms^{-1}. A woman rides a bicycle with a speed of 10 ms^{-1}. in the north direction. What is the direction in which she should hold her umbrella?

125. Man is at rest and find rain is falling with speed 50m/s at angle 37° from vertical; now man starts moving with speed V_m, then find V_m so that rain appears to falling vertical downward with respect to moving man; also find V_{rm}/V_r

126. A man standing on a road has to hold his umbrella at 30° with the vertical to keep the rain away. He throws the umbrella and starts running at 10 km/hr then he finds that rain drops are hitting his head vertically, then speed of rain drops with respect to moving man:-

(*a*) 20 km/hr (*b*) $10\sqrt{3}$ km/hr
(*c*) $10\sqrt{3}$ km/hr (*d*) 10 km/hr

127. A man walks in rain with a velocity of 5 kmh^{-1}. The rain drops strike at him at an angle of 45° with the horizontal. Velocity of rain if it is falling vertically downward-

(*a*) 5 kmh^{-1} (*b*) 4 kmh^{-1}
(*c*) 3 kmh^{-1} (*d*) 1 kmh^{-1}

128. A car with vertical windshield moves in a rain storm at a speed of 40 km/hr. The rain drops fall vertically with constant speed of 20 m/s. The angle at which rain drops strike the windshield is

(*a*) $\tan^{-1}\dfrac{5}{9}$ (*b*) $\tan^{-1}\dfrac{9}{95}$

(*c*) $\tan^{-1}\dfrac{3}{2}$ (*d*) $\tan^{-1}\dfrac{2}{3}$

129. A man sitting in a bus travelling in a direction from west to east with a speed of 40 km/h observes that the rain-drops are falling vertically downwards. To another man standing on ground the rain will appear.

(*a*) To fall vertically downwards
(*b*) To fall at an angle going from west to east
(*c*) To fall at an angle going from east to west
(*d*) The information given is insufficient to decide the direction of the rain

Kinematics of Circular Motion

130. Find angular and linear displacement in one revolution.

131. Find angle rotated by angular displacement vector in one rotation.

132. Find angular displacement of hr. hand, minute hand and second hand of clock in 12 hr.

133. A fly wheel is accelerated uniformly from rest and rotates through 5 rad in the first second. The angle rotated by the fly wheel in the next second, will be:

(*a*) 7.5 rad (*b*) 15 rad
(*c*) 20 rad (*d*) 30 rad

134. Angular velocity of minute hand of a clock is:-

(*a*) $\dfrac{2\pi}{1800}$ rad/s (*b*) 8π rad/s

(*c*) $\dfrac{\pi}{1800}$ rad/s (*d*) $\dfrac{\pi}{30}$ rad/s

135. Angular displacement of object $\theta = t^2 + 2t + 5$ then, find angular speed at 2 sec and in 2-sec.?

136. Angular velocity of a rotating object is given by the equation: $\omega = 6t - t^2 + 6$ Find the time at which the angular acceleration becomes zero?

137. Object completes 7 rotation in 22 sec on circular path of radius 1 m then find angular speed.??

138. A body performing uniform circular motion completed 140 revolution in a second. Its angular speed is

(*a*) 880 rad/s (*b*) 440 rad/s
(*c*) 220 rad/s (*d*) 240 rad/s

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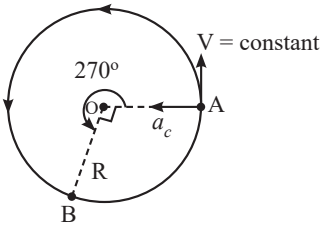
139. Find average acceleration between A and B.



140. Find angular speed of hr. hand

141. Body moving in uniform circular motion rotated by 120° then find change in velocity.

142. In uniform circular motion acceleration is:?

(*a*) Constant (*b*) Variable

143. Angular speed of a uniformly circulating body with time period T is

(*a*) $2\pi T$ (*b*) $\frac{2\pi}{T}$

(*c*) πT (*d*) $\frac{\pi}{T}$

144. An object moving in a circular path at constant speed has constant

(*a*) Energy (*b*) Velocity

(*c*) Acceleration (*d*) Displacement

145. The angle between velocity vector and acceleration vector in uniform circular motion is

(*a*) 0° (*b*) 180°

(*c*) 90° (*d*) 45°

146. Two cyclists cycle along circular tracks of radii R_1 and R_2 at uniform rates. If both of them take same time to complete one revolution, then their angular speeds are in the ratio

(*a*) $R_1 : R_2$ (*b*) $R_2 : R$

(*c*) 1 : 1 (*d*) $R_1R_2 : 1$

147. Speed of an object moving in circular path of radius 10 m with angular speed 2 rad/s is

(*a*) 10 m/s (*b*) 5 m/s

(*c*) 20 m/s (*d*) 30 m/s

148. Centripetal acceleration of a cyclist completing acceleration of a cyclist completing 7 rounds in a minute along a circular track of radius 5 m with a constant speed, is

(*a*) 2.7 m/s^2 (*b*) 4 m/s^2

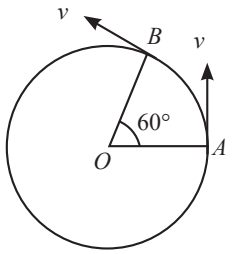
(*c*) 3.78 m/s^2 (*d*) 6 m/s^2

149. If the frequency of an object in uniform circular motion is doubled, its acceleration becomes

(*a*) Two times (*b*) Four times

(*c*) Half (*d*) One fourth

150. A particles is moving in a circle of radius *r* having centre at O, with a constant speed *v*. The magnitude of change in velocity in moving from A to B is



(*a*) $2v$ (*b*) 0

(*c*) $\sqrt{3}v$ (*d*) v

151. A particle is moving with constant speed in a circular path. When the particle turns by an angle 90°, the ratio of instantaneous velocity is $\pi : x\sqrt{2}$. The value of *x* will be

(*a*) 2 (*b*) 5

(*c*) 1 (*d*) 7

152. A body revolves with constant speed *v* in a circular path of radius *r*. The magnitude of its average acceleration during motion between two points in diametrically opposite direction is

(*a*) 0 (*b*) $\frac{v^2}{r}$

(*c*) $\frac{2v^2}{\pi r}$ (*d*) $\frac{v^2}{2r}$

153. A body is moving on a circle of radius 80 m with a speed 20 m/s which is decreasing at the rate 5 m/s^2 at an instant. The angle made by its acceleration with its velocity is

(*a*) 45° (*b*) 90°

(*c*) 135° (*d*) 0°

154. A car is moving at a speed of 40 m/s on a circular track of radius 400 m. This speed is increasing at the rate of 3 m/s^2. The acceleration of car is

(*a*) 4 m/s^2 (*b*) 7 m/s^2

(*c*) 5 m/s^2 (*d*) 3 m/s^2

155. A car travelling with linear velocity *v* on circular path of radius *r* its speed increasing at rate α, then find acceleration.

156. The distance of a particle moving on a circle of radius 12 m measured from a fixed point on the circle and measured along the circle is given by $s = 2t^3$ (in meters). The ratio of its tangential to centripetal acceleration at $t = 2$sec.

(*a*) 4 : 1 (*b*) 1 : 2

(*c*) 2 : 1 (*d*) 3 : 1

157. A car is going round a circle of radius R_1 with constant speed. Another car is going round a circle or radius R_2 with constant speed. If both of them take same time to complete the circles, the ratio of their angular speeds and linear speeds will be

(*a*) $\sqrt{\frac{R_1}{R_2}}, \frac{R_1}{R_2}$ (*b*) 1, 1

(*c*) $1, \frac{R_1}{R_2}$ (*d*) $\frac{R_1}{R_2}$

158. If θ is angle between the velocity and acceleration of a particle moving on a circular path with decreasing speed, then

(*a*) $\theta = 90°$ (*b*) $0° < \theta < 90°$

(*c*) $90° < \theta < 180°$ (*d*) $0° \le \theta \le 180°$

159. If speed of an object revolving in a circular path is doubled angular speed is reduced to half of original value, then centripetal acceleration will become/remain

(*a*) Same (*b*) Double

(*c*) Half (*d*) Quadruple

160. A motor car is travelling at 30 m/sec on a circular road of radius 500 m. It is increasing its speed at the rate of 2.0 ms^{-2}. The total acceleration is:

(*a*) 1.8 ms^{-2} (*b*) 2 ms^{-2}

(*c*) 3.8 ms^{-2} (*d*) 2.7 ms^{-2}

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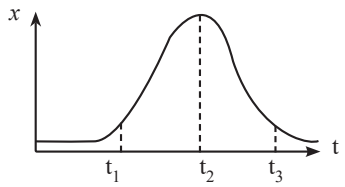
MR* CORNER

1. **Statement I:** When a particle moves with constant velocity, its average velocity, it's instantaneous velocity and it's speed are all equal.

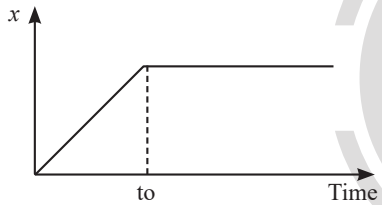
   Statement II: If a particle is accelerating, it is either speeding up or speeding down.

2. Given figure shows the x-coordinate of particle is function of time.



   (*i*) Sign of velocity at time t_1 = _____.
   (*ii*) Sign of acceleration at time t_2 = _____.
   (*iii*) Sign of velocity at time t_3 = _____.
   (*iv*) sign of acceleration at time t_3 = _____.

3. For a given figure



   Statement I: The velocity increases up to a time to, and then becomes constant.

   Statement II: The particle moves at a constant velocity up to a time to, and then stops.

4. A stone is released from an elevator going up with an acceleration *a* The acceleration of the stone before and after the release is _____ and _____ respectively.

5. *A* person standing near the edge of the top of a building has two balls *A* and *B*. The ball *A* is thrown vertically upward and *B* is released at the same time. If ball *A* hits ground with speed V_A and ball *B* hits ground with speed V_s then we have

   (*a*) $V_A = V_B$
   (*b*) $V_A > V_B$
   (*c*) $V_B > V_A$
   (*d*) Relation between V_A & V_B depends upon height of building

6. Two bullets are fired simultaneously, horizontally and with different speeds from the same place. Then which of the following statements is correct.

   (*a*) Both bullet will hit the ground simultaneously and with some speed
   (*b*) Bullet with faster speed will hit ground first.
   (*c*) Both bullet will hit ground simultaneously, will have different vertical component of velocity while hitting ground.
   (*d*) Both bullet will hit ground simultaneously, will have some vertical component of velocity but they will hit ground with different net speed.

7. **Statement I:** It is possible to have a situation in which $\left|\frac{d\vec{v}}{dt} \neq 0\right|$ but $\frac{d|\vec{v}|}{dt} = 0$.

   Statement II: The average velocity of particle moving on a straight line is zero in time interval. It is possible that the instantaneous velocity is never zero in the interval.

8. An object may have_____Without having_____.

   (*a*) Varying speed, varying velocity.
   (*b*) Varying velocity, varying speed.
   (*c*) Non zero acceleration, varying velocity.
   (*d*) Both (*b*) and (*d*)

9. **Statement I:** For motion in straight line, if the position and velocity have same sign, the particle is moving towards the origin.

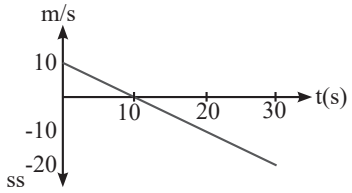
   Statement II: If the velocity is zero for a time interval, the acceleration in zero at any instant within the time interval.

   Statement III: The velocity of a particle is zero at t = 0, then acceleration at t = 0 must be zero.

10. **Statement I:** The magnitude of average velocity in an interval is always equal to its average speed in that interval.

    Statement II: If is not impossible to have a situation in which is which the speed of the particle is never zero but the average speed in an interval is zero.

11. For given graph



    Statement I: The particle has never turned around.

    Statement II: The average speed in the interval 0 to 10 seconds is the same as average speed in interval 10s to 20s.

12. **Statement I:** If the acceleration of a particle as seen from two frames S_1 and S_2 have equal magnitude of 5 m/s², then frames must be at rest with respect to each other.

    Statement II: for above given case, acceleration of S_2 with respect to S_1 May be anything between zero and 10 m/s²

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Answer Key

1. (i) $\sqrt{2}$ m/s, (ii) 0 m/s **2.** $\vec{v} = 6\hat{i} + 4\hat{j}, \vec{a} = 6\hat{i} + -2\hat{j}$ **3.** $\vec{a} = -4\text{m/s}^2$ **4.** $5\sqrt{2}$ m/s **5.** (*d*) **6.** $\frac{\sqrt{5}}{4}$

7. $\theta = 60°$ **8.** $20\sqrt{2}$ **9.** 1 s **10.** (*a*) **11.** (60) **12.** $\vec{a} = \frac{5}{2}\hat{i} + \frac{5}{2}\hat{j}$ **13.** (*b*) **14.** $5\sqrt{2}$ **15.** $\sqrt{5}$

16. $(4\hat{i} - 4\hat{j})\,m/s, (12\hat{i} + 6\hat{i})m$ **17.** A → III, B → IV, C → II **18.** (*a*) **19.** (*d*) **20.** $y = x^2$

21. $x^2 + y^2 = 3^2$ (Circle) **22.** $\frac{x^2}{16} + \frac{y^2}{9} = 1$ (ellipse) **3.** (*d*) **24.** $y = \frac{x^2}{4}$ **25.** $x^2 - y^2 = K$ **26.** (*b*)

27. $\mu = 45$m, $T = 6$s, $R = 240$ m, $\theta = 37°$ **28.** (*d*) **29.** (*c*) **30.** (*b*) **31.** (*b*) **32.** (*b*) **33.** (*a*) **34.** (*b*)

35. (*d*) **36.** $R = \frac{1}{2} g\, t_1 . t_2$ **37.** (*d*) **38.** (*c*) **39.** (*a*) **40.** (*b*) **41.** (*c*) **42.** (*c*)

43. $\theta = 53$, $T_f = 8$, R = 240m **44.** $\theta = \tan^{-1}(\beta/\alpha)$, $R = \frac{2\alpha\beta}{r}, H = \frac{\beta^2}{2r}$ **45.** $t_f = 2$sec, H = 2m, R = 6m **46.** $h = \frac{x_1 x_2 \tan\theta}{x_1 + x_2}$

47. $h = \frac{10}{7} m$ **48.** $t = \frac{u}{g\sin\theta}$ **49.** (*a*) **50.** (*c*) **51.** (*a*) **52.** (*a*) **53.** (*a*) **54.** (*b*)

55. (*a*) **56.** (*a*) **57.** (*b*) **58.** (*a*) **59.** (*a*) **60.** (*b*) **61.** (*a*) **62.** (*a*) **63.** (*b*) **64.** (*b*)

65. (*b*) **66.** (*b*) **67.** (*c*) **68.** (*d*) **69.** (*b*) **70.** (*b*) **71.** (*c*) **72.** (*c*) **73.** (*c*)

74. $\tan\alpha = \frac{\tan\theta}{2}$ **75.** (*c*) **76.** (*c*) **77.** (*c*) **78.** (*c*) **79.** $t = 3$ sec. **80.** (*a*) **81.** (*c*) **82.** (*a*)

83. (*a*) **84.** (*b*) **85.** (*b*) **86.** (*b*) **87.** (*a*) **88.** (*b*) **89.** (*a*) **90.** $|u| = (\sqrt{5})u$ **91.** $u = \sqrt{\frac{nb^2 g}{2a}}$

92. $\vec{V}_{RP} = -7\hat{i} + \hat{j}$ **93.** (*d*) **94.** (*c*) **95.** $\vec{u}_r = (20\sqrt{3} + 30)\hat{i} + 20\hat{j}$ **96.** 10 m/s **97.** (*b*) **98.** (*b*)

99. $\vec{U}_{AB} = 5\sqrt{3}\hat{j}$ **100.** $D_{min} = 50\sqrt{2}$ m **101.** $40\sqrt{2}$ m **102.** (i) –D, (ii) –A, (iii) –C, (iv) –B **103.** (*a*)

104. (*c*) **105.** (*c*) **106.** (*b*) **107.** (*b*) **108.** (*b*) **109.** (*a*) **110.** 120 m

111. 8.33 sec, Drift = $(8 + V_m \cos 37°)$ time **112.** (*d*) **113.** (*b*) **114.** (*a*) **115.** (*d*) **116.** (*d*)

117. 30°, $x = 5\sqrt{3}$ m **118.** $t = \frac{H}{V_B \sin\theta_B - V_A \sin\theta_A}$, $V_A \cos\theta_A = V_B \cos\theta_B$ **119.** (*c*) **120.** (*b*) **121.** (*c*) **122.** (*b*)

123. (*c*) **124.** $\theta = \tan^{-1}\left(\frac{1}{3}\right)$ from vertical **125.** $V_m = 30$ m/s, $V_{rm}/V_r = \frac{4}{5}$ **126.** (*b*) **127.** (*a*) **128.** (*a*)

129. (*b*) **130.** $\theta = 2\pi$ radian, linear displacement = 0 **131.** (0°)

132. $\theta_{Hr.\ hand} = 2\pi$ rad, $\theta_{Mn.\ hand} = 24\pi$ rad, $\theta_{Sec.\ hand} = 1440\pi$ rad **133.** (*b*) **134.** (*c*) **135.** 6 rad/s **136.** t = 3 sec, 4rad/sec

137. 2 rad/s **138.** (*a*) **139.** $\frac{4v^2}{3\sqrt{2}\pi R}$ **140.** $\frac{2\pi}{60}$ rad/s **141.** $v\sqrt{3}$ m/s **142.** (*b*) **143.** (*b*)

144. (*a*) **145.** (*c*) **146.** (*c*) **147.** (*c*) **148.** (*c*) **149.** (*b*) **150.** (*d*) **151.** (*a*) **152.** (*c*) **153.** (*c*)

154. (*c*) **155.** $\sqrt{\left(\frac{u^2}{r}\right)^2 + \alpha^2}$ **156.** (*b*) **157.** (*c*) **158.** (*c*) **159.** (*a*) **160.** (*d*)

MR* CORNER

1. I. True, II. False **2.** (i) Positive, (ii) Negative, (iii) Negative, (iv) Positive **3.** I. False, II. True

4. *a* upwards, g downwards **5.** (*b*) **6.** (*d*) **7.** I. True, II. False **8.** (*d*)

9. I. False, II. True, III. False **10.** Both are False. **11.** I. False, II. True **12.** I. False, II. True

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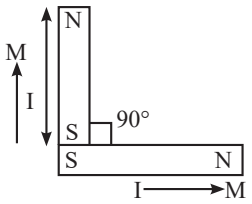
32 Magnetism & Matter

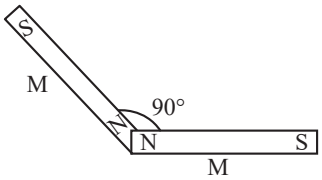
(Practice Questions)

Bar Magnet as Magnetic Dipole

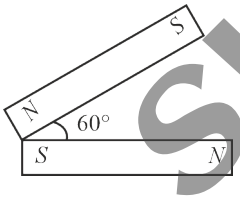
1. Find net magnetic dipole moment (M).



2. Find net magnetic dipole moment (M).



3. Find net magnetic dipole moment if each have magnetic dipole moment M.



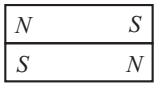
4. Two identical thin bar magnets each of length l and pole strength m are placed at right angle to each other with north pole of one touching the south pole of the other. Magnetic moment of the system is-

(*a*) $2\,ml$ (*b*) ml (*c*) $\sqrt{2}\,ml$ (*d*) $\frac{ml}{2}$

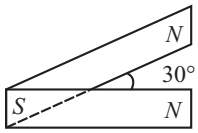
5. Following figures show the arrangement of bar magnets in different configurations. Each magnet has magnetic dipole moment $\vec{m}$. Which configuration has highest net magnetic dipole moment?

(*a*)

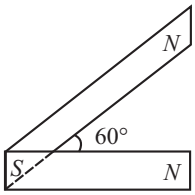
(*b*)



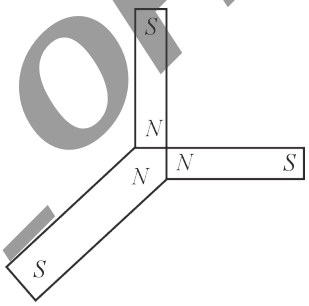
(*c*)



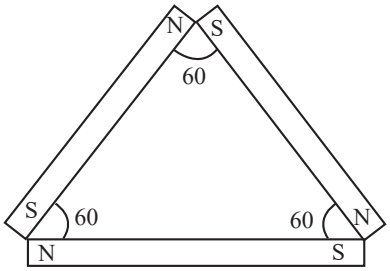
(*d*)



6. Magnetic moment of each magnet is M then net magnetic dipole moment is-



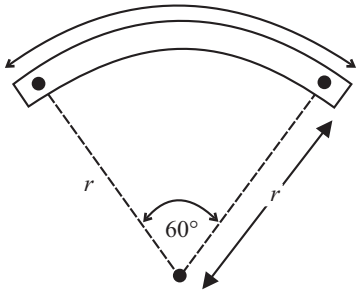
7. If each magnet has magnetic dipole moment M then find M_{net} as shown in figure



8. A steel wire of length l has a magnetic moment M. It is then bent into a semi-circular arc. The new magnetic moment is-

(*a*) M (*b*) $2M/\pi$ (*c*) M/π (*d*) $2M\pi$

9. A bar magnet of length 'l' and magnetic dipole moment 'M' is bent in the form of an arc as shown in figure. The new magnetic dipole moment will be-



(*a*) $\frac{2}{\pi}M$ (*b*) $\frac{M}{2}$ (*c*) M (*d*) $\frac{3}{\pi}M$

10. A wire of length 314 cm carrying current of 14 A is bent to form a circle. The magnetic moment of the coil is _____ Am^2.

(Given $\pi = 3.14$)

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Cutting of Bar Magnet

11. A long magnetic needle of length $2L$, magnetic moment M and pole strength m unit is broken into two at the mid point. The magnetic moment and pole strength of each piece will be-

(*a*) $M/2, m/2$ (*b*) $M, m/2$ (*c*) $M/2, m$ (*d*) M, m

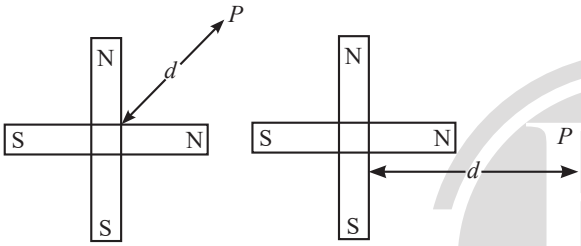
12. A bar magnet of magnetic moment M is cut into two equal parts along its length. The magnetic moment of either part is-

(*a*) $2M$ (*b*) M

(*c*) $M/2$ (*d*) Zero

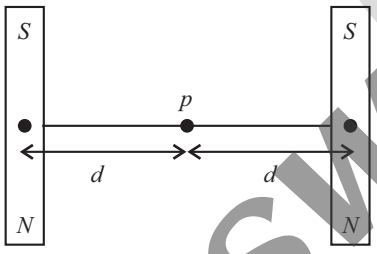
Magnetic Field due to Bar Magnet

13. Two identical bar magnets, each of magnetic moment M, are placed as shown in figure find the net magnetic field at point P



(*i*) (*ii*)

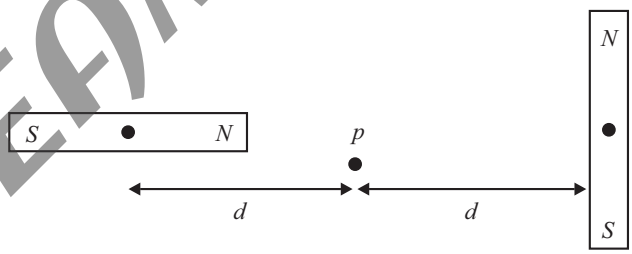
14. Two identical bar magnets, each of magnetic moment M, are placed as shown in figure, Magnetic field at point P is-



(*a*) $2\left(\frac{\mu_0}{4\pi}\right)\frac{M}{d^3}$ (*b*) $\sqrt{5}\left(\frac{\mu_0}{4\pi}\right)\frac{M}{d^3}$

(*c*) $\left(\frac{\mu_0}{4\pi}\right)\frac{M}{d^3}$ (*d*) $2\sqrt{5}\left(\frac{\mu_0}{4\pi}\right)\frac{M}{d^3}$

15. In the given figure, what angle does the net magnetic field at point P is making with xi-axis.



16. Point A and B are situated perpendicular to the axis of a small bar magnet at large distance x and $3x$ from its centre on opposite sides. The ratio of the magnetic fields at A and B will be approximately equal to-

(*a*) 2 : 9 (*b*) 1 : 9 (*c*) 27 : 1 (*d*) 9 : 1

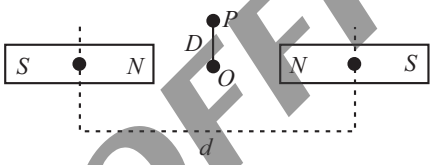
17. Two small bar magnets are placed in a line at certain distance d apart. If the length of each magnet is negligible compared to d, the force between them will be inversely proportional to-

(*a*) d^2 (*b*) d (*c*) d^3 (*d*) d^4

18. A bar magnet of magnetic moment M is placed at right angles to a magnetic induction B. If a force F is experienced by each pole of the magnet, the length of the magnet will be-

(*a*) MB/F (*b*) BF/M (*c*) MF/B (*d*) F/MB

19. Two identical bar magnets are fixed with their centres at a distance d apart. A stationary charge Q is placed at P in between the gap of the two magnets at a distance D from the centre O as shown in the figure.



(*a*) Zero

(*b*) Directed along OP

(*c*) Directed along PO

(*d*) Directed perpendicular to the plane of paper

20. **Statement-I:** In an isolated conductor, free electrons keep on moving but no net magnetic force acts on a conductor in a magnetic field.

Statement-II: In a conductor, the average velocity of thermal motion of electrons is zero.

Hence no current flows through the conductor.

(*a*) Statement-I is true, statement-I is true; statement-II is a correct explanation for statement-I.

(*b*) Statement-I is true, statement-II is true and statement-II is not a correct explanation for statement-I.

(*c*) Statement-I is true, statement-II is false.

(*d*) Statement-I is false, statement-II is true.

Magnetic field lines

21. Which of the following statement regarding magnetic lines of force is correct?

(*a*) Total magnetic flux linked with a closed surface is always zero.

(*b*) They need not be perpendicular to the surface from where they start or where they meet.

(*c*) They may or may not pass through a conductor

(*d*) All of these

22. **Statement-I:** Magnetic field lines are imaginary lines, the tangent to which at any point gives direction of magnetic force on particle having magnetic property.

Statement-II: Similar to electric field lines, magnetic field lines form close loop.

(*a*) Both statement-I and statement-II are false.

(*b*) Statement-I is true but statement-II is false.

(*c*) Statement-I is false but statement-II is true.

(*d*) Both statement-I and statement-II are true.

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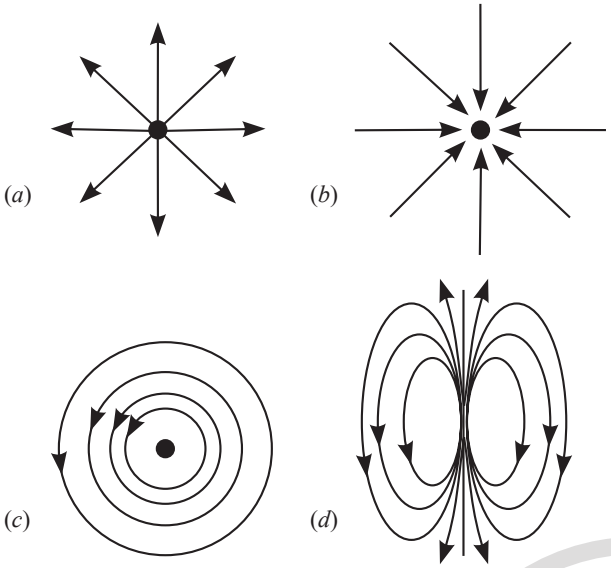
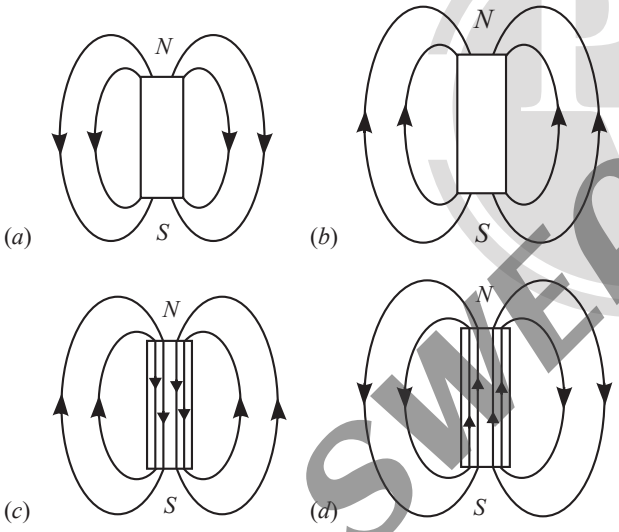
23. Which of the field patterns given in the figure is valid for electric field as well as for magnetic field?



24. The magnetic field lines due to a bar magnet are correctly shown in-



Magnetic Flux

25. A rod with circular cross-section are 2 cm^2 and length 40 cm is wound uniformly with 400, turns of an insulated wire. If a current of 0.4 A flows in the wire windings, the total magnetic flux produced inside windings is $4\pi \times 10^{-6}$ Wb. The relative permeability of the rod is-

(Given: Permeability of vacuum $\mu_0 = 4\pi \times 10^{-7}\ NA^{-2}$)

(*a*) 12.5 (*b*) 32/5 (*c*) 125 (*d*) 5/16

Gauss Law in Magnetism

26. Gauss's law in magnetism ensure that-

(*a*) Magnetic monopoles do not exist

(*b*) Magnetic field lines form closed loops

(*c*) Magnetic field is conservative

(*d*) Both (*a*) and (*b*)

Bar Magnet in Uniform Magnetic Field

27. A magnetic needle lying parallel to a magnetic field requires W units of work to turn it through 60°. The torque needed to maintain the needle in this position will be-

(*a*) W (*b*) $\sqrt{3}W$ (*c*) $\frac{\sqrt{3W}}{2}$ (*d*) $2W$

28. A bar magnetic is hung by a thin cotton thread in a uniform horizontal magnetic field and is in equilibrium state. The energy required to rotate it by 60° is W. Now the torque required to keep the magnetic in a new position which is attained by rotating it 30° further is-

(*a*) $\sqrt{3}\ W$ (*b*) $2W\sqrt{3}$ (*c*) $2W$ (*d*) $W/\sqrt{3}$

29. A bar magnet having pole strength m is placed at right angles to magnetic induction B. If a torque τ is produced in magnet due to force on each pole, length of magnet will be-

(*a*) τ/mB (*b*) $2\tau/mB$

(*c*) $2\tau B/m$ (*d*) $2\tau m/B$

30. A bar magnet having a magnetic moment of $2 \times 10^4\ J\ T^{-1}$ is free to rotate in a horizontal plane. A horizontal magnetic field $B = 6 \times 10^{-4}\ T$ exists in the space. The work done in taking the magnet slowly from a direction parallel to the field to a direction 60° from the field is-

(*a*) 12 J (*b*) 6 J (*c*) 2 J (*d*) 0.6 J

31. A short bar magnet of magnetic moment 0.4 $J\ T^{-1}$ is placed in uniform magnetic field of 0.16 T. The magnet is in stable equilibrium when the potential energy is-

(*a*) 0.064 J (*b*) –0.064 J

(*c*) zero (*d*) –0.082 J

32. A 250-turn rectangular coil of length 2.1 cm and width 1.25 cm carries a current of 85 μA and subjected to a magnetic field of strength 0.85 T. Work done for rotating the coil by 180° against the torque is-

(*a*) 4.55 μJ (*b*) 2.3 μJ

(*c*) 1.15 μJ (*d*) 9.4 μJ

33. A bar magnet having a magnetic moment 5.0 Am^2 is placed in parallel position relative to a magnetic field of 0.4 T. The amount of work done in turning the magnet form parallel to antiparallel position relative to the field direction is-

(*a*) 4 J (*b*) 1 J (*c*) 2 J (*d*) Zero

34. A bar magnet is oscillating in the Earth's magnetic field with a period T. What happens to its period and motion if its mass is quadrupled?

(*a*) Motion remains simple harmonic with time period = $T/2$

(*b*) Motion remains SHM with time period = $2T$

(*c*) Motion remains SHM with time period = $4T$

(*d*) Motion remains SHM and period remains nearly constant

35. A magnetic needle of negligible breadth and thickness compared to its length, oscillates in a horizontal plane with period T. The needle is broken in such a way in 4 equal parts that each new needle has same magnetic pole strength that parent needle has but it's length is decreased to one-fourth time of it's initial. Now time period of oscillation for each part has become $x\ T$. Find x.

(*a*) 4 (*b*) 1/4 (*c*) 1 (*d*) 2

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36. Two bar magnets having same geometry with magnetic moments M and $2M$, are firstly placed in such a way that their similar poles are in same side then its time period of oscillation is T_1. Now the polarity of one of the magnet is reversed then time period of oscillation is T_2, then -

(*a*) $T_1 < T_2$ (*b*) $T_1 = T_2$ (*c*) $T_1 > T_2$ (*d*) $T_2 = \infty$

37. Two bar magnets oscillate in a horizontal plane in earth's magnetic field with time periods of 3*s* and 4*s* respectively. If their moments of inertia are in the ratio of 3 : 2, then the ratio of their magnetic moments will be-

(*a*) 2 : 1 (*b*) 8 : 3 (*c*) 1 : 3 (*d*) 27 : 16

38. A magnetic needle of negligible breadth and thickness compared to its length, oscillates in a horizontal plane with period *T*. The needle is broken in such a way in *n* equal parts that each new part has same length as it's original parent needle has but magnetic pole strength has been decreased to *n* times. Now time period of oscillation for each part has become *x T*. Find *x*.

39. The time period of a freely suspended magnet is 4 *s*. If it is broken in length into two equal parts and one part is suspended in the same way, then its time period will be-

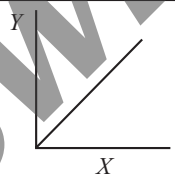
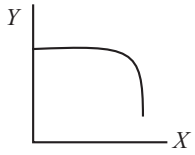
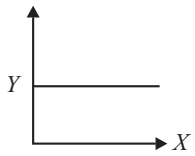
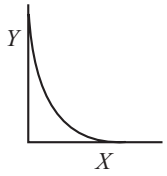
(*a*) 2 s (*b*) 4 s (*c*) 0.5 s (*d*) 0.25 s

40. A vibration magnetometer placed in magnetic meridian has a small bar magnet. The magnet executes oscillations with a time period of 2 sec in earth's horizontal magnetic field of 24 micro Tesla. When a horizontal field of 18 micro Tesla is produced opposite to the earth's field by placing a current carrying wire, the new time period of magnet will be-

(*a*) 1 s (*b*) 2 s (*c*) 3 s (*d*) 4 s

Magnetisation

41. Match List-I with List-II

	List-I (Y vs X)		List-II (Shape of Graph)
A.	Y = magnetic susceptibility X = magnetising field	i.	
B.	Y = magnetic field, X = distance from centre of a current carrying wire for $x < a$ (Where a = radius of wire)	ii.	
C.	Y = magnetic field X = distance from centre of a current carrying wire for $x > a$ (where a = radius of wire)	iii.	
D.	Y = magnetic field inside solenoid X = distance from center	iv.	

Choose the correct answer from the options given below:

(*a*) A-iii, B-i, C-iv, D-ii (*b*) A-i, B-iii, C-ii, D-iv

(*c*) A-iv, B-i, C-iii, D-ii (*d*) A-iii, B-iv, C-i, D-ii

Magnetism in Matter

42. Domain formation is the necessary feature of-

(*a*) Diamagnetism (*b*) Paramagnetism

(*c*) Ferromagnetism (*d*) All of these

43. In a ferromagnetic material, below the curie temperature, a domain is defined as-

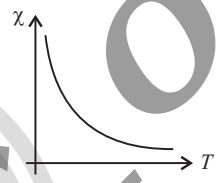
(*a*) A macroscopic region with zero magnetization.

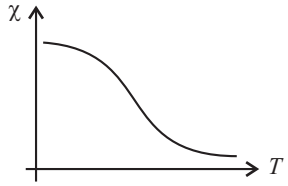
(*b*) A macroscopic region with saturation magnetization.

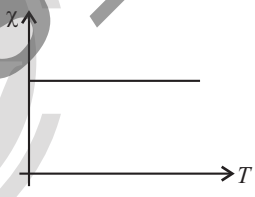
(*c*) A macroscopic region with randomly oriented magnetic dipoles.

(*d*) A macroscopic region with consecutive magnetic dipoles oriented in opposite direction.

44. The variation of magnetic susceptibility (χ) with absolute temperature (T) for a ferromagnetic material is-

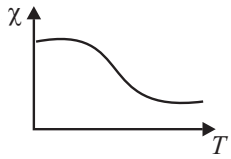
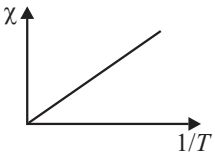
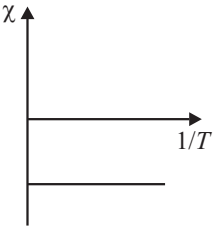
(*a*) 

(*b*) 

(*c*) 

(*d*)

45. Match column-I with column-II.

	Column-I		Column-II
i.	Paramagnetic substance	A.	
ii.	Diamagnetic substance	B.	
iii.	Ferromagnetic substance	C.	

Choose the correct answer from the options given below:

(*a*) i-A, ii-C, iii-B (*b*) i-C, ii-A, iii-B

(*c*) i-A, ii-B, iii-C (*d*) i-B, ii-C, iii-A

46. The universal property of all substances is-

(*a*) Diamagnetism (*b*) Ferromagnetism

(*c*) Paramagnetism (*d*) All of these

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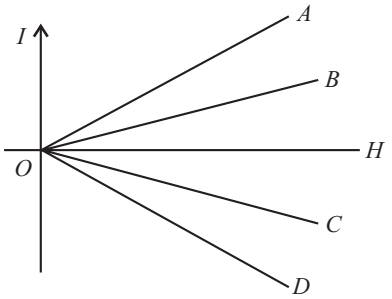
47. The variation of the intensity of magnetisation (I) with respect to the magnetizing field (H) in a diamagnetic substance is described by the graph.



(*a*) OC (*b*) OD (*c*) OA (*d*) OB

48. The magnetic susceptibility is negative for-

(*a*) Paramagnetic and ferromagnetic material
(*b*) Diamagnetic material only
(*c*) Paramagnetic material only
(*d*) Ferromagnetic material only

49. When a ferromagnetic substance is heated to a temperature above its Curie temperature, it-

(*a*) Behaves like a paramagnetic substance
(*b*) Behaves like a diamagnetic substance
(*c*) Remains ferromagnetic
(*d*) Is permanently magnetized

50. **Statement-I:** The ferromagnetic property depends on temperature. At high temperature, ferromagnet becomes paramagnet.

Statement-II: At high temperature, the domain wall area of a ferromagnetic substance increases.

(*a*) Both statement-I and statement-II is false.
(*b*) Statement-I is true but statement-II is false.
(*c*) Statement-I is false but statement-II is true.
(*d*) Both statement-I and statement-II are true.

51. Select the incorrect statement-

(*a*) In a diamagnetic substance net magnetic moment of each atom/molecule is zero.
(*b*) In a paramagnetic substance net magnetic moment of each atom / molecule is non-zero.
(*c*) In a ferromagnetic material net magnetic moment of each domain is zero.
(*d*) In a ferromagnetic material net magnetic moment of each domain is non-zero.

52. Relative permeability of superconductors is-

(*a*) 0 (*b*) 1 (*c*) –1 (*d*) 0.5

53. **Statement-I:** For diamagnetic substance $-1 \le \chi < 0$, where χ is the magnetics susceptibility.

Statement-II: Diamagnetic substances when placed in an external magnetic field, tend to move from stronger to weaker part of the field.

(*a*) Both statement-I and statement-II are false.
(*b*) Statement-I is true but statement-II is false.
(*c*) Statement-I is false but statement-II is true.
(*d*) Both statement-I and statement-II are true.

54. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).

Assertion (A): The diamagnetic substances do not obey Curie's law.

Reason (R): At Curie point ferromagnetic substances start behaviang as paramagnetic substances.

In the light of the above statements, choose the most appropriate answer from the options given below:

(*a*) Both (A) and (R) are true and (R) is the correct explanation of (A).
(*b*) Both (A) and (R) are true and (R) is Not the correct explanation of (A).
(*c*) (A) is true but (R) is false.
(*d*) (A) is false but (R) is true.

55. The magnetic susceptibility is negative for-

(*a*) Ferromagnetic material only
(*b*) Paramagnetic and ferromagnetic materials
(*c*) Diamagnetic material only
(*d*) Paramagnetic material only

56. **Statement-I:** Susceptibilities of paramagnetic and ferromagnetic substances increase with decrease in temperature.

Statement-II: Diamagnetism is a result of orbital motions of electrons developing magnetic moments opposite to the applied magnetic field.

(*a*) Both statement-I and statement-II are false.
(*b*) Statement-I is true but statement-II is false.
(*c*) Statement-I is false but statement-II is true.
(*d*) Both statement-I and statement-II are true.

57. **Statement-I:** The diamagnetic property depends on temperature.

Statement-II: The induced magnetic dipole moment in a diamagnetic sample is always opposite to the magnetizing field.

(*a*) Both statement-I and statement-II are false.
(*b*) Statement-I is true but statement-II is false.
(*c*) Statement-I is false but statement-II is true.
(*d*) Both statement-I and statement-II are true.

58. The magnetic moment of a diamagnetic atom is-

(*a*) Much greater than one (*b*) 1
(*c*) Between zero and one (*d*) Equal to zero

59. If a diamagnetic substance is brought near the north or the south pole of a bar magnet, it is-

(*a*) Repelled by the north pole and attracted by the south pole.
(*b*) Attracted by the north pole and repelled by the south pole.
(*c*) Attracted by both the poles.
(*d*) Repelled by both the poles.

60. Curie temperature above which-

(*a*) Paramagnetic material becomes ferromagnetic material.
(*b*) Ferromagnetic material becomes diamagnetic material
(*c*) Ferromagnetic material becomes paramagnetic material.
(*d*) Paramagnetic material becomes diamagnetic material.

61. Nickel shows ferromagnetic property at room temperature. If the temperature is increased beyond Curie temperature, then it will show-

(*a*) Anti ferromagnetism (*b*) No magnetic property
(*c*) Diamagnetism (*d*) Paramagnetism

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62. A diamagnetic material in a magnetic field moves-

(*a*) From stronger to the weaker parts of the field.

(*b*) From weaker to the stronger parts of the field.

(*c*) Perpendicular to the field.

(*d*) In none of the above directions.

63. Paramagnetic substances:

A. Align themselves along the directions of external magnetic field.

B. Attract strongly towards external magnetic field.

C. Has susceptibility little more than zero.

D. Move from a region of strong magnetic field to weak magnetic field.

Choose the most appropriate answer from the options given below:

(*a*) A, C, D (*b*) B, D only

(*c*) A, B, C only (*d*) A, C only

64. According to Curies law, the magnetic susceptibility of a substance at an absolute temperature T is proportional to-

(*a*) $1/T$ (*b*) T (*c*) $1/T^2$ (*d*) T^2

65. Among which the magnetic susceptibility does not depend on the temperature?

(*a*) Diamagnetism (*b*) Paramagnetism

(*c*) Ferromagnetism (*d*) Ferrite

66. They hysteresis curve is studied generally for-

(*a*) Paramagnetic materials (*b*) Diamagnetic materials

(*c*) Ferromagnetic materials (*d*) All of these

67. Electromagnets are made of soft iron because soft iron has-

(*a*) Low retentivity and high coercive force

(*b*) High retentivity and high coercive force

(*c*) Low retentivity and low coercive force

(*d*) High retentivity and low coercive force

68. Magnetic materials used for making permanent magnets (P) and magnets in a transformer (T) have different properties of the following. Which property best matches for the type of magnet required?

(*a*) T : Large retentivity, small coercivity

(*b*) P : Large retentivity, large coercivity

(*c*) P : Small retentivity, large coercivity

(*d*) T : Large retentivity, large coercivity

69. The susceptibility of a paramagnetic material is 99. The permeability of the material in Wb/A-m, is-

[Permeability of free space μ_0 $4\pi \times 10^{-7}$ Wb/A-m]

(*a*) $4\pi \times 10^{-7}$ (*b*) $4\pi \times 10^{-4}$ (*c*) $4\pi \times 10^{-5}$ (*d*) $4\pi \times 10^{-6}$

70. In an iron rod. Ratio of intensity of magnetization to that of magnetic intensity in 599 units. Iron rod is then subjected to magnetizing field of 1200 A/m. The permeability of material of rod is-

(*a*) $8\pi \times 10^{-5}\ T\,mA^{-1}$ (*b*) $2.4\pi \times 10^{-5}\ T\,mA^{-1}$

(*c*) $2.4\pi \times 10^{-7}\ T\,mA^{-1}$ (*d*) $2.4\pi \times 10^{-4}\ T\,mA^{-1}$

71. **Assertion (A):** Non-polar materials do not have any permanent dipole moment.

Reason (R): When a non-polar material is placed in an electric field, the centre of the positive charge distribution of it's individual atom or molecule coincides with the centre of the negative charge distribution.

(*a*) Both A and R arc true but R is not the correct explanation of A.

(*b*) A is true but R is false.

(*c*) Both A and R are true and R is the correct explanation of A.

(*d*) A is false but R is true.

72. **Statement-I:** Curie's temperature is temperature above which ferromagnetic material becomes paramagnetic material.

Statement-II: Relative magnetic permeability does not depend on temperature for diamagnetic material.

(*a*) Both statement-I and statement-II are false.

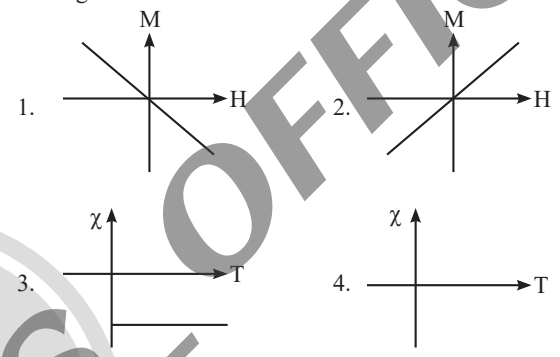
(*b*) Statement-I is true but statement-II is false.

(*c*) Statement-I is false but statement-II is true.

(*d*) Both statement-I and statement-II are true.

73. Following plots show magnetization (M) vs magnetizing field (H) and magnetic susceptibility (χ) vs temperature (T) graph-

Which of the following combination will be represented by a diamagnetic material?



(*a*) 2, 3 (*b*) 2, 4 (*c*) 1, 3 (*d*) 1, 4

74. Who am I ?

(*i*) When I am placed in an external magnetic field, I have very-very strong tendency to move from region of weak magnetic field towards strong one. There is domain formation inside me and I can be easily magnetised.

(*ii*) When I am placed in an external magnetic field, I have tendency to move from stronger to weaker part of external magnetic field. Hence magnetic field lines are expelled by me. I possess negative value of magnetic susceptibility.

75. Which of the following statement are correct?

A. Electric monopoles do not exist whereas magnetic monopoles exist.

B. Magnetic field lines due to a solenoid at its ends and outside cannot be completely straight and confined.

C. Magnetic field lines are completely confined within a toroid.

D. Magnetic field lines inside a bar magnet are not parallel.

E. $\chi = -1$ is the condition for a perfect diamagnetic material, where χ is its magnetic susceptibility.

(*a*) (B) and (C) only (*b*) (B) and (D) only

(*c*) (C) and (E) only (*d*) (A) and (B) only

76. Match the column-I with column-II.

Column-I		Column-II	
A.	Paramagnetic substance	P.	$\chi = -1$
B.	Diamagnetic substance	Q.	$\chi_m < 1$
C.	Super conductor	R.	$\chi_m >> 1$
D.	Ferromagnetic substance	S.	$\mu_r > 1$

(*a*) A→S; B→Q; C→P; D→R

(*b*) A→R; B→P; C→Q; D→S

(*c*) A→S; B→P; C→Q; D→R

(*d*) A→R; B→Q; C→P; D→S

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Answer Key

1. $\sqrt{2}$M **2.** (M) **3.** M **4.** (*c*) **5.** (*c*) **6.** M($\sqrt{2}$–1) **7.** $M_{net} = O$ **8.** (*b*) **9.** (*d*)

10. 11A.m^2 **11.** (*c*) **12.** (*c*) **13.** (*i*) $\vec{B} = \frac{2\sqrt{2}km}{d^3}$, (*ii*) $B = \frac{\sqrt{5}k.m}{d^3}$ **14.** (*a*) **15.** $\theta = \sin^{-1}\left(\frac{1}{\sqrt{5}}\right)$ **16.** (c)

17. (*d*) **18.** (*a*) **19.** (*a*) **20.** (*a*) **21.** (*d*) **22.** (*a*) **23.** (*d*) **24.** (*d*) **25.** (*c*) **26.** (d)

27. (*b*) **28.** (*c*) **29.** (*b*) **30.** (*b*) **31.** (*b*) **32.** (*d*) **33.** (*a*) **34.** (*b*) **35.** (*b*) **36.** (a)

37. (*b*) **38.** (1) **39.** (*a*) **40.** (*d*) **41.** (*a*) **42.** (*c*) **43.** (*b*) **44.** (*b*) **45.** (*d*) **46.** (a)

47. (*a*) **48.** (*b*) **49.** (*a*) **50.** (*b*) **51.** (*c*) **52.** (*a*) **53.** (*d*) **54.** (*b*) **55.** (*c*) **56.** (*d*)

57. (*c*) **58.** (*d*) **59.** (*d*) **60.** (*c*) **61.** (*d*) **62.** (*a*) **63.** (*d*) **64.** (*a*) **65.** (*a*) **66.** (*c*)

67. (*c*) **68.** (*b*) **69.** (*c*) **70.** (*d*) **71.** (*b*) **72.** (*d*) **73.** (c)

74. (*i*) Ferromagnetic material, (*ii*) diamagnetic material **75.** (*c*) **76.** (a)

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