6 Work, Power and Energy

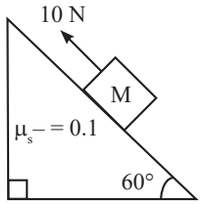
JEE-Main

Work Done by Constant Force, Variable Force, Kinetic Energy

1. Two bodies of mass 4g and 25g are moving with equal kinetic energies. The ratio of magnitude of their linear momentum is:
[27 Jan, 2024 (Shift-I)]
(*a*) 3 : 5 (*b*) 5 : 4 (*c*) 2 : 5 (*d*) 4 : 5

2. A block of mass 100kg slides over a distance of 10 m on a horizontal surface. If the co-efficient of friction between the surface is 0.4, then the work done against friction (in J) is: **[29 Jan, 2024 (Shift-I)]**
(*a*) 4200 (*b*) 3900 (*c*) 4000 (*d*) 4500

3. A block of mass 1 kg is pushed up a surface inclined to horizontal at an angle of 60° by a force of 10 N parallel to the inclined surface as shown in figure. When the block is pushed up by 10 m along inclined surface, the work done against frictional force is:
[g = 10 m/s^2] **[30 Jan, 2024 (Shift-II)]**



(*a*) $5\sqrt{3}$ J (*b*) 5 J (*c*) 5×10^3 J (*d*) 10 J

4. An artillery piece of mass M_1 fires a shell of mass M_2 horizontally. Instantaneously after the firing, the ratio of kinetic energy of the artillery and that of the shell is: **[31 Jan, 2024 (Shift-I)]**
(*a*) $M_1/(M_1 + M_2)$ (*b*) $\frac{M_2}{M_1}$
(*c*) $M_2/(M_1 + M_2)$ (*d*) $\frac{M_1}{M_2}$

5. A bullet of mass 50 g is fired with a speed 100 m/s on a plywood and emerges with 40 m/s. The percentage loss of kinetic energy is:
[06 April, 2024 (Shift-I)]
(*a*) 32% (*b*) 44% (*c*) 16% (*d*) 84%

6. Four particles *A*, *B*, *C*, *D* of mass *m*/2, *m*, 2*m*, 4*m*, have same momentum, respectively. The particle with maximum kinetic energy is: **[06 April, 2024 (Shift-I)]**
(*a*) D (*b*) C (*c*) A (*d*) B

7. When kinetic energy of a body becomes 36 times of its original value, the percentage increase in the momentum of the body will be: **[06 April, 2024 (Shift-II)]**
(*a*) 500% (*b*) 600% (*c*) 6% (*d*) 60%

8. Three bodies *A*, *B* and *C* have equal kinetic energies and their masses are 400 g, 1.2 kg and 1.6 kg respectively. The ratio of their linear momenta is: **[08 April, 2024 (Shift-I)]**
(*a*) $1 : \sqrt{3} : 2$ (*b*) $1 : \sqrt{3} : \sqrt{2}$
(*c*) $\sqrt{2} : \sqrt{3} : 1$ (*d*) $\sqrt{3} : \sqrt{2} : 1$

9. A force $(3x^2 + 2x - 5)$ N displaces a body from x = 2 m to x = 4 m. Work done by this force is …… J.
[09 April, 2024 (Shift-II)]

10. Identify the correct statements from the following:
A. Work done by a person in lifting a bucket out of a well by means of a rope tied to the bucket is negative.
B. Work done by gravitational force in lifting a bucket out of a well by a rope tied to the bucket is negative.
C. Work done by friction on a body sliding down an inclined plane is positive.
D. Work done by an applied force on a body moving on a rough horizontal plane with uniform velocity is zero.
E. Work done by the air resistance on an oscillating pendulum is negative.
Choose the correct answer from the options given below:
[29 Jan, 2023 (Shift-II)]
(*a*) B and E only (*b*) A and C only
(*c*) B, D and E only (*d*) B and D only

11. A force $F = (5 + 3y^2)$ acts on a particle in the y direction, where F is newton and y is in meter. The work done by the force during a displacement from y = 2*m* to y = 5*m* is _____.
[1 Feb, 2023 (Shift-II)]

12. A lift of mass M = 500 kg is descending with speed of 2 ms^{-1}. Its supporting cable begins to slip thus allowing it to fall with a constant acceleration of 2 ms^{-2}. The kinetic energy of the lift at the end of the fall through to a distance of 6m will be _____ kJ.
[31 Jan, 2023 (Shift-I)]

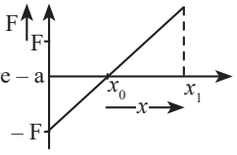
13. A small particle moves to position $5\hat{i} - 2\hat{j} + \hat{k}$ from its initial position $2\hat{i} + 3\hat{j} - 4\hat{k}$ under the action of force $5\hat{i} + 2\hat{j} + 7\hat{k}$ N. The value of work done will be J. **[1 Feb, 2023 (Shift-I)]**

14. A force $\vec{F} = (2 + 3x)\hat{i}$ acts on a particle in the x direction where F is in newton and x is in meter. The work done by this force during a displacement from x = 0 to x = 4 m, is _____ J.
[11 April, 2023 (Shift-I)]

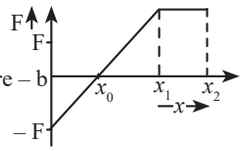
15. A block of mass 10 kg is moving along x-axis under the action of force $F = 5xN$. The work done by the force in moving the block from $x = 2\ m$ to 4 m will be _____J. **[15 April, 2023 (Shift-I)]**

16. Arrange the four graphs in descending order of total work done; where W_1, W_2, W_3, and W_4, are the work done corresponding to figure A, B, C and d respectively. **[26 June, 2022 (Shift-II)]**

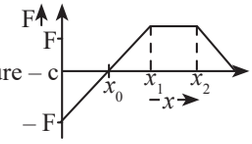
(A) Figure – a



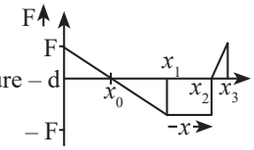
(B) Figure – b



(C) Figure – c



(D) Figure – d

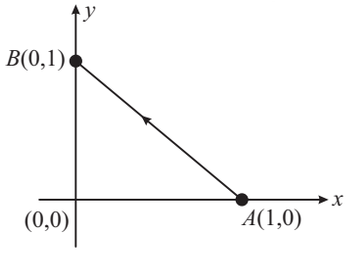


(*a*) $W_3 > W_2 > W_1 > W_4$ (*b*) $W_3 > W_2 > W_4 > W_1$
(*c*) $W_2 > W_3 > W_4 > W_1$ (*d*) $W_2 > W_3 > W_1 > W_4$

17. A force of $F = (5y + 20)\,\hat{j}N$ acts on a particle. The work done by this force when the particle is moved from $y = 0m$ to $y = 10\ m$ is _____ J. **[25 July, 2021 (Shift-II)]**

18. Two persons A and B perform same amount of work in moving a body through a certain distance d with application of forces acting at angle 45° and 60° with the direction of displacement respectively. The ratio of force applied by person A to the force applied by person B is $\frac{1}{\sqrt{x}}$. The value of x is _____ . **[27 Aug, 2021 (Shift-I)]**

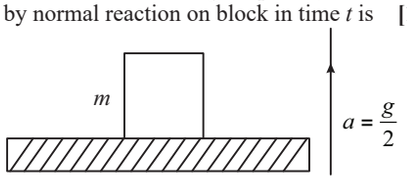
19. Consider a force $\vec{F} = -x\hat{i} + y\hat{j}$. The work done by this force in moving a particle from point $A(1,0)$ to $B(0,1)$ along the line segment is (All quantities are in SI units) **[9 Jan, 2020 (Shift-I)]**



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

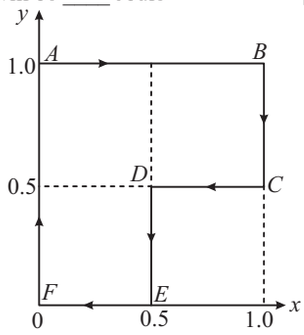
20. A person pushes a box on a rough horizontal platform surface. He applies a force of 200 N over a distance of 15 m. Thereafter, he gets progressively tired and his applied force reduces linearly with distance to 100 N. The total distance through which the box has been moved is 30m. What is the work done by the person during the total movement of the box? **[4 Sep, 2020 (Shift-II)]**
(*a*) 5690 J (*b*) 3280 J (*c*) 5250 J (*d*) 2780 J

21. A block of mass m is kept on a platform which starts from rest with constant acceleration $g/2$ upward, as shown in figure. Work done by normal reaction on block in time t is **[10 Jan, 2019 (Shift-I)]**



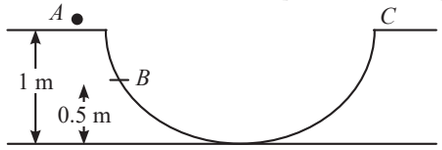
(*a*) $-\frac{mg^2t^2}{8}$ (*b*) $\frac{mg^2t^2}{8}$ (*c*) 0 (*d*) $\frac{3mg^2t^2}{8}$

22. A particle is moved along a path AB-BC-CD-DE-EF-FA, as shown in figure, in presence of a force $\vec{F} = (\alpha y\hat{i} + 2\alpha x\hat{j})$ N where x and y are in meter and $a = -1$ N/m^{-1}. The work done on the particle by this force $\vec{F}$ will be ____ Joule **[JEE Adv, 2019]**



Work Energy Theorem, Mechanical Energy Conservation

23. A particle is placed at the point A of a frictionless track ABC as shown in figure. It is gently pushed toward right. The speed of the particle when it reaches the point B is : (Take $g = 10$ m/s^2). **[30 Jan, 2024 (Shift-I)]**

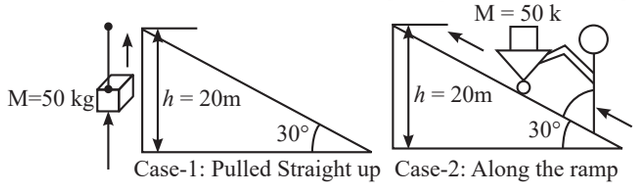


(*a*) 20 m/s (*b*) $\sqrt{10}$ m/s (*c*) $2\sqrt{10}$ m/s (*d*) 10 m/s

24. If a rubber ball falls from a height h and rebounds upto the height of $h/2$. The percentage loss of total energy of the initial system as well as velocity of ball before it strikes the ground, respectively, are: **[04 April, 2024 (Shift-I)]**

(*a*) 50%, $\sqrt{\frac{gh}{2}}$ (*b*) 50%, $\sqrt{gh}$ (*c*) 40%, $\sqrt{2gh}$ (*d*) 50%, $\sqrt{2gh}$

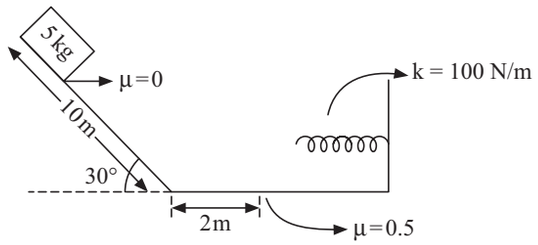
25. A body of mass 50 kg is lifted to a height of 20 m from the ground in the two different ways as shown in the figures. The ratio of work done against the gravity in both the respective cases, will be: **[05 April, 2024 (Shift-I)]**



Case-1: Pulled Straight up Case-2: Along the ramp

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

26.



A block is simply released from the top of an inclined plane as shown in the figure above. The maximum compression in the spring when the block hits the spring is: **[08 April, 2024 (Shift-II)]**

(*a*) $\sqrt{6}$ m (*b*) 2 m (*c*) 1 m (*d*) $\sqrt{5}$ m

27. A particle of mass *m* moves on a straight line with its velocity increasing with distance according to the equation $v = \alpha\sqrt{x}$, where α is a constant. The total work done by all the forces applied on the particle during its displacement from $x = 0$ to $x = d$, will be: **[09 April, 2024 (Shift-I)]**

(*a*) $\frac{m}{2\alpha^2 d}$ (*b*) $\frac{md}{2\alpha^2}$ (*c*) $\frac{m\alpha^2 d}{2}$ (*d*) $2m\alpha^2 d$

28. A 0.4 *kg* mass takes 8s to reach ground when dropped from a certain height '*P*' above surface of earth. The loss of potential energy in the last second of fall is _____ *J*.
[Take g = 10 m/s^2] **[29 Jan, 2023 (Shift-I)]**

29. A car accelerates from rest to *u* m/s. The energy spent in this process is EJ. The energy required to accelerate the car from *u* m/s to 2u m/s is nEJ. The value of *n* is _____.
[13 April, 2023 (Shift-II)]

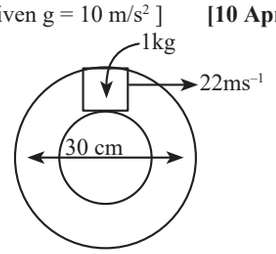
30. A particle of mass 10g moves in a straight line with retardation 2*x*, where *x* is the displacement in SI units. Its loss of kinetic energy for above displacement is $\left(\frac{10}{x}\right)^{-n} J$.

The value of *n* will be _____. **[6 April, 2023 (Shift-I)]**

31. Given below are two statements:
Statement-I: A truck and a car moving with same kinetic energy are brought to rest by applying brakes which provide equal retarding forces. Both come to rest in equal distance.
Statement-II: A car moving towards east takes a turn and moves towards north, the speed remains unchanged. The acceleration of the car is zero.
In the light of given statements, choose the most appropriate answer from the options given below. **[12 April, 2023 (Shift-I)]**

(*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 incorrect
(*d*) Both Statement-I and Statement-II are correct

32. A closed circular tube of average radius 15 cm, whose inner walls are rough, is kept in vertical plane. A block of mass 1 kg just fit inside the tube. The speed of block is 22 m/s, when it is introduced at the top of tube. After completing five oscillations, the block stops at the bottom region of tube. The work done by the tube on the block _____ is J. [Given g = 10 m/s^2] **[10 April, 2023 (Shift-I)]**



33. 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]. **[12 April, 2023 (Shift-I)]**

34. 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 $\frac{x}{4}$. The value of *x* is
[6 April, 2023 (Shift-II)]

35. A body of mass 0.5 kg travels on straight line path velocity $u = (3x^3 + 4)$ m/s. The net work done by the force during its displacement from $x = 0$ to $x = 2$m is: **[25 July, 2022 (Shift-I)]**

(*a*) 64 J (*b*) 60 J
(*c*) 120 J (*d*) 128 J

36. A particle of mass 500 gm is moving in a straight line with velocity $v = bx^{5/2}$. The work done by the net force during its displacement from $x = 0$ to $x = 4$ m is (Take: $b = 0.25$ $m^{-3/2}$ s^{-1})
[29 June, 2022 (Shift-I)]

(*a*) 2 J (*b*) 4 J (*c*) 8 J (*d*) 16 J

37. As per the given figure, two blocks each of mass 250g are connected to a spring of spring constant 2Nm^{-1}. If both are given velocity *v* in opposite directions, then maximum elongation of the spring is:
[26 July, 2022 (Shift-I)]

(*a*) $\frac{v}{2\sqrt{2}}$ (*b*) $\frac{v}{2}$
(*c*) $\frac{v}{4}$ (*d*) $\frac{v}{\sqrt{2}}$

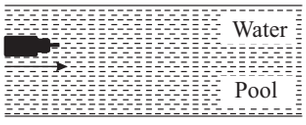
38. If momentum of a body is increased by 20%, then its kinetic energy increases by **[29 July, 2022 (Shift-II)]**

(*a*) 36 % (*b*) 40 % (*c*) 44 % (*d*) 48 %

39. A block of mass 2 kg moving on a horizontal surface with speed of 4 ms^{-1} enters a rough surface ranging from $x = 0.5$ m to $x = 1.5$ m. The retarding force in this range of rough surface is related to distance by $F = -kx$, where $k = 12$ Nm^{-1}.The speed of the block as it just crosses the rough surface will be: **[28 June, 2022 (Shift-II)]**

(*a*) zero (*b*) 1.5 ms^{-1}
(*c*) 2.0 ms^{-1} (*d*) 2.5 ms^{-1}

40. A bullet of mass 200g having initial kinetic energy 90 J is shot inside a long swimming pool as shown in the figure. If it's kinetic energy reduces to 40 J within 1s, the minimum length of the pool, the bullet has to travel so that it completely comes to rest is
[28 July, 2022 (Shift-II)]

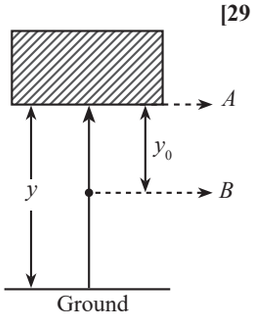


(*a*) 45 m (*b*) 90 m
(*c*) 125 m (*d*) 25 m

41. 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:
[24 June, 2022 (Shift-I)]

(*a*) 50.0 J (*b*) 12.5 J
(*c*) 25.0 J (*d*) 0 J

42. In the given figure, the block of mass m is dropped from the point '*A*'. The expression for kinetic energy of block when it reaches point '*B*' is: **[29 June, 2022 (Shift-II)]**



(*a*) $\frac{1}{2}mg\,y_0^2$ (*b*) $\frac{1}{2}mg\,y^2$

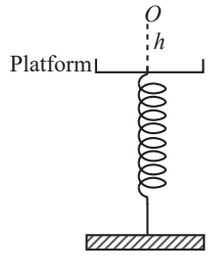
(*c*) $mg\,(y - y_0)$ (*d*) $mg\,y_0$

43. A 0.5 kg block moving at a speed of 12 ms^{-1} compresses a spring through a distance 30 cm when its speed is halved. The spring constant of the spring will be _____ Nm^{-1}.

[25 June, 2022 (Shift-I)]

44. 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 $g = 10\ ms^{-2}$)

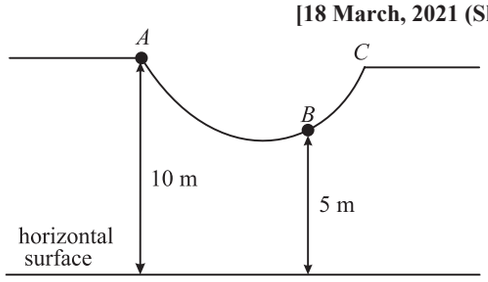
[24 June, 2022 (Shift-I)]



45. A ball of mass 4 kg, moving with a velocity of 10 ms^{-1}, collides with a spring of length 8m and force constant 100 Nm^{-1}. The length of the compressed spring is x m. The value of x, to the nearest integer, is_____. **[18 March, 2021 (Shift-II)]**

46. As shown in the figure, a particle of mass 10 kg is placed at a point *A*. When the particle is slightly displaced to its right, it starts moving and reaches the point *B*. The speed of the particle at *B* is x m/s. The value of 'x' to the nearest integer is (Take $g = 10\ m/s^2$)

[18 March, 2021 (Shift-I)]

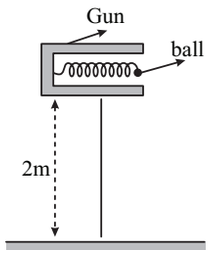


47. A body of mass '*m*' dropped from a height '*h*' reaches the ground with a speed of $0.8\sqrt{gh}$. The value of work done by the air-friction is: **[1 Sep, 2021 (Shift-II)]**

(*a*) –0.68 mgh (*b*) 0.64 mgh

(*c*) mgh (*d*) 1.64 mgh

48. In a spring gun having spring constant 100N/m a small ball '*B*' of mass 100 g is put in its barrel (as shown in figure) by compressing the spring through 0.05 m. There should be a box placed at a distance '*d*' on the ground so that the ball falls in it. If the ball leaves the gun horizontally at a height of 2 m above the ground . The value of *d* is _____m. **[20 July, 2021 (Shift-I)]**



49. A uniform chain of length 3 meter and mass 3 kg overhangs a smooth table with 2 meter 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 $g = 10\ m/s^2$) **[26 Aug, 2021 (Shift-I)]**

50. An engine is attached to a wagon through a shock absorber of length 1.5 m. The system with a total mass of 40,000 kg is moving with a speed of 72 kmh^{-1} when the brakes are applied to bring it to rest. In the process of the system being brought to rest, the spring of the shock absorber gets compressed by 1.0 m. If 90% of energy of the wagon is lost due to friction, the spring constant is _____ $\times 10^5$ N/m. **[1 Sep, 2021 (Shift-II)]**

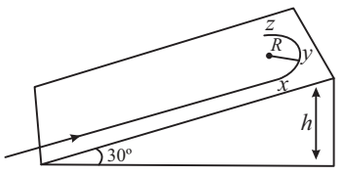
51. A body of mass 2 kg is driven by an engine delivering a constant power of 1 J/s. The body starts from rest and moves in a straight line. After 9 seconds, the body has moved a distance (in m) _____.

[5 Sep, 2020 (Shift-II)]

52. A cricket ball of mass 0.15 kg is thrown vertically up by a bowling machine so that it rises to a maximum height of 20 m after leaving the machine. If the part pushing the ball applies a constant force F on the ball and moves horizontally a distance of 0.2 m while launching the ball, the value of F (in N) is ($g = 10\ ms^{-2}$) _____.

[3 Sep, 2020 (Shift-I)]

53. A student skates up a ramp that makes an angle 30° with the horizontal. He/she starts (as shown in the figure) at the bottom of the ramp with speed v_0 and wants to turn around over a semicircular path xyz of radius R during which he/she reaches a maximum height h (at point y) from the ground as shown in the figure. Assume that the energy loss is negligible and the force required for this turn at the highest point is provided by his/her weight only, then (g is the acceleration due to gravity) **[JEE Adv, 2020]**



(*a*) $v_0^2 - 2gh = \frac{1}{2}gR$

(*b*) $v_0^2 - 2gh = \frac{\sqrt{3}}{2}gR$

(*c*) The centripetal force required at points x and z is zero

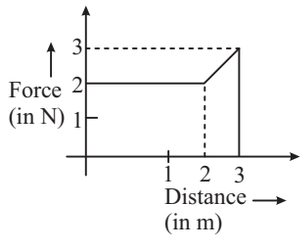
(*d*) The centripetal force required is maximum at points x and z

54. A force acts on a 2 kg object so that its position is given as a function of time as $x = 3t^2 + 5$. What is the work done by this force in first 5 seconds? **[9 Jan, 2019 (Shift-II)]**

(*a*) 850 J (*b*) 950 J

(*c*) 875 J (*d*) 900 J

55. 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 the figure. The kinetic energy of the particle after it has travelled 3 m is **[8 April, 2019 (Shift-I)]**



(*a*) 6.5 J (*b*) 2.5 J (*c*) 4 J (*d*) 5 J

56. A particle which is experiencing a force, given by $\vec{F} = 3\hat{i} - 12\hat{j}$, undergoes a displacement of $\vec{d} = 4\hat{i}$. If the particle had a kinetic energy of 3 J at the beginning of the displacement, what is its kinetic energy at the end of the displacement? **[10 Jan, 2019 (Shift-II)]**

(*a*) 9 J (*b*) 12 J (*c*) 10 J (*d*) 15 J

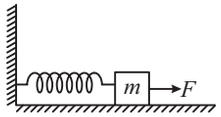
57. A wedge of mass $M = 4m$ lies on a frictionless plane. A particle of mass m approaches the wedge with speed *v*. There is no friction between the particle and the plane or between the particle and the wedge. The maximum height climbed by the particle on the wedge is given by: **[9 April, 2019 (Shift-II)]**

(*a*) $\frac{2v^2}{7g}$ (*b*) $\frac{v^2}{g}$ (*c*) $\frac{2v^2}{5g}$ (*d*) $\frac{v^2}{2g}$

58. A body of mass 1 kg falls freely from a height of 100 m, on a platform of mass 3 kg which is mounted on a spring having spring constant $k = 1.25 \times 10^6$ *N/m*. The body sticks to the platform and the spring's maximum compression is found to be x. Given that $g = 10\ ms^{-2}$, the value of *x* will be close to: **[11 Jan, 2019 (Shift-I)]**

(*a*) 40 cm (*b*) 4 cm (*c*) 80 cm (*d*) 8 cm

59. A block of mass *m*, lying on a smooth horizontal surface, is attached to a spring (of negligible mass) of spring constant *k*. The other end of the spring is fixed, as shown in the figure. The block is initially at rest in an equilibrium position. If now the block is pulled with a constant force *F*, the maximum speed of the block is **[9 Jan, 2019 (Shift-I)]**



(*a*) $\frac{2F}{\sqrt{mk}}$ (*b*) $\frac{F}{\pi\sqrt{mk}}$ (*c*) $\frac{\pi F}{\sqrt{mk}}$ (*d*) $\frac{F}{\sqrt{mk}}$

60. A uniform cable of mass '*M*' and length '*L*' is placed on a horizontal surface such that its $\left(\frac{1}{n}\right)^{th}$ 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 **[9 April, 2019 (Shift-I)]**

(*a*) $\frac{MgL}{n^2}$ (*b*) $\frac{MgL}{2n^2}$ (*c*) $\frac{2MgL}{n^2}$ (*d*) $nMgL$

61. A massless spring ($k = 800$ N/m), attached with a mass (500 g) is completely immersed in 1 kg of water. The spring is stretched by 2 cm and released so that it starts vibrating. What would be the order of magnitude of the change in the temperature of water when the vibrations stop completely? (Assume that the water container and spring receive negligible heat and specific heat of mass = 400 J/kg K, specific heat of water = 4184 J/kg K)

[9 April, 2019 (Shift-II)]

(*a*) 10^{-3} K (*b*) 10^{-4} K (*c*) 10^{-1} K (*d*) 10^{-5} K

Power

62. A body of mass 2 kg begins to move under the action of a time dependent force given by $\vec{F} = \left(6t\,\hat{i} + 6t^2\,\hat{j}\right)N$ The power developed by the force at the time t is given by: **[31 Jan, 2024 (Shift-II)]**

(*a*) $(6t^4 + 9t^5)$W (*b*) $(3t^3 + 6t^5)$W

(*c*) $(9t^5 + 6t^3)$W (*d*) $(9t^3 + 6t^5)$W

63. A body is moving unidirectionally under the influence of a constant power source. Its displacement in time *t* is proportional to: **[05 April, 2024 (Shift-II)]**

(*a*) t^2 (*b*) $t^{2/3}$ (*c*) $t^{3/2}$ (*d*) t

64. 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

[30 Jan, 2023 (Shift-II)]

65. The ratio of powers of two motors is $\frac{3\sqrt{x}}{\sqrt{x}+1}$, that are capable of raising 300 kg water in 5 minutes and 50 kg water in 2 minutes respectively from a well of 100 m deep. The value of *x* will be

[13 April, 2023 (Shift-I)]

(*a*) 2 (*b*) 4 (*c*) 2.4 (*d*) 16

66. A body of mass 1 *kg* begins to move under the action of a time dependent force $\vec{F} = (t\hat{i} + 3t^2\,\hat{j})N$. where $\hat{i}$ and $\hat{j}$ are the unit vectors along *x* and *y* axis. The power developed by above force, at the time $t = 2s$. will be _____ W. **[24 Jan, 2023 (Shift-II)]**

67. A block of mass 5 kg starting from rest pulled up on a smooth incline plane making an angle of 30° with horizontal with an affective acceleration of 1 ms^{-2}. The power delivered by the pulling force at $t = 10$ s from the start is _____W.
[Use $g = 10\ ms^{-2}$] (calculate the nearest integer value)

[11 April, 2023 (Shift-II)]

68. If the maximum load carried by an elevator is 1400 kg(600 kg – Passenger + 800 kg – elevator), which is moving up with a uniform speed of $3ms^{-1}$ and the frictional force acting on it is 2000 *N*, then the maximum power used by the motor is _____ kW ($g = 10\ m\ s^2$).

[10 April, 2023 (Shift-II)]

69. A particle of mass m is moving in a circular path of constant radius *r* such that its centripetal acceleration (a) is varying with time *t* as $a = k^2rt^2$, where k is a constant.

The power delivered to the particle by the force acting on it is given as **[28 June, 2022 (Shift-I)]**

(*a*) Zero (*b*) $mk^2r^2t^2$ (*c*) mk^2r^2t (*d*) mk^2rt

70. Sand is being dropped from a stationary dropper at a rate of 0.5 kgs^{-1} on a conveyor belt moving with a velocity of $5ms^{-1}$. The power needed to keep the belt moving with the same velocity will be:

[27 July, 2022 (Shift-I)]

(*a*) 1.25 W (*b*) 2.5 W (*c*) 6.25 W (*d*) 12.5 W

71. Water falls from a 40 m high dam at the rate of 9×10^4 kg per hour. Fifty percentage of gravitational potential energy can be converted into electrical energy. Using this hydro electric energy number of 100 W lamps, that can be lit, is:
(Take g = 10 ms^{-2}) **[28 June, 2022 (Shift-II)]**

(*a*) 25 (*b*) 50 (*c*) 100 (*d*) 18

72. A constant power delivering machine has towed a box, which was initially at rest, along a horizontal straight line. The distance moved by the box in time '*t*' is proportional to:**[18 March, 2021 (Shift-I)]**

(*a*) $t^{1/2}$ (*b*) t (*c*) $t^{3/2}$ (*d*) $t^{2/3}$

73. A body at rest is moved along a horizontal straight line by a machine delivering a constant power. The distance moved by the body in time '*t*' is proportional to: **[20 July, 2021 (Shift-II)]**

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

74. An automobile of mass '*m*' accelerates starting from origin and initially at rest, while the engine supplies constant power *P*. The position is given as a function of time by :

[27 July, 2021 (Shift-II)]

(*a*) $\left(\frac{8P}{9m}\right)^{\frac{1}{2}} t^{\frac{3}{2}}$ (*b*) $\left(\frac{9P}{8m}\right)^{\frac{1}{2}} t^{\frac{3}{2}}$ (*c*) $\left(\frac{9m}{8P}\right)^{\frac{1}{2}} t^{\frac{3}{2}}$ (*d*) $\left(\frac{8P}{9m}\right)^{\frac{1}{2}} t^{\frac{2}{3}}$

75. An elevator in a building can carry a maximum of 10 persons with the average mass of each person being 68 kg. The mass of the elevator itself is 920 kg and it moves with a constant speed of 3 m/s. The frictional force opposing the motion is 6000 N. If the elevator is moving up with its full capacity, the power delivered by the motor to the elevator must be at least (g = 10 m/s^2)

[7 Jan, 2020 (Shift-II)]

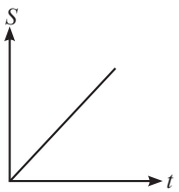
(*a*) 62360 W (*b*) 56300 W (*c*) 48000 W (*d*) 66000 W

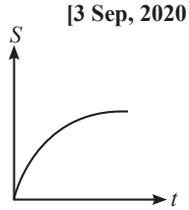
76. A 60 HP electric motor lifts an elevator having a maximum total load capacity of 2000 kg. If the frictional force on the elevator is 4000 N, the speed of the elevator at full load is close to : (1 HP = 746 W, g = 10 ms^{-2}) **[7 Jan, 2020 (Shift-I)]**

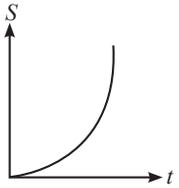
(*a*) 1.5 ms^{-1} (*b*) 1.9 ms^{-1} (*c*) 2.0 ms^{-1} (*d*) 1.7 ms^{-1}

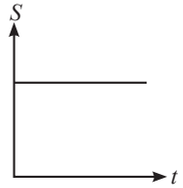
77. A particle is moving unidirectionally on a horizontal plane under the action of a constant power supplying energy source. The displacement (*s*) - time (*t*) graph that describes the motion of the particle is (graphs are drawn schematically and are not to scale)

[3 Sep, 2020 (Shift-II)]

(*a*) 

(*b*) 

(*c*) 

(*d*) 

Potential Energy & Equilibrium

78. The potential energy function (in *J*) of a particle in a region of space is given as $U = (2x^2 + 3y^3 + 2z)$. **[29 Jan, 2024 (Shift-I)]**
Here *x*, *y* and *z* are in meter. The magnitude of *x*-component of force (in *N*) acting on the particle at point *P* (1, 2, 3) *m* is:

(*a*) 2 (*b*) 6
(*c*) 4 (*d*) 8

79. Potential energy as a function of *r* is given by, $U = \frac{A}{r^{10}} - \frac{B}{r^5}$, where *r* is the interatomic distance, A and B are positive constant. The equilibrium distance between the two atoms will be:

[24 June, 2022 (Shift-II)]

(*a*) $\left(\frac{A}{B}\right)^{\frac{1}{5}}$ (*b*) $\left(\frac{B}{A}\right)^{\frac{1}{5}}$

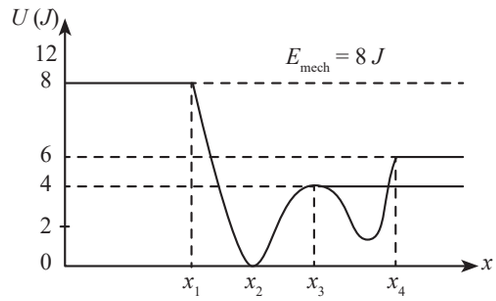
(*c*) $\left(\frac{2A}{B}\right)^{\frac{1}{5}}$ (*d*) $\left(\frac{B}{2A}\right)^{\frac{1}{5}}$

80. The potential energy of a particle of mass 4 kg in motion along the *x*-axis is given by $U = 4(1 - \cos 4x)$J. The time period of the particle for small oscillation ($\sin\theta \simeq \theta$) is $\left(\frac{\pi}{K}\right)$ s. The value of *K* is _____.

[28 July, 2022 (Shift-II)]

81. 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_{mech} = 8 J, the incorrect statement for this system is: **[27 July, 2021 (Shift-II)]**

(*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 the slowest speed.
(*d*) at $x = x_2$, *K.E.* is greatest and the particle is moving at the fastest speed.



[where *K.E.* = kinetic energy]

82. The potential energy (U) of a diatomic molecule is a function dependent on *r* (interatomic distance) as $U = \frac{\alpha}{r^{10}} - \frac{\beta}{r^5} - 3$

Where, α and β are positive constants. The equilibrium between two atoms will be $\left(\frac{2\alpha}{\beta}\right)^{\frac{a}{b}}$, where a = _____

[25 Feb, 2021 (Shift-I)]

Vertical Circular Motion

83. A ball suspended by a thread swings in a vertical plane so that its magnitude of acceleration in the extreme position and lowest position are equal. The angle (θ) of thread deflection in the extreme position will be: **[27 Jan, 2024 (Shift-II)]**

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

(*c*) $\tan^{-1}\left(\frac{1}{2}\right)$ (*d*) $2\tan^{-1}\left(\frac{1}{\sqrt{5}}\right)$

84. A stone of mass 900g is tied to a string and moved in a vertical circle of radius 1m making 10 rpm. The tension in the string, when the stone is at the lowest point is (if $\pi^2 = 9.8$ and g = 9.8 m/s^2) **[29 Jan, 2024 (Shift-II)]**

(*a*) 97 N (*b*) 9.8 N

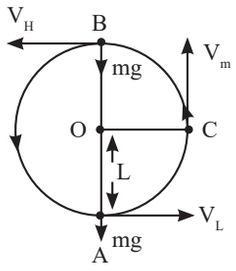
(*c*) 8.82 N (*d*) 17.8 N

85. The bob of a pendulum was released from a horizontal position. The length of the pendulum is 10m. If it dissipates 10% of its initial energy against air resistance, the speed with which the bob arrives at the lowest point is: [Use, g : 10 ms^{-2}] **[29 Jan, 2024 (Shift-II)]**

(*a*) $6\sqrt{5}$ ms^{-1} (*b*) $5\sqrt{6}$ ms^{-1}

(*c*) $5\sqrt{5}$ ms^{-1} (*d*) $2\sqrt{5}$ ms^{-1}

86. A bob of mass 'm' is suspended by a light string of length 'L'. It is imparted a minimum horizontal velocity at the lowest point A such that it just completes half circle reaching the top most position B. The ratio of kinetic energies $\frac{(K.E.)_A}{(K.E.)_B}$ is: **[29 Jan, 2024 (Shift-II)]**



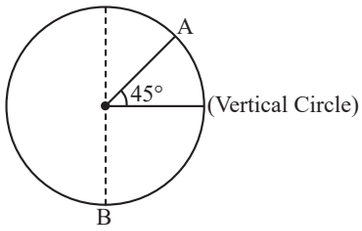
(*a*) 3 : 2 (*b*) 5 : 1 (*c*) 2 : 5 (*d*) 1 : 5

87. A simple pendulum of length 1 m has a wooden bob of mass 1 kg. It is struck by a bullet of mass 10^{-2} kg moving with a speed of 2×10^2 ms^{-1}. The bullet gets embedded into the bob. The height to which the bob rises before swinging back is. (use g = 10 m/s^2)

[1 Feb, 2024 (Shift-I)]

(*a*) 0.30 m (*b*) 0.20 m (*c*) 0.35 m (*d*) 0.40 m

88. A body of m kg slides from rest along the curve of vertical circle from point A to B in friction less path. The velocity of the body at B is: **[04 April, 2024 (Shift-II)]**



(given, R = 14 m, g = 10 m/s^2 and $\sqrt{2}$ = 1.4)

(*a*) 19.8 m/s (*b*) 21.9 m/s

(*c*) 16.7 m/s (*d*) 10.6 m/s

89. 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 **[24 June, 2022 (Shift-II)]**

(*a*) The same throughout the motion

(*b*) Minimum at the highest position of the circle path

(*c*) Minimum at the lowest position of the circular path

(*d*) Minimum when the rope is the horizontal position

90. A stone tied to a string of length *L* is whirled in a vertical circle with the other end of the string at the centre. At a certain instant of time, the stone is at its lowest position and has a speed *u*. The magnitude of change in its velocity, as it reaches a position where the string is horizontal, is $\sqrt{x(u^2 - gL)}$. The value of *x* is **[27 June, 2022 (Shift-II)]**

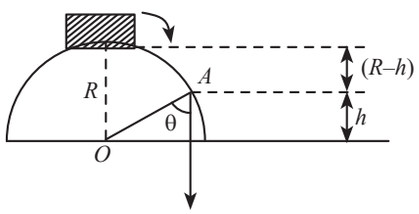
(*a*) 3 (*b*) 2 (*c*) 1 (*d*) 5

91. A pendulum of length 2 m consists of a wooden bob of mass 50 g. 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*/3and the bob just completes the vertical circle. The value of *v* is _____ ms^{-1}(g = 10 m/s^2) **[27 June, 2022 (Shift-I)]**

92. A small bob tied at one end of a thin string of length 1m 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 = 10 m/s^2) **[25 Feb, 2021 (Shift-I)]**

93. A small block slides down from the top of hemisphere of radius *R* = 3 *m* as shown in the figure. The height '*h*' at which the block will lose contact with the surface of the sphere is _____ *m*. **[27 July, 2021 (Shift-II)]**

(Assume there is no friction between the block and the hemisphere)



JEE-Advanced

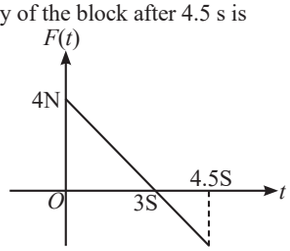
Work Done By Constant Force, Variable Force

Single Correct

1. The work done on a particle of mass m by a force, $K\left[\frac{x}{\left(x^2+y^2\right)^{3/2}}\hat{i}+\frac{y}{\left(x^2+y^2\right)^{3/2}}\hat{j}\right]$ (K being a constant of appropriate dimensions), when the particle is taken from the point $(a, 0)$ to the point $(0, a)$ along a circular path of radius a about the origin in the $x-y$ plane is **C-41.29 W-53.51 UA-5.2 (JEE Adv. 2013)**

(a) $\frac{2K\pi}{a}$ (b) $\frac{K\pi}{a}$ (c) $\frac{K\pi}{2a}$ (d) 0

2. A block of mass 2 kg is free to move along the x-axis. It is at rest and from $t = 0$ onwards it is subjected to a time-dependent force $F(t)$ in the x-direction. The force $F(t)$ varies with t as shown in the figure. The kinetic energy of the block after 4.5 s is **(IIT-JEE 2010)**



(a) 4.50 J (b) 7.50 J (c) 5.06 J (d) 14.06 J

3. A force $F=-k(y\hat{i}+x\hat{j})$ (where, k is a positive constant) acts on a particle moving in the $x-y$ plane. Starting from the origin, the particle is taken along the positive X-axis to the point $(a, 0)$ and then parallel to the Y-axis to the point (a, a). The total work done by the force F on the particle is **(IIT-JEE 1998)**

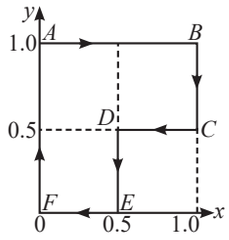
(a) $-2ka^2$ (b) $2ka^2$ (c) $-ka^2$ (d) ka^2

4. A uniform chain of length L and mass M is lying on a smooth table and one-third of its length is hanging vertically down over the edge of the table. If g is acceleration due to gravity, the work required to pull the hanging part onto the table is **(IIT-JEE 1985)**

(a) MgL (b) $MgL/3$ (c) $MgL/9$ (d) $MgL/18$

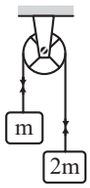
Numerical Types/Integer Types

5. A particle is moved along a path AB-BC-CD-DE-EF-FA, as shown in figure, in presence of a force $\vec{F}=(\alpha y\hat{i}+2\alpha x\hat{j})$ N where x and y are in meter and $\alpha = -1$ N/m^{-1}. The work done on the particle by this force $\vec{F}$ will be ____ Joule **C-15 W-71 UA-14 (JEE Adv. 2019)**



Subjective

6. A light inextensible string that goes over a smooth fixed pulley as shown in the figure connects two blocks of masses 0.36 kg and 0.72 kg. Taking $g = 10$ ms^{-2}, find the work done (in Joule) by string on the block of mass 0.36 kg during the first second after the system is released from rest. **(IIT-JEE 2009)**



7. The displacement x of a particle moving in one dimension, under the action of a constant force is related to the time t by the equation $t=\sqrt{x}+3$ where x is in metre and t in second. Find

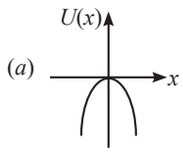
(a) the displacement of the particle when its velocity is zero, and

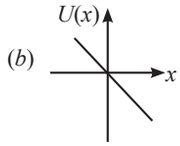
(b) the work done by the force in the first 6 s. **(IIT-JEE 1980)**

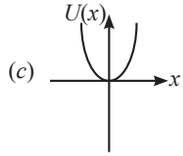
Potential Energy

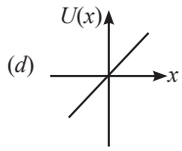
Single Correct

8. A particle is placed at the origin and a force $F = kx$ is acting on it (where, k is a positive constant). If $U(0) = 0$, the graph of $U(x)$ versus x will be (where, U is the potential energy function) **(IIT-JEE 2004)**

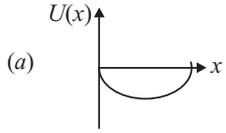
(a)


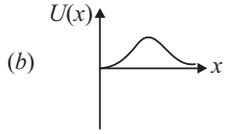
(b)


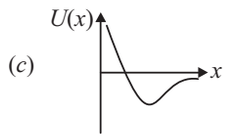
(c)


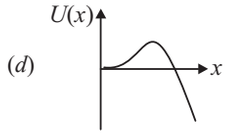
(d)


9. A particle, which is constrained to move along x-axis, is subjected to a force in the same direction which varies with the distance x of the particle from the origin as $F(x) = -kx + ax^3$. Here, k and a are positive constants. For $x \geq 0$, the functional form of the potential energy $U(x)$ of the particle is **(IIT-JEE 2002)**

(a)


(b)


(c)


(d)


Match the Column

10. A particle of unit mass is moving along the x-axis under the influence of a force and its total energy is conserved. Four possible forms of the potential energy of the particle are given in Column-I (a and U_0 are constants). Match the potential energies in Column-I to the corresponding statements in Column-II **(JEE Adv. 2015)**

Column-I

A. $U_1(x)=\frac{U_0}{2}\left[1-\left(\frac{x}{a}\right)^2\right]^2$

B. $U_2(x)=\frac{U_0}{2}\left(\frac{x}{a}\right)^2$

C. $U_3(x)=\frac{U_0}{2}\left(\frac{x}{a}\right)^2\exp\left[-\left(\frac{x}{a}\right)^2\right]$

D. $U_4(x)=\frac{U_0}{2}\left[\frac{x}{a}-\frac{1}{3}\left(\frac{x}{a}\right)^3\right]$

Column-II

P. The force acting on the particle is zero at $x = a$

Q. The force acting on the particle is zero at $x = 0$

R. The force acting on the particle is zero at $x = -a$

S. The particle experiences an attractive force towards $x = 0$ in the region $|x| < a$

T. The particle with total energy $\frac{U_0}{4}$ can oscillate about the point $x = -a$

(a) (A)→(P, Q, T); (B) → (Q, T) (C)→(P, Q, R, S) (D)→(P, R, T)

(b) (A)→(P, Q, R, T) (B)→(Q, S) (C)→(P, Q, R) (D)→(P, R, T)

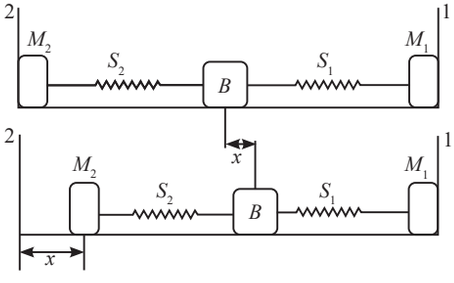
(c) (A)→(P, Q, R, T) (B)→(Q, S) (C)→(P, Q, R, S) (D)→(P, R, T)

(d) (A)→(P, Q, R, T) (B)→(Q, S)D (C)→(P, Q, S, T) (D)→(P, R, S)

Energy and Work-Energy Theorem

Single Correct

11. A block (B) is attached to two unstretched springs S_1 and S_2 with spring constants k and $4k$, respectively. The other ends are attached to two supports M_1 and M_2 not attached to the walls. The springs and supports have negligible mass. There is no friction anywhere. **(IIT-JEE 2008)**



The block B is displaced towards wall 1 by a small distance x and released. The block returns and moves a maximum distance y towards wall 2. Displacements x and y are measured with respect to the equilibrium position of the block B. The ratio $\frac{y}{x}$ is

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

12. **Statement-I:** A block of mass m starts moving on a rough horizontal surface with a velocity v. It stops due to friction between the block and the surface after moving through a certain distance. The surface is now tilted to an angle of 30° with the horizontal and the same block is made to go up on the surface with the same initial velocity v. The decrease in the mechanical energy in the second situation is smaller than that in the first situation.

Statement-II: The coefficient of friction between the block and the surface decreases with the increase in the angle of inclination. **(IIT-JEE 2007)**

(a) If Statement-I is true, Statement-II is true; Statement-II is the correct explanation for Statement-I

(b) If Statement-I is true, Statement-II is true; Statement-II is not a correct explanation for Statement-I

(c) If Statement-I is true; Statement-II is false

(d) If Statement-I is false; Statement-II is true

13. An ideal spring with spring constant k is hung from the ceiling and a block of mass M is attached to its lower end. The mass is released with the spring initially unstretched. Then the maximum extension in the spring is **(IIT-JEE 2002)**

(a) $\frac{4Mg}{k}$ (b) $\frac{2Mg}{k}$ (c) $\frac{Mg}{k}$ (d) $\frac{Mg}{2k}$

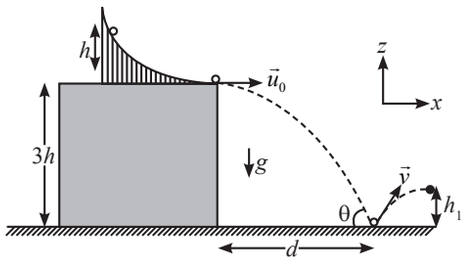
14. Two masses of 1 g and 4 g are moving with equal kinetic energies. The ratio of the magnitudes of their momenta is **(IIT-JEE 1980)**

(a) 4 : 1 (b) $\sqrt{2}$:1 (c) 1 : 2 (d) 1 : 16

Multiple Correct

15. A slide with a frictionless curved surface, which becomes horizontal at its lower end, is fixed on the terrace of a building of height $3h$ from the ground, as shown in the figure. A spherical ball of mass m is released on the slide from rest at a height h from the top of the terrace. The ball leaves the slide with a velocity $\vec{u}_0 = u_0\hat{x}$ and falls on the ground at a distance d from the building making an angle θ with the horizontal. It bounces off with a velocity $\vec{v}$ and reaches a maximum height h_1. The acceleration due to gravity is g and the coefficient of restitution of the ground is $\frac{1}{\sqrt{3}}$. Which of the following statements is/are correct?

C-11 W-12.56 UA-42.27 PC-34.16 (JEE Adv. 2023)

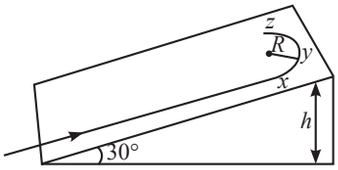


(a) $\vec{u}_0 = \sqrt{2gh}\,\hat{x}$ (b) $\vec{v} = \sqrt{2gh}\,(\hat{x}-\hat{z})$

(c) θ = 60° (d) $\frac{d}{h_1} = 2\sqrt{3}$

16. A student skates up a ramp that makes an angle 30° with the horizontal. He/she starts (as shown in the figure) at the bottom of the ramp with speed v_0 and wants to turn around over a semicircular path xyz of radius R during which he/she reaches a maximum height h (at point y) from the ground as shown in the figure. Assume that the energy loss is negligible and the force required for this turn at the highest point is provided by his/her weight only, then (g is the acceleration due to gravity)

C-12.76 W-35.23 UA-37.62 PC-14.39 (JEE Adv. 2020)



(a) $v_0^2 - 2gh = \frac{1}{2}gR$

(b) $v_0^2 - 2gh = \frac{\sqrt{3}}{2}gR$

(c) The centripetal force required at points x and z is zero

(d) The centripetal force required is maximum at points x and z

17. A particle of mass m is initially at rest at the origin. It is subjected to a force and starts moving along the X-axis. Its kinetic energy K changes with time as $dK/dt = \gamma t$, where γ is a positive constant of appropriate dimensions. Which of the following statements is (are) true? **C-8.49 W-27.19 UA-14.89 PC-49.42 (JEE Adv. 2018)**

(a) The force applied on the particle is constant

(b) The speed of the particle is proportional to time

(c) The distance of the particle from the origin increases linearly with time

(d) The force is conservative

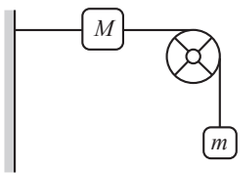
18. A particle is acted upon by a force of constant magnitude which is always perpendicular to the velocity of the particle. The motion of the particle takes place in a plane. It follows that **(IIT-JEE 1987)**

(a) Its velocity is constant (b) Its acceleration is constant

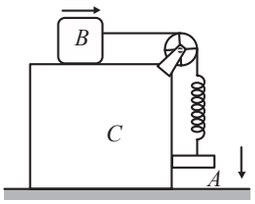
(c) Its kinetic energy is constant (d) It moves in a circular path

Subjective

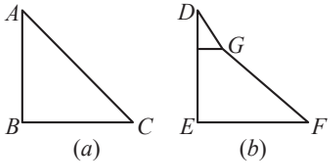
19. A string, with one end fixed on a rigid wall, passing over a fixed frictionless pulley at a distance of 2 m from the wall, has a point mass $M = 2$ kg attached to it at a distance of 1 m from the wall. A mass $m = 0.5$ kg attached at the free end is held at rest so that the string is horizontal between the wall and the pulley and vertical beyond the pulley. What will be the speed with which the mass M will hit the wall when the mass m is released? (Take $g = 9.8$ m/s^2) **(IIT-JEE 1985)**



20. Two blocks A and B are connected to each other by a string and a spring; the string passes over a frictionless pulley as shown in the figure. Block B slides over the horizontal top surface of a stationary block C and the block A slides along the vertical side of C, both with the same uniform speed. The coefficient of friction between the surfaces of blocks is 0.2. Force constant of the spring is 1960 N/m. If mass of block A is 2 kg. Calculate the mass of block B and the energy stored in the spring. **(IIT-JEE 1982)**

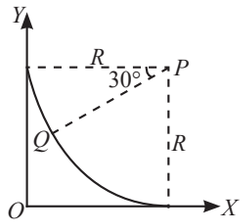


21. In the figures (a) and (b) AC, DG and GF are fixed inclined planes, $BC = EF = x$ and $AB = DE = y$. A small block of mass M is released from the point A. It slides down AC and reaches C with a speed v_C. The same block is released from rest from the point D. It slides down DGF and reaches the point F with speed v_F. The coefficients of kinetic frictions between the block and both the surfaces AC and DGF are μ. Calculate v_C and v_F **(IIT-JEE 1980)**



Passage Based Questions

Paragraph (Q. 22-23): A small block of mass 1 kg is released from rest at the top of a rough track. The track is a circular arc of radius 40 m. The block slides along the track without toppling and a frictional force acts on it in the direction opposite to the instantaneous velocity. The work done in overcoming the friction up to the point Q, as shown in the figure, is 150 J. (Take the acceleration due to gravity, $g = 10$ ms^{-2}) **(JEE Adv. 2013)**



22. The speed of the block when it reaches the point Q is

C-37.04 W-39.84 UA-23.12

(a) 5 ms^{-1} (b) 10 ms^{-1}

(c) 10 $\sqrt{3}$ ms^{-1} (d) 20 ms^{-1}

23. The magnitude of the normal reaction that acts on the block at the point Q is **C-32.93 W-36.42 UA-30.64**

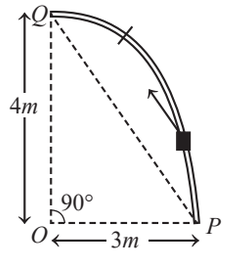
(a) 7.5 N (b) 8.6 N

(c) 11.5 N (d) 22.5 N

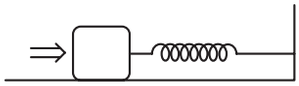
Numerical Types/Integer Types

24. Consider an elliptically shaped rail PQ in the vertical plane with $OP = 3\ m$ and $OQ = 4$ m. A block of mass 1 kg is pulled along the rail from P to Q with a force of 18 N, which is always parallel to line PQ (see figure). Assuming no frictional losses, the kinetic energy of the block when it reaches Q is $(n \times 10)$ J. The value of n is (take acceleration due to gravity = 10 ms^{-2})

C-30.08 W-61.51 UA-8.41 (JEE Adv. 2014)



25. A block of mass 0.18 kg is attached to a spring of force constant 2 n/m. The coefficient of friction between the block and the floor is 0.1. Initially the block is at rest and the spring is unstretched. An impulse is given to the block as shown in the figure. The block slides a distance of 0.06 m and comes to rest for the first time. The initial velocity of the block in m/s is $v = \frac{N}{10}$. Then N is **(IIT-JEE 2011)**



Fill in the Blanks

26. A cricket ball of mass 0.15 kg is thrown vertically up by a bowling machine, so that it rises to a maximum height of 20 m after leaving the machine. If the part pushing the ball applies a constant force F on the ball and moves horizontally a distance of 0.2 m, while launching the ball, the value of F (in N) is (Take, g =10 ms^{-2}) ..... .

(JEE Adv. 2015)

Power

Single Correct

27. A wind-powered generator converts wind energy into electric energy. Assume that the generator converts a fixed fraction of the wind energy intercepted by its blades into electrical energy. For wind speed v, the electrical power output will be proportional to **(IIT-JEE 2000)**

(*a*) v (*b*) v^2 (*c*) v^3 (*d*) v^4

28. A particle of mass m is moving in a circular path of constant radius r such that its centripetal acceleration a_c is varying with time t as $a_c = k^2 rt^2$, where k is a constant. The power delivered to the particle by the force acting on it is **(IIT-JEE 1994)**

(*a*) $2\pi mk^2r^2$ (*b*) mk^2r^2t (*c*) $\frac{\left(mk^4r^2t^5\right)}{3}$ (*d*) Zero

29. A body is moved along a straight line by a machine delivering constant power. The distance moved by the body in time t is proportional to **(IIT-JEE 1984)**

(*a*) $t^{1/2}$ (*b*) $t^{3/4}$ (*c*) $t^{3/2}$ (*d*) t^2

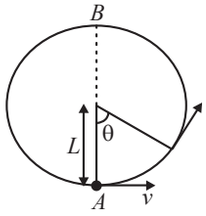
Numerical Types/Integer Types

30. A particle of mass 0.2 kg is moving in one dimension under a force that delivers a constant power 0.5 W to the particle. If the initial speed (in ms^{-1}) of the particle is zero, the speed (in ms^{-1}) after 5s is **(JEE Adv. 2013)**

Vertical Circular Motion

Single Correct

31. A bob of mass M is suspended by a massless string of length L. The horizontal velocity v at position A is just sufficient to make it reach the point B. The angle θ at which the speed of the bob is half of that at A, satisfies **(IIT-JEE 2008)**



(*a*) $\theta = \frac{\pi}{4}$ (*b*) $\frac{\pi}{4} < \theta < \frac{\pi}{2}$

(*c*) $\frac{\pi}{2} < \theta < \frac{3\pi}{4}$ (*d*) $\frac{3\pi}{4} < \theta < \pi$

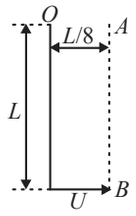
32. A stone tied to a string of length L is whirled in a vertical circle with the other end of the string at the center. At a certain instant of time, the stone is at its lowest position, and has a speed u. The magnitude of the change in its velocity as it reaches a position, where the string is horizontal, is **(IIT-JEE 1998)**

(*a*) $\sqrt{u^2 - 2gL}$ (*b*) $\sqrt{2gL}$

(*c*) $\sqrt{u^2 - gL}$ (*d*) $\sqrt{2(u^2 - gL)}$

Subjective

33. A particle is suspended vertically from a point O by an inextensible massless string of length L. A vertical line AB is at a distance $L/8$ from O as shown in figure. The object is given a horizontal velocity u. At some point, its motion ceases to be circular and eventually the object passes through the line AB. At the instant of crossing AB, its velocity is horizontal. Find u. **(IIT-JEE 1999)**



Numerical Types/Integer Types

34. A bob of mass m, suspended by a string of length l_1, is given a minimum velocity required to complete a full circle in the vertical plane. At the highest point, it collides elastically with another bob of mass m suspended by a string of length l_2, which is initially at rest. Both the strings are massless and inextensible. If the second bob, after collision acquires the minimum speed required to complete a full circle in the vertical plane, the ratio $\frac{l_1}{l_2}$ is

C-28.57 W-29.87 UA-41.56 (JEE Adv. 2013)

ANSWER KEY

JEE-Main

1. (*c*)	**2.** (*c*)	**3.** (*b*)	**4.** (*b*)	**5.** (*d*)	**6.** (*b*)	**7.** (*a*)	**8.** (*a*)	**9.** (58)	**10.** (*a*)
11. [132]	**12.** [7]	**13.** [40]	**14.** [32]	**15.** [30]	**16.** (*a*)	**17.** [450]	**18.** [2]	**19.** (*d*)	**20.** (*c*)
21. (*d*)	**22.** [0.75]	**23.** (*b*)	**24.** (*d*)	**25.** (*a*)	**26.** (*b*)	**27.** (*c*)	**28.** [300]	**29.** [3]	**30.** [2]
31. (*a*)	**32.** [–245]	**33.** [784]	**34.** [375]	**35.** (*b*)	**36.** (*d*)	**37.** (*b*)	**38.** (*c*)	**39.** (*c*)	**40.** (*a*)
41. (*c*)	**42.** (*c*)	**43.** [600]	**44.** [120]	**45.** [2]	**46.** [10]	**47.** (*a*)	**48.** [1]	**49.** [40]	**50.** [16]
51. [18.00]	**52.** [150.00]	**53.** (*a*, *d*)	**54.** (*d*)	**55.** (*a*)	**56.** (*d*)	**57.** (*c*)	**58.** (*)	**59.** (*d*)	**60.** (*b*)
61. (*d*)	**62.** (*d*)	**63.** (*c*)	**64.** [4]	**65.** (*d*)	**66.** [100]	**67.** [300]	**68.** [48]	**69.** (*c*)	**70.** (*d*)
71. (*b*)	**72.** (*c*)	**73.** (*b*)	**74.** (*a*)	**75.** (*d*)	**76.** (*b*)	**77.** (*c*)	**78.** (*c*)	**79.** (*c*)	**80.** [2]
81. (*c*)	**82.** [1]	**83.** (*b*)	**84.** (*b*)	**85.** (*a*)	**86.** (*b*)	**87.** (*b*)	**88.** (*b*)	**89.** (*b*)	**90.** (*b*)
91. [10]	**92.** [5]	**93.** (*b*)							

JEE-Advanced

1. (*d*)	**2.** (*c*)	**3.** (*c*)	**4.** (*d*)	**5.** [0.75]	**8.** (*a*)	**9.** (*d*)	**10.** (*c*)	**11.** (*c*)	**12.** (*c*)
13. (*b*)	**14.** (*c*)	**15.** (*a*, *c*, *d*)	**16.** (*a*, *d*)	**17.** (*a*, *b*, *d*)	**18.** (*c*, *d*)	**22.** (*b*)	**23.** (*a*)	**24.** [*5*]	**25.** [4]
26. [150]	**27.** (*c*)	**28.** (*b*)	**29.** (*c*)	**30.** [5]	**31.** (*d*)	**32.** (*d*)	**34.** [5]		

EXPLANATIONS