

Physics

NEB-Model Questions - 2078

Time: 3 hrs

Full marks: 75

Pass marks: 27

Attempt all questions

Group 'A'

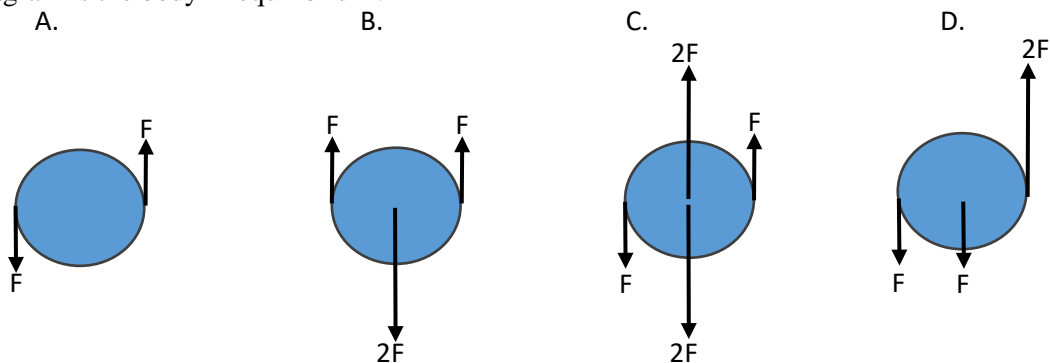
Circle the best alternative to the following questions.

(11×1 = 11)

1. A metre rule is used to measure the length of a piece of string in a certain experiment. It is found to be 20 cm long to the nearest millimeter. How should this result be recorded in a table of results?

(A) 0.2000m (B) 0.200m (C) 0.20m (D) 0.2m

2. Forces are applied to a rigid body. The forces all act in the same plane. In which diagram is the body in equilibrium?



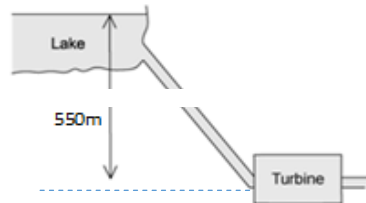
3. An athlete makes a long jump and follows a projectile motion. Air resistance is negligible.

Which one of the following statements is true about the athlete?



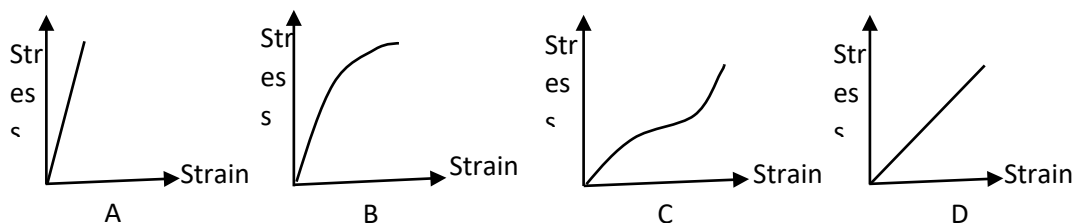
- (A) The athlete has a constant horizontal and vertical velocities.
 - (B) The athlete has a constant horizontal velocity and constant downward acceleration.
 - (C) The athlete has a constant upward acceleration followed by a constant downward acceleration.
 - (D) The athlete has a constant upward velocity followed by a constant downward velocity.
4. At Kulekhani-I Hydro-power station, water flows from Indra Sarowar into the turbines that are a vertical distance of 550 m below the lake, as shown in the

diagram. Generally, 780 000kg of water flows into the turbines every minute. The turbines have the efficiency of 85%. What is the output power of the turbines?



- (A) 71 MW (B) 60MW (C) 4.2 GW (D) 3.6 GW

5. Graphs of stress-strain for four different materials are shown below. Which graph represents the stiffest material?



6. A boy walks towards a stationary plane mirror at a speed of 1.2 ms^{-1} . What is the relative speed of approach of the boy and his image?

- A. zero B. 1.2 ms^{-1} C. 2.4 ms^{-1} D. 1.44 ms^{-1}

7. The critical angle between an equilateral prism and air is 45° . What happens to the incident ray perpendicular to the refracting surface?

- A. It is reflected totally from the second surface and emerges perpendicular from the third surface.
 B. It gets reflected from second and third surfaces and emerges from the first surface
 C. It keeps reflecting from all the three sides of the prism and never emerges out.
 D. After deviation, it gets refracted from the second surface.

8. In the formation of a rainbow, the light from the sun on water droplets undergoes which of the following phenomenon/phenomena?

- A. dispersion only B. only total reflection.
 C. dispersion and total internal reflection D. scattering

9. In what unit is the power of lens measured?

- A. watt B. metre C. dioptre D. Hertz

10. A piece of wire of resistance R is bent through 180° at mid-point and the two halves are twisted together. What is the resistance of the wire thus formed?

- (A) $R/4$ (B) $R/2$ (C) R (D) $2R$

11. What are the elementary particles with half spin called?

- (A) quarks (B) bosons (C) fermions (D) hadrons

Group 'B'

Write short answer to the following questions.

8X5=40

1.

- (a) State the law of conservation of momentum. [2]
 (b) A jumbo jet of mass 4×10^5 kg travelling at a speed of 5000 m/s lands on the airport. It takes 2 minutes to come to rest. Calculate the average force applied by the ground on the aeroplane. [2]
 (c) After landing the aeroplanes' momentum becomes zero. Explain how the law of conservation holds here. [1]

OR

- (a) State Hook's law. [2]
 (b) The walls of the tyres on a car are made of a rubber compound. The variation with stress of the strain of a specimen of this rubber compound is

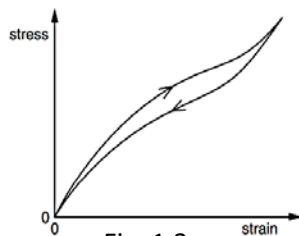


Fig. 1.2.

shown in Fig. 1.2.

As the car moves, the walls of the tyres end and straighten continuously. Use Fig. 1.2 to explain why the walls of the tyres become warm. [3]

2.

- (a) What is meant by specific latent heat of vaporization of water = 2.26 MJ kg^{-1} ? [1]
 (b) A 1.0kW kettle contains 500g of boiling water. Calculate the time needed to evaporate all the water in the kettle. (Specific latent heat of vaporization of water = 2.26 MJ kg^{-1}). [3]
 (c) Explain why the actual time needed is a little longer than the time calculated in 2(b). [1]

3.

- (a) State any three properties of an ideal gas as assumed by the kinetic theory of gas. [3]

- (b) A student needed to use the ideal gas for a certain experiment. But, the ideal gas does not exist. Suggest what two different things this student could do to solve his problem.

[2]

4.

- (a) Define temperature gradient in an object. [1]

(b) An electric kitchen range has a total wall area of 1.40 m^2 and is insulated with a layer of fiber glass that has a temperature of 175°C and its outside surface is 35°C . The fiber glass has a thermal conductivity of $0.040 \text{ W m}^{-1}\text{K}^{-1}$. Calculate the rate of flow of heat through the insulation, assuming the fibre as a flat slab of area of 1.40 m^2 . [3]

- (c) How might the rate of conduction be affected if the fiber absorbs moisture? Justify your answer. [1]

5. Figure 5.1 shows a ray of light is entering and emerging through a part of a convex lens.

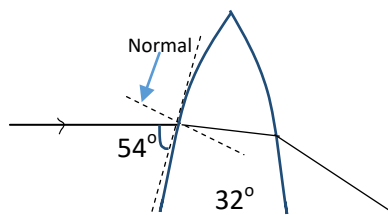


Fig. 5.1

- (i) Define 'convex lens', and state one daily application of it. [2]
 (i) Explain why this lens is also called converging lens? [1]
 (ii) Calculate the refractive index of the material of the lens shown in the figure. [2]

OR

- (a) Define 'concave mirror' and state one daily application of it. [2]

(b) A certain projector uses a concave mirror for projecting an object's image on a screen. It produces an image that is 5 times bigger than the object and the screen is 5m away from the mirror as shown in Fig. 5.2.

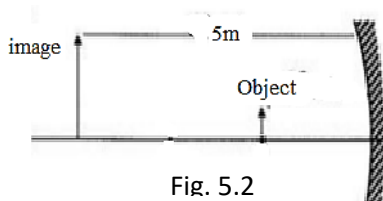


Fig. 5.2

- (i) Give reason why is the image larger than the object? [2]
 (ii) Calculate the focal length of the mirror. [2]

6. (a) Sketch an electric field pattern around two identical negative point charges shown

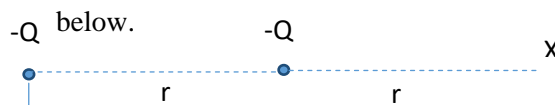


Fig. 6.1

[2] **U**

- (b) Obtain an equation, in terms of Q and r , for the field strength at point X due to two charges shown in shown in Fig. 6.1 [3]

7.

- (a) Define capacitance of a parallel plate capacitor and state one application of it in electric circuit. [2]
- (b) Three capacitors each of $1000\mu\text{F}$ are connected in an electric circuit as shown below.

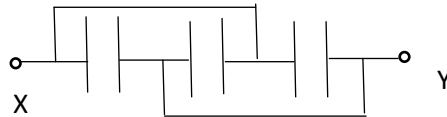


Fig. 7.1

- (i) Identify the type of combination shown in Fig. 7.1, and calculate the effective capacitance of the combination. [1+2]

8.

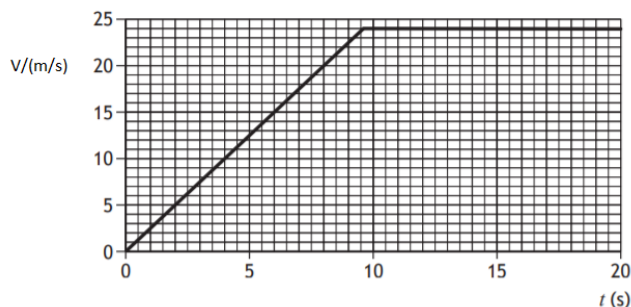
- (a) What is it meant by power of a heater is 2 kW? [1]
- (b) Calculate the resistance of the above mentioned heater when it is connected to 220V source. [2]
- (c) Suggest what changes must be done to the heater so that it gives more heat. Justify your answer. [2]

Group 'C'

Give long answer to the following questions

(3 × 8 = 24)

9. A box at rest is accelerated by a rope attached with a motor as shown in the Fig 2.1. The velocity-time graph given below shows the pattern of its motion for 20 s.



- (a) If the box is pulled with constant unbalanced force 10N. Show that the initial acceleration of the box is 2.5 ms^{-2} , and calculate its mass. [2+1]
- (b) After 2.0 second the box is being pulled by a constant force 12 N. Determine the size of frictional forces acting on the box at this time. [2]
- (c) Determine the distance of the box travels along the ground at 8.0s. [3]

10. A boy is operating a remote-controlled toy car on a horizontal circular track, as shown in the track has a radius of 1.8 m and the car travels around the track with a constant speed.

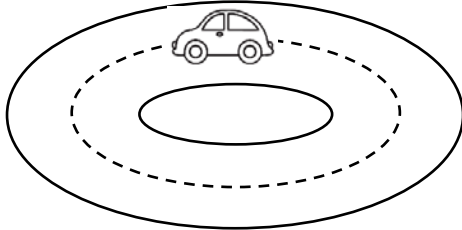


Fig. 10.1

- (i) Explain why the car is accelerating, even though it is travelling at a constant speed. [2]
- (ii) The car has a mass of 0.50 kg. The boy now increases the speed of the car to 6.0 m s^{-1} . The total radial friction between the car and the track has a maximum value of 7.0 N. Show by calculation that the car cannot continue to travel in a circular path. [3]
- (iii) The car is now placed on a track, which includes a raised section. This is shown in

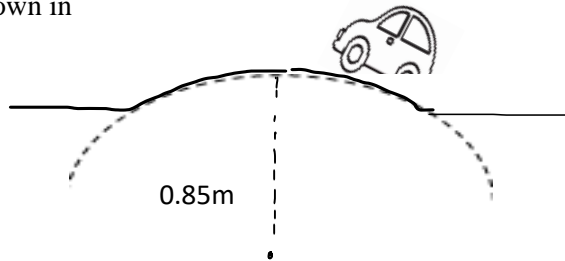


Fig. 1.2

The raised section of the track can be considered as the arc of a circle, which has radius r of 0.85 m. The car will lose contact with the raised section of track if its speed is greater than v_{max} . Show that v_{max} is given by the relationship $v_{\text{max}} = \sqrt{rg}$.

OR

Juno is a NASA orbiter with a mission to survey Jupiter. It is in an elliptical orbit around Jupiter as shown in the figure below.



The gravitational potential at point A in the orbit of Juno is $-1.70 \times 10^9 \text{ J kg}^{-1}$.

- (a) State what is meant by a gravitational potential at point A is $-1.70 \times 10^9 \text{ J kg}^{-1}$. [2]
- (b) At point B, Juno is $1.69 \times 10^8 \text{ m}$ from the centre of Jupiter. If the mass of Jupiter is $1.90 \times 10^{27} \text{ kg}$, calculate the gravitational potential at point B. [3]
- (c) The mass of Juno is $1.6 \times 10^3 \text{ kg}$. Determine the change in gravitational potential energy if Juno moves from Point A to Point B. [3]

11.

- (a) Explain how Rutherford's α -scattering experiment suggested that the nucleus of an atom is very small, very dense and positively charged. [3]
- (b) Considering that the α -particles carry average kinetic energy of $2.00 \times 10^{10} \text{ J}$, calculate the maximum size of the gold nucleus. [Atomic number of gold is 79 and $e = 1.60 \times 10^{-19} \text{ C}$] [3]
- (c) Explain why the radius of the gold nucleus must be much smaller than the value calculated in 11(b) above. [2]

Model Questions 2078 - 1

Attempt all questions:

Group A

Circle the best alternative to the following questions:

11X1=11

- 1) Which of the sets give below may represent the magnitudes of three vectors adding to be zero?

a) 2, 4, 8
b) 4, 8, 16
c) 1, 2, 1
d) 0.5, 1, 2
- 2) The figure shows displacement – time graph of a particle moving on the X-axis.

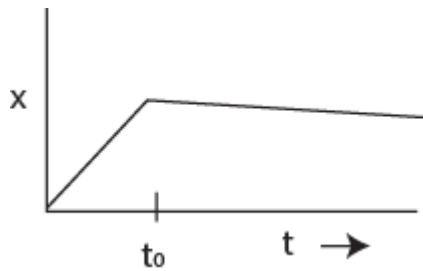


Figure 1

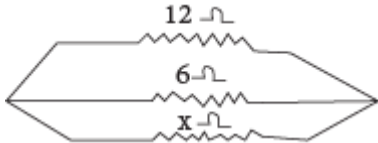
Which of the following statement is true?

- a) The particle is continuously going to +ve x direction.
 - b) The particle is at rest.
 - c) The velocity increases upto a time t and then becomes constant.
 - d) The particle moves at a constant velocity upto a time t_0 and then stops.
- 3) In a projectile motion, the velocity

a) Is always perpendicular to the acceleration.
b) Is never perpendicular to the acceleration.
c) Is perpendicular to the acceleration for one instant only.
d) Is perpendicular to the acceleration. for two instant
 - 4) A block of mass m is placed on a smooth inclined plane of inclination θ with the horizontal. The force exerted by the plane on the block has a magnitude

a) mg
b) $\frac{mg}{\cos \theta}$
c) $mg \cos \theta$
d) $mg \tan \theta$
 - 5) The work done by the external forces on a system equals the change in

a) total energy
b) kinetic energy
c) potential energy
d) none of these
 - 6) A point object is placed at a distance of 30 cm from a convex mirror of focal length 30 cm. The image will form at

- a) at infinity b) pole c) focus d) 15 cm behind the mirror
- 7) The rays of different colours fail to converge at a point after going through a converging lens. This defect is called
- a) spherical aberration b) distortion c) coma d) chromatic aberration
- 8) A double convex lens has two surfaces of equal radii R and refractive index $\mu = 1.5$. we have
- a) $f = \frac{R}{2}$ b) $f = R$ c) $f = -R$ d) $f = 2R$
- 9) The image formed by a concave mirror
- a) is always real b) is always virtual
- c) is certainly real if the object is virtual d) is certainly virtual if object is real
- 10) The diagram shows a parallel combination of three resistors. The total resistance of the combination is 3Ω . What is the resistance of resistor X?
- 
- a) 2Ω b) 3Ω c) 6Ω d) 12Ω
- 11) An electron is a
- a) meson b) baryon c) hadron d) lepton

Group B

Write short answer to the following questions.

8X5=40

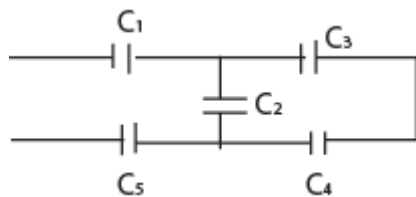
- 1)
- a) What do you mean by centripetal force? 2
- b) A hose directs a horizontal jet of water, moving with a velocity of the jet is $5 \times 10^{-4} \text{ m}^2$. If the density of water is 1000 kg m^{-3} . Calculate the force on the wall assuming that the water is brought to rest there. 3

OR

- a) How does 'g' at a point vary with distance from the centre of the earth? Where is the highest value of g? 2
- b) A uniform wire of density 7800 kg m^{-3} weights 16 g and 2.5m long. It lengthens by 1.2 mm when stretched by a force of 80 N. calculate the Young's modulus and the energy stored in the wire. 3
- 2)
- a) State Newton's law of cooling. 2
- b) 10 g of steam at 100°C is passed into a mixture of 100 g of water and 10 g of ice at 0°C . Find the resulting temperature of mixture. 3
- 3)
- a) What is black body radiation? 2
- b) A glass flask of volume 500 cm^3 is just filled with mercury at 0°C . How much mercury overflows when the temperature of the system is raised at 80°C ? 3
- 4)
- a) Write down the unit of thermal conductivity. 1
- b) A gas enclosed in a vessel exerts pressure on its walls. Why? 2
- c) Why are there two types of coefficient of expansion of a gas? 2
- 5)
- a) Mention the conditions of total internal refraction. 1
- b) A glass prism is immersed in water. What happened to the value of angle of minimum deviation? 2
- c) How can you distinguish between a concave lens and a concave lens without touching the surfaces? 2

OR

- a) What are conditions for the production of pure spectrum? 1
- b) The image obtained by a lens of power 5D is three times the length of the object. Calculate the object and image distances. 2
- c) Define angular magnification of a lens. 2
- 6)
- a) State Coulomb's law. 1
- b) More charge can be stored in a metal if it is highly polished than when it's surface is rough. Explain. 1
- c) An electron of mass $9.1 \times 10^{-31} \text{ kg}$ and charge $1.6 \times 10^{-19} \text{ C}$ is situated in a uniform electric field of intensity $12 \times 10^4 \text{ Vm}$. Find the time it takes to travel 1 cm from rest. 3
- 7)
- a) What is meant by relative permittivity? 1
- b) Is it possible to charge a capacity to any potential? 1
- c) In the given circuit, applied potential between ab is 220 V. What is the equivalent capacitance of network between a and b?
- Given $C_1 = C_5 = 8.4 \mu\text{F}$, $C_2 = C_3 = C_4 = 4.2 \mu\text{F}$



8)

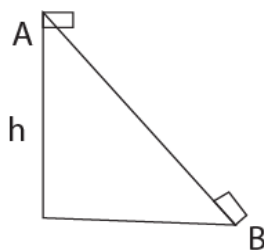
- a) Define temperature coefficient of resistance. 1
- b) Why a voltmeter is always connected in parallel with the load resistance? 1
- c) A resistance of $1200\ \Omega$ and of $800\ \Omega$ are placed in series with a 24 V supply. What will be the reading on a voltmeter of internal resistance $600\ \Omega$ when placed across (i) the $1200\ \Omega$ resistance (ii) the $800\ \Omega$ resistor? 3

Group C

Give long answer to the following questions

(3 × 8 = 24)

- 9) Suppose you want to place a 100 kg weather satellite into a circular orbit 300 km above the earth's surface.
 - a) What speed, period and radial acceleration must it have? 3
 - b) How much work has to be done to place this satellite in orbit? 3
 - c) How much additional work would have to be done to make this satellite escape the earth? The earth's radius is $R_E = 6380\text{ km}$ and its mass is $5.97 \times 10^{24}\text{ kg}$. 2
- 10)
 - a) A block of mass M is pulled along a horizontal surface by applying a force at an angle θ with the horizontal. The coefficient of friction between the block and the surface is μ . If the block travels at a uniform velocity. Find the work done by this applied force during a displacement of the block. 4
 - b) A block of mass m slides along a frictionless surface as shown in fig. 1. If it is released from rest at A. what is its speed at B? 2



- c) A porter lifts a suitable weight $m\text{ kg}$ from the platform and puts it on his hand $h\text{ m}$ above the platform. How much the work is done by the porter? 2

OR

- a) A particle of mass m is suspended from a ceiling through a string of length l . The particle moves in a horizontal circle of radius r . Find the speed of the particle and the tension in the string. 4

- b) A cylindrical bucket filled with water is whirled around a vertical circle of radius r . what can be the minimum speed at the top of the path if water does not fall out from the bucket? 2
- c) The particles of equal mass go around a circle of radius R under the action of their mutual gravitational attraction. Find the speed of each particle. 2
- 11)
- a) What do you mean by mass defect and Binding energy? 3
- b) Draw B.E. curve. 2
- c) Calculate the binding energy and binding energy per nucleon of ${}_{28}\text{Ni}^{62}$.
- Atomic mass of ${}_{28}\text{Ni}^{62}$ is 61.928349 amu, mass of proton = 1.0072825 amu, 1 amu = 931.5 MeV mass of neutron = 1.008665 amu. 3

Model Questions 2078 – 2

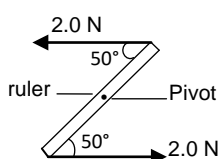
Attempt All Questions.

Group 'A'

Circle the best alternative to the following questions:

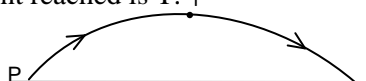
11X1=11

- 1) If p is the momentum of an object of mass m , the expression $\frac{p^2}{m}$ has base unit identical to
- a. Energy b. Force c. Power d. velocity
- 2) A ruler of length 0.30 m is pivoted at its centre. Equal and opposite forces of magnitude 20 N are applied to the ends of the ruler, creating a couple as shown



What is the magnitude of the torque of the couple on the ruler when it is in the position shown

- a. 0.23Nm b. 0.39 Nm c. 0.46 Nm d. 0.60 Nm
- 3) In the absence of air resistance, a stone is thrown from P and follows a parabolic path in which the highest point reached is T.

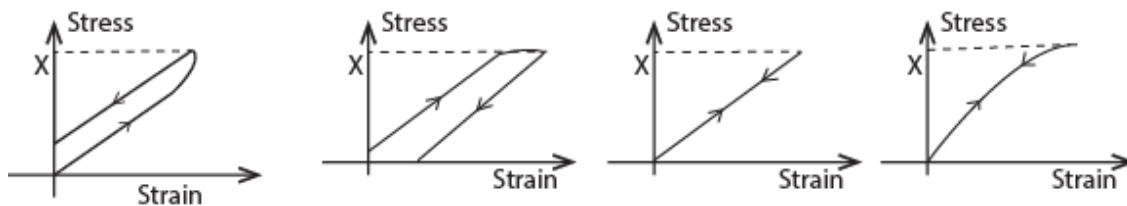


The vertical component of acceleration of the stone is

- a. Zero at T b. Great at T
- c. Greatest at P d. The same at P as at T
- 4) A power station has an efficiency of 40% and generates 1000 MW of electric power. What is the input power and the wasted power?

	Input power/MW	Wasted power/ MW
A	1000	400
B	1000	600
C	1400	400
D	2500	1500

- 5) A metal wire is gradually loaded until it passes the elastic limit to the point where the stress is x . The load is taken off gradually, which graph represents the stress against strain.



- 6) The phenomenon used in optical fibres for transmission of light energy is
 a. Total internal reflection b. Scattering c. Diffraction d. Refraction.
- 7) If the refractive index of the material of equilateral prism is $\sqrt{3}$, then angle of minimum deviation of the prism.
 a. 30° b. 45° c. 60° d. 75°
- 8) The focal length of a convex lens will be maximum for
 a. Blue light b. Yellow light c. green light d. red light
- 9) The two thin lenses of focal length +60 cm and - 20 cm are placed in contact the focal length of combination is
 a. + 5 cm b. - 15 cm c. + 30 cm d. - 30 cm
- 10) A current flows in a wire of circular cross section with the free electrons travelling at drift velocity v . What is the drift velocity for the same current in a wire of the same material but of half the radius?
 a. $\frac{v}{4}$ b. $\frac{v}{2}$ c. $4v$ d. v e. $2v$
- 11) Which is the particle antiparticle pair?
 a. Electron and proton b. Electron and positron
 c. Proton and neutron d. Neutron & electron.

Group 'B'

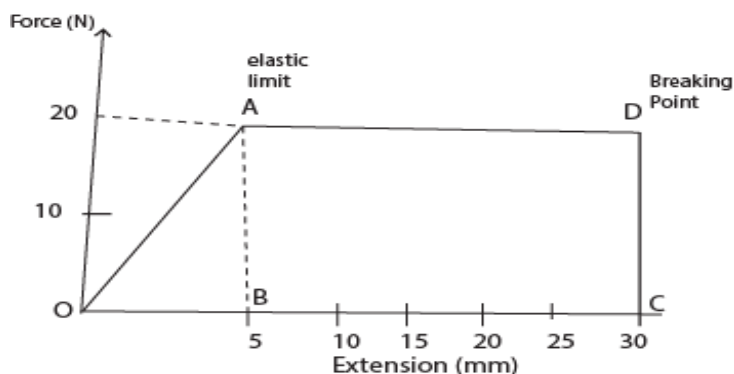
Write short answer to the following questions.

8X5=40

- 1) a. Write down the equation that defines linear momentum. Is the momentum a vector or a scalar quantity? 1
 b. A trolley of mass 2.0 kg is moving with a velocity 0.6 m/s. It collides with a second, stationary trolley of mass 4.0kg. They stick together and move off at 0.2 ms⁻¹.
 i) Show that momentum is conserved in this collision. 2
 ii) Explain whether the collision is elastic or inelastic. 2

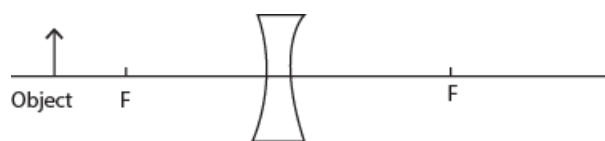
Or,

- a. State Hooke's law and write down the expression for energy stored in a stretched wire. 2



b. Figure shows a simplified version of a force - extension graph for a piece of metal.
Find

- i) The strain energy (energy stored) when the metal is stretched to its elastic limit.
- ii) Work done must be done to break the metal. 3
- 2) a. What is meant by specific heat capacity of a solid? 1
- b. A block of aluminium has a mass of 0.50 kg . It is heated using a 36W heater for 3 minutes and its temperature increases from 12°C. Calculate the specific heat capacity of aluminium. 3
- 3) a. What is meant by ideal gas? 1
- b. The pressure p of an ideal gas of density ρ is given by the expression $P = \frac{1}{3} \rho \langle c^2 \rangle$ 1
- i) Identify the quantity $\langle c^2 \rangle$
- ii) Deduce an expression for the average translational kinetic energy of a gas molecule in terms of thermodynamic temperature T . 3
- 4) a. Two layered window plane of equal thickness keeps a room warmer than a single layered window plane of double thickness. Explain your reasoning. 2
- b. Estimate the rate of heat loss from a room through a glass window of area 2m^2 and thickness 3 mm when the temperature of room is 20°C.
(Thermal conductivity of glass is $1.2 \text{ W m}^{-1} \text{ K}^{-1}$) 2
- c. If surrounding's temperature is very low than 1 layered glass window may crack, why? 1
- 5) a. A small object is placed on the principal axis of, and 150 m. away from a diverging lens of focal length 100 mm.
- i) Copy fig 6.99 and draw rays to show how an image is formed by the lens.

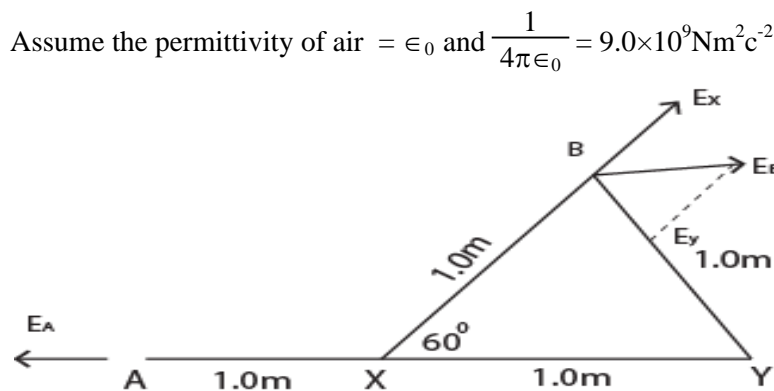


- ii) Calculate the distance of the image from the lens. 2
- b. The diverging lens in practical is replaced by a converging lens, also of focal length 100 mm, the object remains in the same position and an image is formed by the converging lens. Compare two properties of this image with those of the image formed by the diverging lens in part. 3

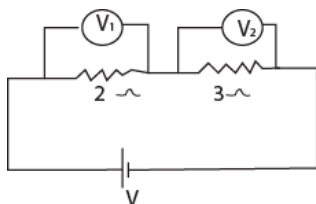
Or

- a. How would you distinguish concave mirror, convex mirror and plane mirror without touching them? 3
- b. When an object is placed 20 cm from a concave mirror a real image magnified three times is formed. Find 2
- i) The focal length of the mirror
- ii) Where the object must be placed to give a virtual image three times the height of the object. 4

- 6) a. Find the potential and
- b. The field strength at points A and B due to two small spheres X and Y, 1.0 m apart in air and carrying charges of $+2.0 \times 10^{-8}\text{C}$ and $-2.0 \times 10^{-8}\text{C}$ respectively.



- 7) a. On what factors capacitance of a capacitor depend on? 1
- b. A parallel plate capacitor consists of the square plates each of side 25 cm, 3.0 mm apart. If a p. d. of 200V is applied. Calculate the charge on the plates with
- i) Air, and
- ii) Paper of relative permittivity 2.5, filling the space between them, 2
- ($\epsilon_0 = 8.9 \times 10^{-12} \text{Fm}^{-1}$)
- 8) A p.d. of V drives current through two resistors of 2Ω and 3Ω joined in series.



- a. If voltmeter V_1 reads 4v what is the current in 2Ω ?

- b. What is the current in 3Ω ?
- c. What does v_2 read p?
- d. What is the value of v ?
- e. Find the value of the single equivalent resistor which, if it replaced the 2Ω and 3Ω resistor in series, would allow the same current to flow when joined to the same p.d. V.

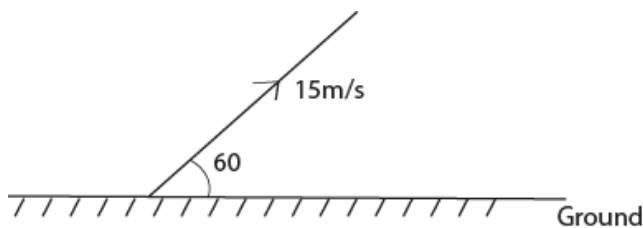
5

Group 'C'

Give long answer to the following questions:

3X8=24

- 9) A ball is thrown from horizontal ground with an initial velocity of 15 ms^{-1} at an angle 60° to the horizontal.



- a. Calculate, for this ball, the initial values of
 - i) Vertical component of velocity 1
 - ii) Horizontal component of velocity 1
- b. Assuming air resistance can be neglected, use your answers in
 - i) To determine the maximum height to which the ball rises
 - ii) Time of flight
 - iii) Horizontal range
- c. Use your answer to (i) to sketch the path of ball, assuming air resistance is negligible. Label this path N. 2
- d. On your sketch in (C) draw the path of the ball, assuming that air resistance cannot be neglected. Label this path A suggest an explanation for any differences between the two paths N and A. 2
- 10) a. A body of mass travels at constant speed in a circular path of radius r . It takes time T to complete one revolution.
 - i) Write down expressions in terms of m r and T for the speed, acceleration, the angular velocity the KE, the momentum of the body. 2
 - ii) Which of these quantities change during a revolution and which remain constant? 1
 - iii) On a sketch show that direction of acceleration and the momentum at a particular instant. 1
- b. What is the acceleration of moon? The moon may be considered to travel about the earth in a circular orbit of radius $3.82 \times 10^8 \text{ m}$ and period $2.36 \times 10^6 \text{ s}$. Why does the moon not fall and hit the earth? 2

By considering the acceleration of free fall at the earth surface, show that the magnitude of the moon's acceleration is consistent with Newton's inverse square law of gravitation. (Radius of earth = $6.36 \times 10^6 \text{m}$)

11)

- a) Which principles are applied in the production of atom bomb and hydrogen bomb? 1
- b) Explain the terms mass defect and binding energy. 2
- c) A city requires 10^7 Watts of electrical power on the average. If this is to be supplied by a nuclear reactor of efficiency 20%. Using ${}^{92}\text{U}_{235}$ as the fuel source.

Calculate

- (i) The energy released by the reactor for one day. 2
- (ii) How much fuel is required per day operation (Energy released by 1 atom of ${}_{92}\text{U}^{235} = 200\text{MeV}$) 2

Model Questions 2078 – 3

Attempt All Questions.

Group 'A'

Circle the best alternative to the following questions:

11X1=11

1. Which of the following length measurements is the most precise?
a. $l = 6 \text{ cm}$ b) $l = 6.00 \text{ cm}$ c) $l = 6.000 \text{ cm}$ d) $l = 6.0 \text{ cm}$
1) A boat is sent across a river with a velocity of 8 kmh^{-1} . If the resultant velocity of the boat is 10 kmh^{-1} , the velocity of river flow is
b. 8 km hr^{-1} b) 10 km/hr c) 6 km hr^{-1} d) 2 km hr^{-1}
2. An athlete makes a long jump and follows a projectile motion. Air resistance is negligible.
Which one of the following statements is true about the athlete?
a) The athlete has a constant horizontal and vertical velocities.
b) The athlete has a constant horizontal velocity and constant downward acceleration.
c) The athlete has a constant upward acceleration followed by a constant downward acceleration.
d) The athlete has a constant upward velocity followed by a constant downward velocity.
3. If the speed of revolution of a particle on the circumference of a circle and the speed gained in falling through a distance equal to half the radius are equal, then the centripetal acceleration will be
a) 9 b) $9/2$ c) $9/3$ d) $9/\sqrt{2}$
4. If the potential energy of a spring is V on stretching it by 2 cm, its potential energy when it is stretched by 10 cm will be
a) $5V$ b) $V/25$ c) $24V$ d) $V/5$
5. A diminished virtual image can be formed only in
a) Plane mirror b) convex mirror
c) concave mirror d) concave – parabolic mirror
6. The _____ of light can change when light is refracted because the velocity changes
a) frequency b) medium c) wavelength d) transparency
7. Which colour of light deviates maximum in the dispersion of white light by prism?
a) Violet b) Blue c) Red d) Green
8. In what unit is the power of lens measured?
a) Watt b) Meter c) Diopetre d) Hertz

9. A wire has resistance 12Ω . It is bent in the form of a circle. The effective resistance between two points on any diameter is equal to

- a) 12Ω b) 6Ω c) 3Ω d) 24Ω

10. What are the elementary particles with half spin called?

- a) quarks b) bosons c) fermions d) hadons

Group 'B'

Write short answer to the following questions.

8X5=40

1.

- a) What is the principle of conservation of energy? 2
 b) A bullet of a mass of 10 g is fired from a gun with a mass of 1 kg with a velocity of 100 m/s. Calculate the velocity of recoil of the gun. 2
 c) Whose K.E. will be more? 1

OR

- a) Define elastic limit and Young's modulus of elasticity. 2
 b) The rubber cord of a catapult is pulled back until its original length has been doubled. Assuming that the cross-section of the cord is 2 mm square, and that young modulus for rubber is 107 Nm^{-2} . Calculate the tension in the cord. If the two arms of the catapult are 6 cm apart and the unstretched length of the cord is 8 cm, what is the stretching force? 3

2.

- a) What is meant by specific latent heat of fusion of ice? 1
 b) Two liquids A and B are at 32°C and 24°C when mixed in equal masses the temperature of the mixture is found to be 28°C . Calculate the ratio of their specific heat. 3
 c) Does the specific heat capacity of substance change with its state? 1

3.

- a) Describe any three different thermodynamic processes. 3
 b) Why specific heat capacity of gas at constant pressure is greater than its specific heat capacity at constant volume? 2

4.

- a) Define temperature gradient in an object. 1
 b) An electric kitchen range has a total wall area of 1.40 m^2 is insulated with a layer of fiber glass that has a temperature of 175°C and its outside surface is 35°C . The fiber glass has a thermal conductivity of $0.040 \text{ Wm}^{-1}\text{K}^{-1}$. Calculate the rate of flow of heat through the insulation, assuming the fiber as a flat slab of area of 1040 m^2 . 3

- c) How might the rate of conduction be affected if the fiber absorbs moisture? Justify your answer. 1
- 5.
- a) Define 'concave mirror' and state on daily application of it. 2
- b) Calculate the focal length of a concave mirror when an object placed at a distance of 40 cm makes image equal to the size of the object. 3
- 6.
- a) Sketch an electric field pattern around two identical point charges shown below:

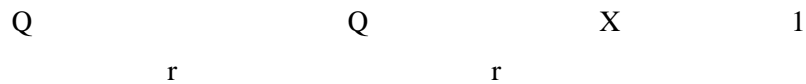


Fig 6.1

- b) Obtain an equation in terms of Q and r , for the field strength at point X due to two charges shown in figure 6.1. 1
- c) Six capacitors each of $100\mu\text{F}$ are connected in an electric circuit as shown below:

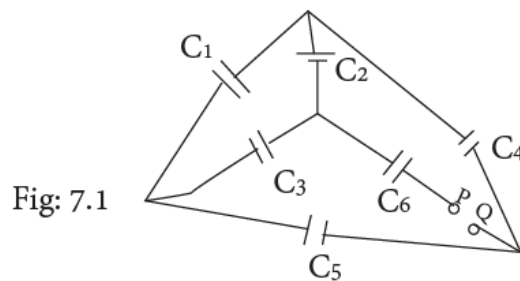


Fig: 7.1

Identify the type of combination shown in fig. 7.1 and calculate the effective capacitance of the combination. 1+2

- 7.
- a) What is it meant by power of heater is 2 KW? 1
- b) Calculate the resistance of the above mentioned heater when it is connected to 220V source. 2
- c) Suggest what changes must be done to the heater so that it gives more heat. Justify your answer. 2

Section 'C'

Give long answer to the following questions:

3X8=24

- 8.
- a) State the laws of limiting friction. 3

- b) A box of mass 15 kg placed on horizontal floor is pulled by a horizontal force. What will be the work done by the force if coefficient of sliding friction between the box and the surface of the floor is 0.3 and body moves at unit distance. 3
- c) Why limiting friction is always greater than kinetic friction? 2
9. A body is operating a remote-controlled toy car on a horizontal circular track as shown in figure.

The track has a radius of 1.8 m and the car travels around the track with a constant speed.

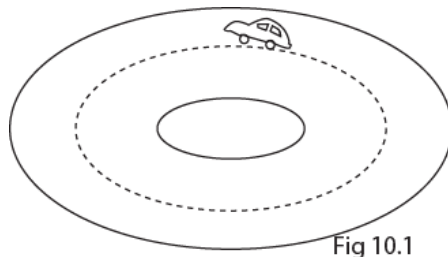


Fig 10.1

- a) Explain why the car is accelerating, even though it is travelling at a constant speed. 2
- b) The car has a mass of 0.50 kg. the boy now increase the speed of the car to 6.0 m/s. the total radial friction between the car and the track has a maximum value of 7.0 N.

Show by calculation that the car cannot continue to travel in a circular path. 3

- c) The raised section of the track can be considered as the arc of circle, which has radius r of 0.85 m. the car will lose contact with the raised section of track if its speed is greater than V_{\max} . Show that V_{\max} is given by the relationship.

$$V_{\max} = \sqrt{rg}$$

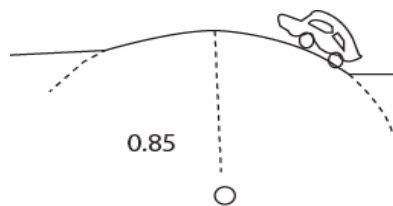


Fig 10.2

10.

- a) Discuss Rutherford's experiment on alpha particle scattering. What are the results of this experiment? 3
- b) Considering that the α -particles carry average kinetic energy of 2×10^{-10} J. Calculate the maximum size of the gold nucleus.

[Atomic number of gold is 79 and $e = 1.6 \times 10^{-19}$ C]

3

- c) Explain why the radius of the gold nucleus must be much smaller than the value calculated in 11 (b) above. 2

Model Questions 2078 – 4

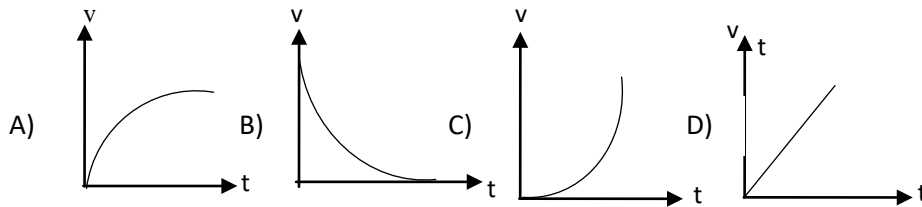
Attempt All Questions.

Group 'A'

Circle the best alternative to the following questions:

11X1=11

- 1) If $x = at + bt^2$, where x is the distance travelled by the body in kilometer while t the time in seconds, then units of b is:
a) kms^{-1} b) kms c) kms^{-2} d) kms^2
- 2) An athlete runs some distance before taking a long jump because:
a) He gains energy to take him through long distance.
b) It helps to apply large force.
c) By running action and reaction force increases.
d) By running he gives himself a larger inertia of motion.
- 3) A ball is dropped from rest and feels air resistance as it falls. Which of the graphs in figure best represents its vertical velocity component as a function of time?

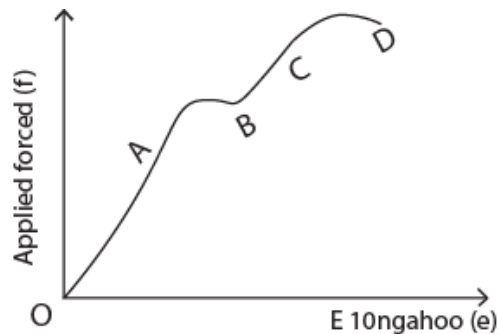


- 4) A car is travelling along a country road that resembles a roller coaster track. If car travels with uniform speed, the force exerted by road on the car is maximum at:

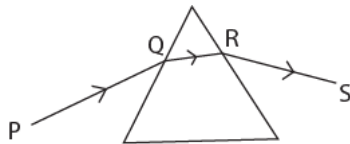


- a) A b) B c) C d) equal at all position A, B & C

- 5) The graph of applied force F versus elongation of wire is shown in figure which portion of this graph is related to Young's modulus of the material of the wire.



- a) OA b) OB c) AC d) CD
- 6) A ray of light falls on a plane mirror at angle of incidence i . The deviation suffered by the ray due to reflection is:
- a) $2i$ b) $180^\circ - 2i$ c) $180^\circ + 2i$ d) $360^\circ - 2i$
- 7) An equilateral prism is kept as shown in figure. A ray PQ incident on one of the faces. For minimum deviation of the incident ray.



- a) PQ must be horizontal
b) QR must be horizontal
c) RS must be horizontal
d) Any one of them may be horizontal
- 8) A prism causes:
- a) Dispersion only
b) Deviation only
c) Deviation and dispersion etc.
d) Neither dispersion nor deviation
- 9) The minimum distance between an object and its real image formed by thin convex lens of focal length is:
- a) $4f$ b) $2f$ c) f d) $f/2$
- 10) The minimum value of charge on any charged body may be:
- a) 1.6×10^{-19} Coulomb b) 1 Coulomb c) $1\mu\text{C}$ d) 4.8×10^{-12} Coulomb

11) The radius R of a nucleus changes with the nucleon number of A of nucleus as:

- a) $R \propto A^{2/3}$ b) $R \propto A^{1/3}$ c) $R \propto A^0$ d) $R \propto A$

Group 'B'

Write short answer to the following questions.

8X5=40

- 1) You want to move a 500 N crate across a level floor. To start the crate moving, you have to pull with a 230 N horizontal force. Once the crate starts to move, you can keep it moving at constant velocity with only 200 N.
 - a) Which Newton's law of motion is applicable in the crate's motion? 1
 - b) Draw free body diagram for crate (i) just before it starts to move (ii) moving at constant speed. 2
 - c) Find the coefficients of static and kinetic friction. 2

Or,

- a) Define Bulk modulus of elasticity.
 - b) Gold winner sunflower oil is packed in a pouch of volume 720 cm^3 . The oil is compressed by increasing the pressure to $5 \times 10^6 \text{ pa.}$ and the volume decreased by 5 cm^3 (i) Calculate the bulk modulus of the liquid and (ii) the compressibility.
- 2)
 - a) Define coefficient of linear expansion. 1
 - b) The length of an iron rod is 50 cm. at 0°C and 50.06 cm, at 100°C . Calculate its length at 50°C . 3
 - c) What do you mean by linear expansivity of iron is $12 \times 10^{-6} / \text{K}$. 1
 - 3)
 - a) Define specific heat capacity. 1
 - b) Specific heat capacity of water is 4200 J/kg K . What do you mean by this? 1
 - c) How can you determine specific heat capacity of a solid by the method of mixture? 3
 - 4)
 - a) What do you mean by ideal gas? 1
 - b) If the number of molecules of a gas in a container is doubled, how does the pressure and total kinetic energy be affected? 2
 - c) The density of nitrogen of NTP is 1.29 kg m^{-3} . Find the r.m.s. speed of nitrogen at NTP. 2
 - 5) Two thin lenses with a focal length of magnitude 15.0 cm. the first diverging and the second converging are located 11.3 cm. apart. An object 1.60 mm tall is placed 25.0 cm. to the left of the first (diverging) lens.
 - a) How far from this first lens is the final image formed? 2
 - b) Is the final image real or virtual? 1
 - c) What is the height of final image? 2

Or,

- A dentist uses a curved mirror to view teeth on the upper side of mouth. Suppose she wants an erect image with a magnification 2.00 when the mirror is 1.25 cm from the tooth.
- What kind of mirror (concave or convex) is needed? Use ray diagram to decide, without performing any calculations. 2
 - What must be the focal length and radius of curvature of the mirror? 2
 - Draw a ray diagram to check your answer in (b). 1
- 6)
- State and prove Gauss's law. 2.5
 - Use Gauss's law to derive electric field intensity near to an infinite plane charge conductor. 2.5
- 7)
- Define potential gradient. 1
 - Derive a relation between electric field intensity and potential gradient. 3
 - Show that 1 volt/metre = 1 Newton / Coulomb. 1
- 8) Two identical light bulb, each with resistance $R = 2\Omega$ are connected to a source with $E = 8\text{ V}$ and negligible internal resistance. Find the current through each bulb. The potential difference across each bulb and the power delivered to each bulb and to the entire network if the bulbs are connected
- In series 2.5
 - In parallel 2.5

Section 'C'

Give long answer to the following questions:

3X8=24

- 9) The position of a particle moving on X – axis is given by $x = At^3 + Bt^2 + Ct + D$
The numerical values of A, B, C, D are 1, 4, -2 and 5 respectively and SI units are used.
Find
- The dimension of A, B, C and D. 2
 - The velocity of the particle at $t = 4\text{ sec}$. 1
 - The acceleration of the particle at $t = 4\text{ sec}$. 1
 - The average velocity during the interval $t = 0$ to $t = 4\text{ sec}$. 2
 - The average acceleration during the interval $t = 0$ to $t = 4\text{ second}$. 2
- 10) A particle of mass m is suspended from a ceiling through a string of length L . The particle moves in a horizontal circle of radius r . find
- The speed of the particle. 1
 - The tension in the string. 2
 - Time-period of the system. 2
 - If the tension in the string is constant and L increases by 1%, find the percentage change in time-period "T". 3

Or,

You wish to put a 1000 kg satellite into a circular orbit 300 km above the earth's surface.

- a) What speed, period and radial acceleration will it have? 3
- b) How much work must be done to the satellite to put it in orbit? 2
- c) How much additional work would have to be done to make the satellite escape the earth. 3

The earth radius and mass are $R_E = 6.37 \times 10^6$ m and $m_E = 5.97 \times 10^{24}$ kg.

11)

- a) Discuss mass defect and binding energy per nucleon? 2
- b) Draw a graph showing the variation of binding energy per nucleon and mass number of the element. Also interpret the graph. 2
- c) Calculate the binding energy and binding energy per nucleon of ${}_{83}\text{Bi}^{209}$.

Given that mass of ${}_{83}\text{Bi}^{209} = 208.980388u$, mass of neutron = 1.008665u and mass of proton = 1.007825 u. 4

Model Questions 2078 – 5

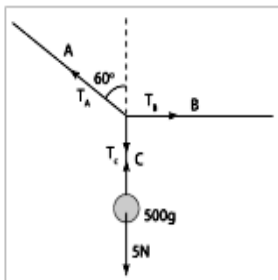
Attempt All Questions.

Group 'A'

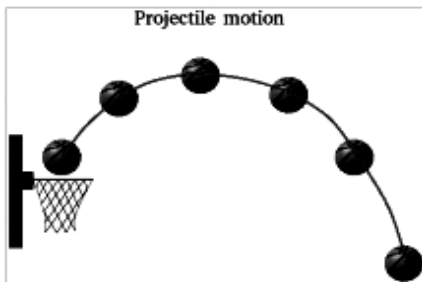
Circle the best alternative to the following questions:

11X1=11

1. A digital weighing machine is used to measure the mass of a stone in a certain experiment. It is found to be 79g to the nearest milligram. How should this result be recorded in a table of results?
(a) 0.7900m (b) 0.790m (c) 0.79m (d) 0.8m
2. Forces are applied to a rigid body. The forces all act in the same plane. Calculate the value of tension T_A and T_B .



- (a) 10N and 10N (b) 10N and 20N (c) 10N and 0N (d) None of these
3. A basketball player throws a basketball towards the net from a distance and the path of the ball is shown. Which one of the following statements is true about the basketball's trajectory?

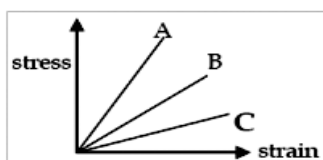


- (a) It has a constant upward acceleration followed by a constant downward acceleration.
(b) It has a constant horizontal velocity and constant downward acceleration.
(c) It has a constant horizontal and vertical velocities,
(d) It has a constant upward velocity followed by a constant downward velocity.

4. A train is climbing an inclination of 1 in 100. If the mass of the train is 10000kg and friction is neglected, what power is needed to climb the inclination at uniform velocity of 20m/s?



- (a) 20 MW (b) 200MW (c) 2.2 GW (d) 7.5 GW
5. Graphs of stress-strain for different materials are shown below. Which graph represents the stiffest material? (a) A (b) B (c) C (d) All three



6. A motorbike moving at a speed of 30m/s overtakes a car moving at 25m/s. Looking at the car from the rear plane mirror placed in the bike, what is the receding velocity of the image of the car?
- (a) zero (b) 5 m/s (c) 10 m/s (d) 12m/s
7. The critical angle between an equilateral prism and air is 45° . What happens to the incident ray perpendicular to the refracting surface, prism being surrounded by water?
- (a) It is reflected totally from the second surface and emerges from the third surface.
 (b) It gets reflected from second and third surfaces and emerges from the first surface.
 (c) It keeps reflecting from all the three sides of the prism and never emerges out.
 (d) After deviation, it gets refracted from the second surface.
8. The colour of the sky is blue during day time and red during morning and evenings. Which physical phenomenon is involved in this?
- (a) dispersion only (b) only total reflection.
 (c) dispersion and total internal reflection (d) scattering
9. What is the dimensional formula of resistivity?
- (a) $[M^1L^3T^{-3}A^{-2}]$ (b) $[M^1L^3T^{-2}A^2]$
 (c) $[M^1L^2T^{-3}A^{-2}]$ (d) $[M^{-1}L^{-3}T^3A^3]$
10. In what units is the power of lens measured?
- (a) watt (b) metre (c) dioptre (d) Hertz
11. What are the elementary particles with half spin called?
- (a) quarks (b) bosons (c) fermions (d) hadrons

Group 'B'

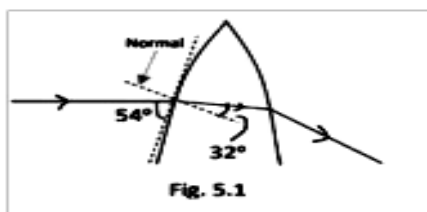
Write short answer to the following questions.

8X5=40

1. (a) Why a heavy rifle kicks more than a short gun? 2
- (b) A bullet of mass 10 g is shot from a revolver of mass 1 kg. If the revolver jerks back with a velocity of 0.2 m/s, calculate the velocity of the bullet. 2
- (c) A loud sound is also produced when the bullet is shot. How is the energy transfer happening in this whole scenario? 1

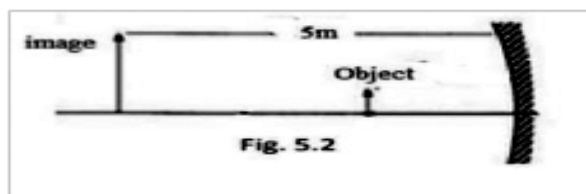
OR

- (a) State Hooke's law. 2
- (b) An arrow of mass 30g is pulled across a bow which extends its length by 6cm. Young's modulus of the given material is $5 \times 10^8 \text{ N/m}^2$. The area of cross section of material of bow is $2 \times 10^{-5} \text{ m}^2$. Calculate the initial velocity of the arrow. 3
2. (a) What is meant by specific latent heat of fusion of ice = 0.336 MJ/kg? 1
- (b) A calorimeter of 50g contains 100g water and 50g of ice. Calculate the heat required to melt all the ice in the calorimeter and to make the temperature of system reach 89°C . (Specific latent heat of fusion of ice = 0.336 MJ/kg, specific heat capacity of material of calorimeter = $0.094 \text{ cal g}^{-1} ^\circ\text{C}^{-1}$) 3
- (c) Explain why ice feels colder than water at 0°C . 1
3. (a) State Charles's and Boyle's law and formulate the ideal gas equation. 3
- (b) Why gas cylinder tend to cool down substantially during parties while producing huge fires during cooking? 2
4. (a) Define temperature gradient in an object. 1
- (b) A woollen glove has a total area of 40 cm^2 . The temperature of skin is 37°C and that of air is 20°C . If the rate of transfer of heat is 2W, and thickness of glove is 5mm. Calculate the thermal conductivity of the material of the glove. 3
- (c) How might the rate of conduction be affected if the glove absorbs moisture? Justify your answer. 1
5. Figure 5.1 shows a ray of light is entering and emerging through a part of a convex lens. (a) Define convex lens', and state one daily application of it. 2
- (b) Explain why this lens is also called converging lens? 1
- (c) Calculate the refractive index of the material of the lens shown in the figure. 2



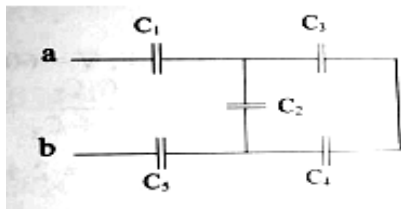
OR

- (a) Define concave mirror' and state one daily application of it. 2
- (b) A certain projector uses a concave mirror for projecting an object's image on a screen. It produces an image that is 5 times bigger than the object and the screen is 5m away from the mirror as shown in Fig. 5.2.



- (c) Give reason why is the image larger than the object? 1
- (d) Calculate the focal length of the mirror. 2

6. (a) Sketch an electric field pattern around two charges equal in magnitude and opposite in sign. 2
 (b) If two charges of magnitude $1\mu\text{F}$ and $-2\mu\text{F}$ are kept at two vertices of an equilateral triangle of length 2m , calculate the value of electric field at the third vertex due to these charges. 3
7. (a) Define capacitance of a parallel plate capacitor and state one application of it in electric circuit. 2
 (b) The potential between a and b is 220V . Given $C_1 = C_5 = 8.4\mu\text{F}$ and $C_2 = C_3 = C_4 = 4.2\mu\text{F}$. Calculate the equivalent capacitance 3

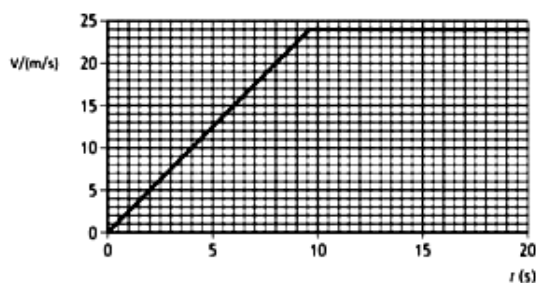


8. (a) What do you mean by resistivity? 1
 (b) Calculate the conductivity of the wire having length 5m , radius 2mm and resistance $1.2\text{m}\Omega$. [2]
 (c) Suggest what changes must be done to the wire to increase its conductance. [2]

Group 'C'

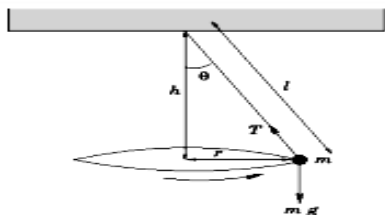
Give long answer to the following questions. (3 x 8 = 24)

9. A box at rest is accelerated by a rope attached with a motor as shown in the figure. The velocity-time graph given below shows the pattern of its motion for 20 s .
 (a) If the box is pulled with constant unbalanced force 10N . Show that the initial acceleration of the box is 2.5 m/s^2 , and calculate its mass. 2+1
 (b) After 2.0 second the box is being pulled by a constant force 12 N . Determine the size of frictional forces acting on the box at this time. 2
 (c) Determine the distance of the box travels along the ground at 8.0 s . 3



10. The given figure is of a conical pendulum.
 The circle has a radius of 0.8 m and length of the thread of pendulum is 1m . The object travels around the path with a constant speed.
 (i) Explain why the object is accelerating, even though it is travelling at a constant speed. 2
 (ii) The object has a mass of 2 kg . Calculate the tension in the thread. Also calculate the time period of revolution. 3

(iii) Calculate the angular velocity, translational velocity and the centripetal force. What happens to the centripetal force if length is increased 4 times keeping other factors constant?



OR

Juno is a NASA orbiter with a mission to survey Jupiter. It is in an elliptical orbit around Jupiter as shown in the figure below.

The gravitational potential at point A in the orbit of Juno is $-1.70 \times 10^9 \text{ J kg}^{-1}$

(a) State what is meant by a gravitational potential at point A is $-1.70 \times 10^9 \text{ J kg}^{-1}$ 2

(b) At point B, Juno is $1.69 \times 10^8 \text{ m}$ from the centre of Jupiter. If the mass of Jupiter is $1.90 \times 10^{27} \text{ kg}$, calculate the gravitational potential at point B. 3



(c) The mass of Juno is $1.6 \times 10^3 \text{ kg}$. Determine the change in gravitational potential energy if Juno moves from Point A to Point B. [3]

11. (a) Give any 6 properties of nucleus. [3]

(b) Give the significance of binding energy for a nucleus [1]

(c) Calculate the binding energy per nucleon of ${}_{26}\text{Fe}^{56}$ using the given information

[mass of proton = 1.007825 amu , mass of neutron = 1.008665 , mass of iron = 55.934939 amu] [4]

Model Questions 2078 - 6

Attempt all questions:

Group A

Circle the best alternative to the following questions:

11X1=11

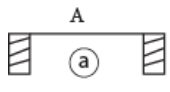
- 1) The mass of a box is 2.3 kg. Two marbles of masses 2.15 g and 12.39 g are added to it. The total mass of the box to the correct number of significant figures is:

a) 2.340 kg
b) 2.3145 kg
c) 2.3 kg
d) 2.31 kg
- 2) A mass M is split into two parts m and $M - m$ which are then separated by a certain distance. What ratio of m/M maximizes the gravitational force between the two parts?

a) $\frac{1}{3}$
b) $\frac{1}{2}$
c) $\frac{1}{4}$
d) $\frac{1}{5}$
- 3) A stone is thrown from the ground so that its range R . the range R is same when its maximum heights are h_1 and h_2 . The relation between R and h_1 and h_2 is

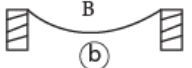
a) $R = \sqrt{h_1 - h_2}$
b) $R = \sqrt{h_1 \cdot h_2}$
c) $R = 2\sqrt{h_1 \cdot h_2}$
d) $R = 4\sqrt{h_1 \cdot h_2}$
- 4) A body is allowed to slide down a frictionless track freely under gravity. The track and s in a semicircular shaped part of diameter D . what should be the maximum height from which the body must fall so that it completes the circle?

a) $GD / 5$
b) $5D / 4$
c) D
d) $2D$
- 5) Five wires A, B, C, D and E are connected between two rigid supports and the same deforming force is applied to them. If these wires have equal initial length and equal area of cross-section, which one appears to be more elastic?



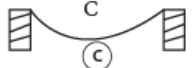
A

(a)



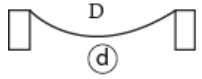
B

(b)



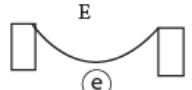
C

(c)



D

(d)



E

(e)
- 6) In grazing incidence and emergence, the critical angle of an equilateral prism is

a) 60°
b) 30°
c) 90°
d) 120°
- 7) The critical angle for refraction from glass to water is 61° . If the refractive index of glass is $\frac{4}{3}$, the refractive index of water is

a) 1.5244
b) 1.53
c) 1.62
d) 1.57

- 8) What does the last ray OME show?

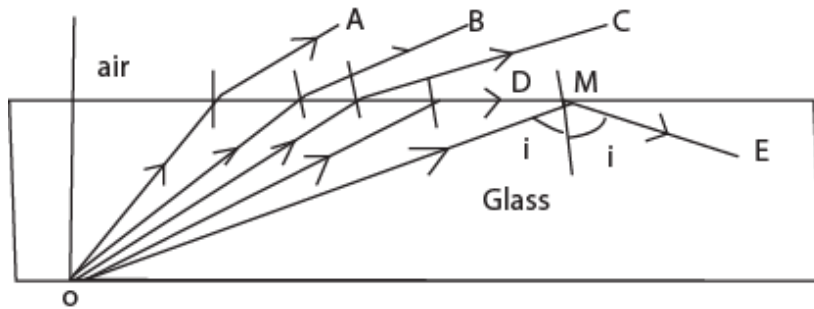


Fig..

- e) Reflection f) Refraction g) Dispersion h) Total internal
- 9) A beam of light converges to a point. 9 cm behind a diverging lens of focal length 15 cm. the image position is:
- a) 22.5 cm b) 18 cm c) 20 dm d) 15 cm
- 10) A cylindrical wire is stretched to increase its length 20%. Calculate the percentage increase in its resistance.
- a) 42% b) 20% c) 80% d) 50%
- 11) What particle do u u d combinations produce?
- a) electron b) proton c) antiproton d) neutron

Group B

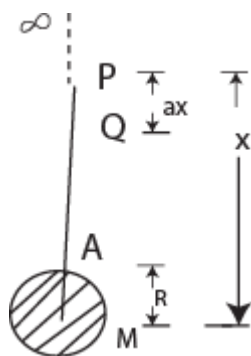
Write short answer to the following questions.

8X5=40

- 1)
- a) State the principle of conservation of linear momentum. 2
- b) A ball of mass 0.05 g strikes a smooth wall normally four times in 2 seconds with a velocity of 2 ms^{-1} . Each time the ball rebounds with the same speed of 10 ms^{-1} . Calculate the average force on the wall. 2
- c) Is momentum conserved in striking the wall? What is the change in momentum? 1

OR

- a) State and explain Hooke's law in elasticity.
- b) In the figure, O is the centre of earth and M is the mass of earth. If an object of mass m is at infinity. What amount of work is to be done to bring the object at point A on the earth's surface whose radius is R . What does the result indicate?3



- 2)
- What does 540 Cal/ gm for water at 100°C to change into steam at 100°C? 1
 - 50 g of ice at -6°C is dropped into water at 0°C. How many grams of water freezes? (Specific heat capacity for ice = 2000J/kgK and L = 80 Cal/gm) 3
 - Why do people feel cold after taking a bath? 1
- 3)
- The pressure exerted by a gas of density δ with root mean square speed is $P = \frac{1}{3} \rho c^2$. How could this relation established? 3
 - The kinetic energy of a gas at absolute zero is zero? Do you agree? Explain.
- 4)
- What is the significance of universal gas constant? 1
 - Two glass bulbs of equal volume are joined by a narrow tube and are filled with a gas at S.T.P. When one bulb is kept at melting ice and other is placed in a hot bath, the new pressure is 877.6 mm of Hg. Estimate the temperature of the hot bath. 3
 - State the principle used to calculate the above temperature. 1
- 5)
- A convex lens L_1 and another convex lens L_2 are joined in such a way that they have no separation between them. If their focal lengths are f_1 and f_2 , draw the ray diagram to show their image formation of an object O. 2
 - What is their equivalent power? 1
 - Derive the expression for total or equivalent focal length of these two thin lenses in contact. 2
- OR**
- Is it possible to get real image from a convex mirror? How? Illustrate in figure.2
 - A mirror forms an erect image 30 cm from the object and twice its height. Where must the mirror be situated? What is its radius of curvature?
 - If the object is real, determine whether the mirror is convex or concave. 1
- 6)
- Sketch to show how do like charges and unlike charges repel and attract each other. 2

- b) Two points A and B are at the distance 'a' and 'b' from a stationary charge Q. what amount of work is to be done by an agent to bring a unit charge from B to A? Explain with figure. 3
- c) Obtain an equation, in terms of Q and r, for the field strength at point X due to two charges as shown in fig 6.1. 3
- 7)
- a) State and explain Gauss's law. 2
- b) How is Gauss's law used to calculate the electric intensity on, outside and inside the surface of a charged sphere? 3
- 8) A battery of e.m.f. 24 v and internal resistance r is connected to a circuit having two parallel resistors of 3Ω and 6Ω in series with 8Ω resistor. The current through 3Ω is 0.8 A. Calculate
- a) r 2.5
- b) the terminal p.d of the battery. 2.5.

Group C

Give long answer to the following questions:

3X8=24

- 9) A train of mass 1×10^5 kg moves at a constant speed of 72 km/hr up a straight inclined road against a frictional force of 1.28×10^4 N. The incline is such that the train rises vertically 1 m for every 100 m traveled along the incline.
- a) Illustrate the necessary diagram. 2
- b) What is the expression for force required by the train to pull up the object? 1
- c) Calculate the rate of increase per second of the potential energy. 2
- d) Find the necessary power developed by the train. 3
- 10)
- a) The maximum vertical distance through which a fully dressed astronaut can jump on earth is 0.5 m. estimate the maximum vertical distance through which he can jump on moon which has a mean density two-third that of earth and radius one-fourth that of earth. 3
- b) Determine the ratio of time duration of his jump on moon to that his jump on the earth assuming that the initial velocity on both places are equal. 2
- c) An earth satellite moves in a circular orbit with a speed of 6.2 km s^{-1} . Find the time of one revolution and its centripetal acceleration. 1+2=3

OR

A stone of mass 500 gm is attached to a string of length 50 cm which will break if the tension in it exceeds 20 N. The stone is whirled in a vertical circle, the axis of rotation being at a height of 100 cm above the ground. The angular speed is very slowly increased until the string breaks.

- a) Why do the string breaks? 1
- b) In what position is this break mostly like to occur? 3
- c) At what angular velocity does it occur? 3
- d) Where will the stone hit the ground? 1

11)

- a) What do you mean by nuclear fission and fusion reactions? Explain them. 2
- b) Illustrate the nuclear fission and fusion reaction of ${}_{92}\text{U}^{235}$ and formation of ${}_2\text{He}^4$ by the fusion of two protons. 2
- c) Find the binding energy per nucleon of ${}_2\text{He}^4$ and ${}_2\text{He}^3$
- If,
- mass of ${}_1\text{H}^1 = 1.00783$ amu
- mass of ${}_0\text{H}^1 = 1.00867$ amu
- mass of ${}_2\text{He}^3 = 3.01667$ amu
- mass of ${}_2\text{He}^4 = 4.00387$ amu
- and $1 \text{ amu} = 931 \text{ MeV}$ 2+2

Model Questions 2078 - 7

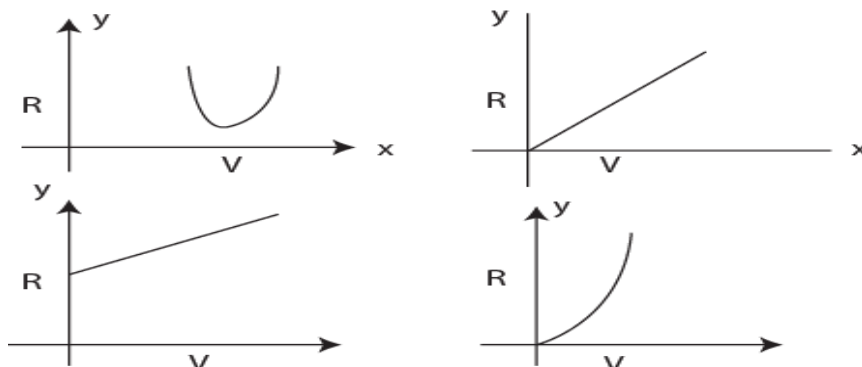
Attempt all questions:

Group A

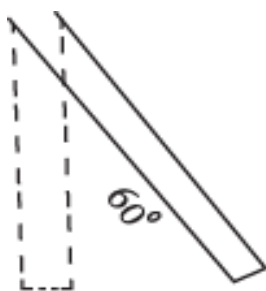
Circle the best alternative to the following questions:

11X1=11

- 1) The value of a physical quantity is written as 0.0250. How many significant figures are in this number?
 a) 2 b) 3 c) 4 d) 5
- 2) Total kinetic energy of a sphere with velocity v is:
 a) $\frac{7}{10}mv^2$ b) $\frac{5}{6}mv^2$ c) $\frac{7}{5}mv^2$ d) $\frac{10}{7}mv^2$
- 3) The graph of range of projectile (on y -axis) as plotted against velocity of projection (x -axis) will be

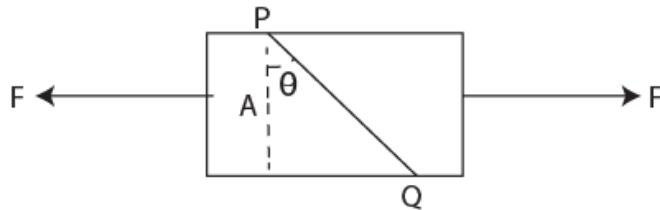


- 4) A stick 2 m long of mass 1.0 kg is pivoted at one end and its displaced through an angle of 60° . The increase in potential energy is ($g = 10 \text{ m/s}^2$)



- | | |
|--|--|
| e) 5 J | f) $5\sqrt{3}$ Joule |
| g) $10\left(1 - \frac{\sqrt{3}}{2}\right) J$ | h) $20\left(1 - \frac{\sqrt{3}}{2}\right) J$ |

- 5) In a figure below a box is subjected to equal and opposite force. PQ is a plane making an angle θ° with the cross section of the box. If the cross sectional area is A. then the tensile stress on PQ is:



- a) $\frac{F}{A}$ b) $\frac{F \cos \theta}{A}$ c) $\frac{F \cos^2 \theta}{A}$ d) $\frac{F}{A \cos \theta}$

- 6) A person approaches a plane mirror with velocity v then the relative velocity of approach of person and his image is:

- i) zero j) v k) $2v$ l) $\frac{v}{2}$

- 7) An equilateral prism having angle 60° has refractive index $\sqrt{2}$. What is the angle of incidence for minimum angle of deviation?

- a) 75° b) 0° c) 45° d) 60°

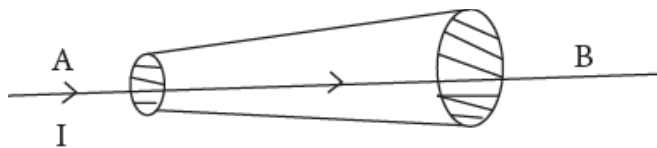
- 8) In the Sun's spectrum, there are several visible and invisible spectrum. If blue and green light are passed through a transparent prism, then deviation of green light will be:

- a) Equal so that they will form achromatic condition.
b) Greater than that of blue light.
c) Smaller than that of blue light.
d) Can't be predicted.

- 9) A convex lens of focal length 0.56 m and concave lens of focal length 1 m are combined. The power of the resulting lens will be:

- a) 1 D b) -1 D c) 0.5 D d) -0.5 D

- 10) A wire has a non-uniform cross-section. It carries a current "i". Then the drift velocity of electron:



- a) Remains constant from A to B.
 - b) Decreases on moving from A to B.
 - c) Increases on moving from A to B.
 - d) First decreases and then becomes constant.
- 11) Quark composition of proton is:
- a) uud
 - b) udd
 - c) uds
 - d) $u \bar{d} \bar{d}$

Group B

Write short answer to the following questions.

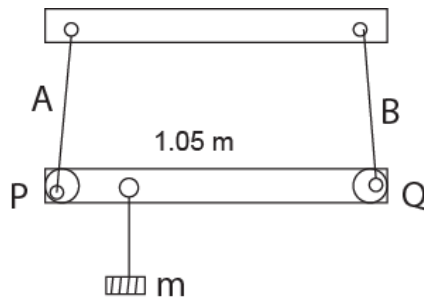
8X5=40

1)

- a) State and explain Newton's third law of motion. 2
- b) A gun weighing 10 kg fires a bullet of 50 g with a velocity of 500 ms^{-1} with what velocity does the gun recoil? 2
- c) What is the resultant momentum of the gun and the bullet after firing? 1

OR

- a) Define Hooke's law and elastic limit. 2



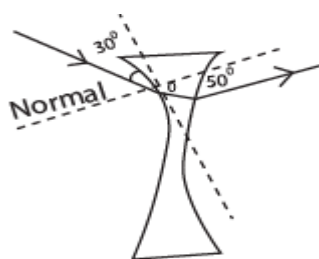
A rod PQ is length 1.05 m having negligible mass is supported at its ends by two wires, one steel (wire A), and the other of aluminum (wire B) of equal lengths as shown in fig 1.1. The cross-sectional area of wires A and B are 1.0 mm^2 and 2.0 mm^2 respectively. At what point along the rod should a mass m be suspended in order to produce equal stresses?

($Y_{\text{steel}} = 200 \text{ GPa}$, $Y_{\text{aluminum}} = 70 \text{ GPa}$)

2)

- a) What do you mean by water equivalent of a substance? 1
- b) In an experiment on the specific heat of a metal, a 0.20 kg block of metal at 150°C is dropped in a copper calorimeter of water equivalent 0.025 kg containing 150 cm^3 of water at 27°C . The final temperature is 40°C . Calculate the specific heat of the metal. 3
- c) Why is water is a very useful cooling agent as well as heating agent? 1

- 3)
- State any three properties of an ideal gas as assumed by the kinetic theory of gas. 3
 - A student needed to use the ideal gas for a certain experiment. But the ideal gas does not exist. Suggest what two different things this student could do to solve his problem. 2
 - Discuss the physical significance of gas constant R .
- 4)
- State Inverse Square law in heat radiation. 1
 - A spherical black body of radius 12cm radiates 450W power at 500 K. if the radius were halved and the temperature doubled. What would be the power radiated? 3
 - How might the power be affected if the material of a spherical blackbody be changed? Justify your answer. 1
- 5) Figure 5.1 shows a ray of light is entering and emerging through a concave lens:
- Define concave lens and state one daily application of it. 2
 - Explain why this lens is also called diverging lens. 1
 - Calculate the refractive index of the material of the lens shown in the figure.



OR

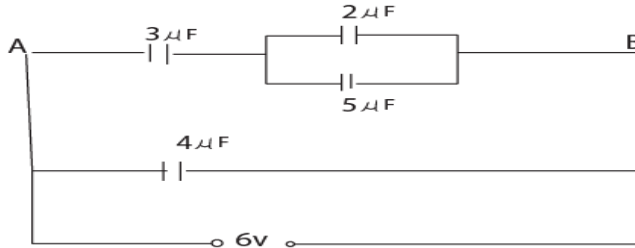
- Define convex mirror and state one daily application of it. 2
 - An object is placed in front of a convex mirror of focal length 30 cm, if the image formed is a quarter of the size of object, find the position of the image. 2
 - Give the reason why the image is smaller than the object. 1
- 6)
- Sketch an electric field pattern around two equal and opposite point charges shown below:



Fig 6.1

- Obtain an equation, in terms of Q and r , for the field strength at point X due to two charges as shown in fig 6.1. 3
- 7)
- Define capacitance of a parallel plate capacitor and state one application of it in electric circuit. 2

- b) Identify the type of combination shown in fig 7.1 and calculate the effective capacitance of the combination. 1+2

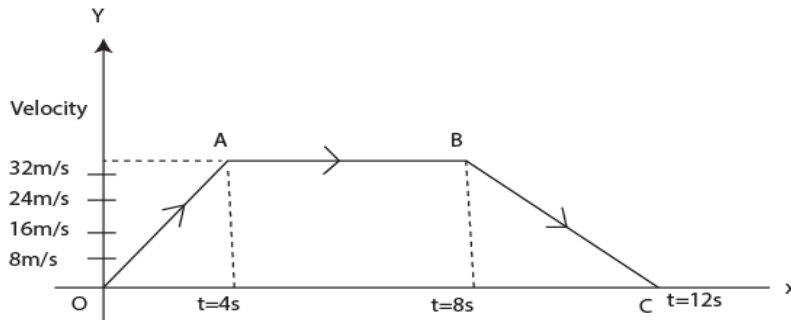


- 8)
- What do you mean by power of a heater is 3 KW? 1
 - Calculate the resistance and current of the above mentioned heater when it is connected to 220 V source. 2
 - Suggest what changes must be done to the heater as that it gives more heat. Justify your answer. 2

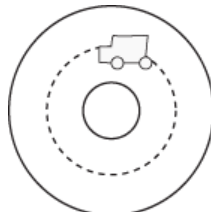
Group C

Give long answer to the following questions: 3X8=24

- 9)
- A box at rest is accelerated by a rope attached with it. Figure shows the pattern of its motion for 8s.
- If the box is pulled with constant unbalanced force 60 N. Show that the initial acceleration is 8 m/s^2 and calculate its mass. 2+1



- After 2.0 second the box is being pulled by a constant force of 200 N. determine the size of the frictional forces acting on the box at this time. 2
 - Determine the distance of the box travels along the ground at 12s. 3
- 10) A boy is operating a remote-controlled car on horizontal circular track, as shown in figure:



- a) Explain why the car is accelerating even though it is travelling at a constant speed. 2
- b) The car has a mass of 0.50 kg. The boy now increases the speed of the car to 6.0 ms^{-1} . The total radial friction between the car and the track has a maximum value of 7.0 N.
Show by calculation that the car cannot continue to travel in circular path. 3
- c) The car is now placed on a track which includes a raised section. This is shown in figure 10.2.

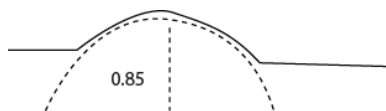


Fig 10.2

The raised section of the track can be considered as the arc of a circle which has radius r of 0.85 m. The car will lose contact with the raised section of the track if the speed is greater than V_{max} . Show that the V_{max} is given by the relationship

$$V_{\text{max}} = \sqrt{rg} . \quad 3$$

OR

- a) What is meant by gravitational potential at a point is $-1.6 \times 10^9 \text{ Jkg}^{-1}$? 3
- b) A proposed communication satellite would revolve around the earth in a circular orbit in the equatorial plane, at a height of 35880 km above the earth's surface. Find the period of revolution of the satellite in hours.
(Radius of the earth = 6370 km, Mass of the earth = $5.98 \times 10^{24} \text{ kg}$). 3
- c) If the mass of the new planet is doubled. What will be the change in time period (other's factors remaining constant) 3

11)

- a) Explain how Rutherford α - scattering experiment suggested that the nucleus of an atom is very small, very dense and positively charged. 3
- b) Consider the α particle carry average kinetic energy of $2.50 \times 10^{10} \text{ J}$. Calculate the maximum size of the gold nucleus. 3
(Atomic no. of gold is .79 and $e = 1.60 \times 10^{-19} \text{ C}$)
- c) Explain why the radius of the gold nucleus must be smaller than the value calculated in (11.b) above. 2

Model Questions 2078 - 8

Attempt all questions:

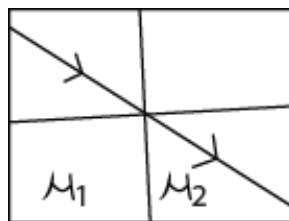
Group A

Circle the best alternative to the following questions:

11X1=11

- 1) The density of a material of a cube is calculated by measuring its mass and a side. What is the maximum percentage error in the density if the errors in the measurement of side and mass are 3% and 4% respectively?
a) 15% b) 13% c) 7% d) 5%
- 2) A boy of mass 40 kg is hanging from the horizontal branch of a tree. The tension in arms is maximum when the angle between the arm is
a) 0° b) 60° c) 90° d) 120°
- 3) A stone is released from the top of a tower. When a constant force is applied by high speed wind on that stone, then the path it follows
a) parabolic b) straight c) hyperbolic d) circular
- 4) Which of the following is always conserved?
a) Kinetic energy
b) Angular momentum
c) Linear momentum
d) Torque
- 5) With the increase in temperature, the Young modulus:
a) increases b) decreases c) remains constant
d) First increases then decreases
- 6) What is the nature of the image formed by the concave mirror when the object is placed at $2F$?
a) Real, inverted, same size
b) Real, erect and magnified
c) Virtual, erect and magnified
d) Does not form any image
- 7) A light ray is passed from one medium of refractive index (μ_1) to another medium of refractive index (μ_2) as shown in figure. The correct relation between μ_1 and μ_2 is:

3



- a) $\mu_1 > \mu_2$
 b) $\mu_1 < \mu_2$
 c) $\mu_1 = \mu_2$
 d) No relation between μ_1 and μ_2
- 8) The angle of deviation produced by a small angle prism of angle A and refractive index is equal to:
- a) $A(\mu - 1)$ b) $\mu(A - 1)$ c) $A(\mu + 1)$ d) $\mu(A + 1)$
- 9) A convex lens is dipped in a liquid whose refractive index μ is equal to the refractive index of lens. Then its focal length will:
- a) become zero b) become infinite
 c) remain unchanged d) become small but not zero
- 10) Find the equivalent resistance of the given electrical circuit:
-
- a) $\frac{R}{2}$ b) $5R$ c) $\frac{3R}{2}$ d) $2R$
- 11) Which of the following elementary particle is chargeless?
- a) electron b) proton c) neutron d) positron

Group B

Write short answer to the following questions.

8X5=40

1)

- a) Define momentum and impulse. Give its unit and dimension. 2
- b) When a man weighing 10 kg in lift is accelerated downward with the acceleration of 1ms^{-2} , then apparent weight is either increased or decreased. Calculate its apparent weight. 2
- c) A block is sliding down a 30° smooth inclined plane. Then coefficient of sliding friction will be what? 1

OR

- a) State Poisson's ratio in elasticity. 2

- b) Read the following two statements below carefully and state, with reasons, if it is true or false.
- The Young's modulus of rubber is greater than that of steel.
 - The stretching of a coil is determined by its shear modulus. 3
- 2)
- What is meant by water equivalent of a substance? Write its unit. 1
 - Calculate the total heat energy required to convert ice at -10°C to steam at 100°C . 3
 - State Newton's law of cooling. 1
- 3)
- State Boyle's law and draw the graph for (i) pressure versus volume (ii) pressure versus reciprocal of volume. 3
 - Discuss the physical significance of gas constant R. 2
- 4)
- What is meant by radiation? 1
 - Solar energy is reaching the earth at the rate of $16 \text{ K Cal m}^{-2} \text{ min}^{-1}$. Convert this in Watt per m^2 . Define solar constant. 3
 - Explain in brief, the process of transfer of heat from a body at higher temperature to the body at lower temperature? 1
- 5)
- Define convex lens and draw ray diagram showing the formation of a virtual image by the convex lens. 2
 - If a converging lens and a diverging lens having the same focal length be in contact, how will the combination of lenses behave? 1
 - The convex lens has focal length 20 cm, the power is how much? Calculate it. 2

OR

- Define concave mirror and state one daily application of it. 2
- State the type of mirror shown in the adjoining figure. 1

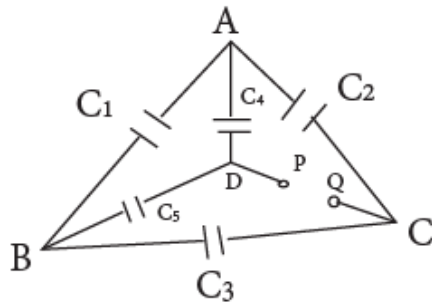


- A concave mirror brings sun light to a focus at a point – 0.40m from its pole. Calculate its focal length. 2
- 6)
- Sketch an electric field pattern around two identical positive point charges as shown below 2
- +Q +Q

- b) Write the formula for the potential difference between any two points in an electric field due to the charge $+Q$. how do you generalize this formula to get the electric potential V at a point at a particular distance, due to the isolated point charge $+Q$. 3

7)

- a) How do you understand the energy of a charged capacitor? Write its general formula. 2
- b) Find the equivalent capacitance the combination as shown in figure in which: $C_1 = C_2 = C_3 = C_4 = C_5 = 100\mu\text{F}$.



8)

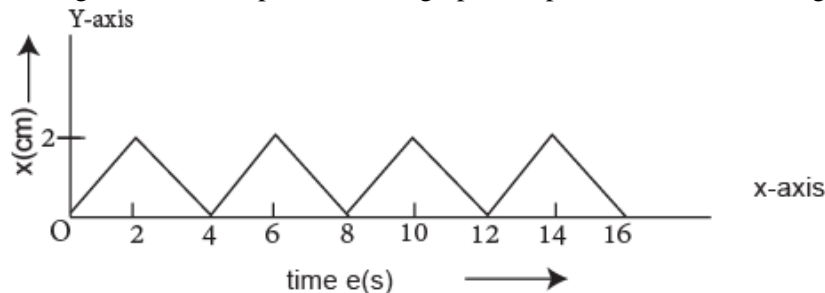
- a) An electric bulb is marked with 100 W. how do you understand its meaning? 1
- b) Calculate the resistance of the above mentioned bulb when it is connected to 220V power supply. 2
- c) Suggest what changes must be done to the bulb so that it gives more heat. Justify your answer. 2

Group C

Give long answer to the following questions:

3X8=24

- 9) The figure shows the position time graph of a particle of mass 0.04 kg.



- a) Suggest a suitable physical context for this motion. 3
- b) What is the time between two consecutive impulses received by the particle? 2
- c) What is the magnitude of each impulse? 3

10)

- a) Why does a cyclist lean to one side, while going along path? In what direction does he lean? 2

- b) A train runs along an unbanked circular bend of radius 30 m at a speed of 54 km/hr. the mass of the train is 106 kg. What provides the necessary centripetal force required for this purpose? The engine or the rails? What is the angle of banking required to prevent wearing out of the rail? 3
- c) How is centripetal force provided in case of the following? 3
 - i) Motion of planets around the sun.
 - ii) Motion of the moon around the earth.
 - iii) Motion of electrons around the nucleus.

OR

- a) If the radius of the earth were to decrease by 1% keeping its mass same, how will the acceleration due to gravity change? 2
 - b) Draw graphs showing the variation of acceleration due to gravity with (i) height (ii) depth from the surface of the earth. 3
 - c) A man can jump 1.5 m high on earth. Calculate the height he may be able to jump on a planet whose density is one fourth that of the earth and whose radius is one third of the earth. 3
- 11)
- a) Calculate the binding energy per nucleon for a Helium nucleus. Given that mass of Helium nucleus = 4.001509 amu, mass of proton = 1.007277 amu, and mass of neutron = 1.008666 amu. 3
 - b) Explain how Rutherford's α - scattering experiment suggested that the nucleus of an atom is very small, very dense and positively charged. 3
 - c) Explain the significance of binding energy per nucleon? 2

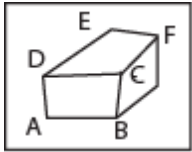
Model Questions 2078 - 9

Attempt all questions:

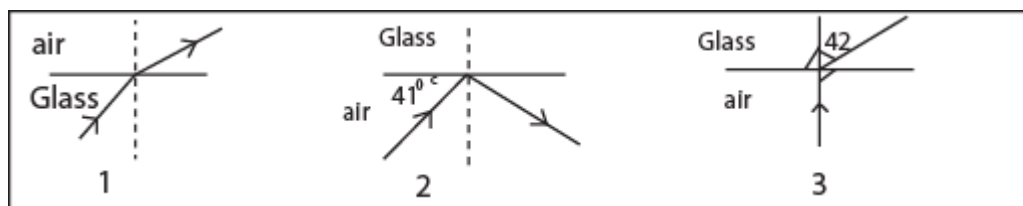
Group A

Circle the best alternative to the following questions:

11X1=11

- 1) If $x = at + bt^2$, where x is distance travelled by the body in kilometer while ' t ' is the time in seconds, then the units of ' b ' is
a) kms^{-1} b) kms c) kms^{-2} d) kms^2
- 2) Two equal masses (m) are projected at the same angle ' θ ' from two points separated by their range with their equal velocity (v). The momentum at the point of their collision is
a) zero b) $2mv\cos\theta$ c) $-2mv\cos\theta$ d) None of these
- 3) A ball of mass ' m ' moving with velocity v makes head on elastic collision with a ball of some mass moving with velocity $2v$ towards it. Taking direction of v as positive velocities of the two balls after collision are
a) $-v$ and $2v$ b) $2v$ and $-v$ c) v and $-2v$ d) -2 and v
- 4) Forces of 10^5 N each applied in opposite direction on the upper and lower faces of a cube of side 10 cm, shifting the upper face parallel to itself by 0.5 cm. if the sides of cube were 20 cm, the displacement would be:

a) 1 cm b) 0.5 cm c) 0.25 cm d) 0.125 cm
- 5) If v is the gravitational potential on the surface of the earth, then what is its value at the center of the earth?
a) $2v$ b) $3v$ c) $\frac{3}{2}v$ d) $\frac{2}{3}v$
- 6) Centre of curvature is not a part of spherical mirror rather it lies _ _ _ _ _ the mirror
a) boundary b) inside c) outside d) None of the above

- 7) Each of the following ray diagram shows a light ray reaching the interface between air and a semi-circular block. Which of them is /are correct? (Critical angle of glass = 42°)



- a) (1) only b) (3) only c) (1) and (2) only d) (2) and (3) only
- 8) A prism is usually in the shape of a
a) sphere b) cube c) Pyramid d) Rectangular box
- 9) Which colour of light deviates maximum in the dispersion of white light by prism?
a) violet b) blue c) green d) red
- 10) A wire has resistance 12Ω . It is bent in the form of a circle. The effective resistance between the two points on any diameter is equal to
a) 12Ω b) 6Ω c) 3Ω d) 24Ω
- 11) Which is not a fundamental particle?
a) electron b) neutron c) neutrino d) positron

Group B

Write short answer to the following questions.

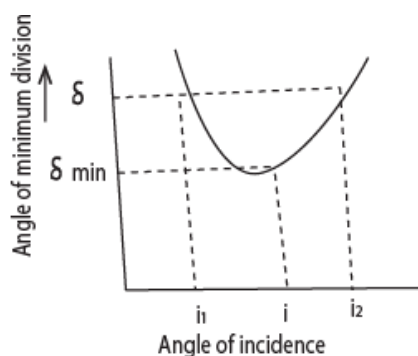
8X5=40

- 1)
- State the principle of moment. 2
 - A force of 100N pull off a sledge of a mass of 10 kg and overcomes a constant frictional force of 10 N. what is the acceleration of the sledge? 2
 - Why does the cricket player lower his hands while catching ball? 1

OR

- Explain the term breaking stress, why elephant has thicker legs as compared to human beings? 2
 - What force must be applied to a steel wire 6 m long and diameter 1.6 mm to produce an extension of 1 mm. ($\gamma_s = 2.6 \times 10^{11} \text{ N/m}^2$) 3
- 2)
- The specific latent heat of fusion of ice is 80 Cal/gm. What does it mean? 1

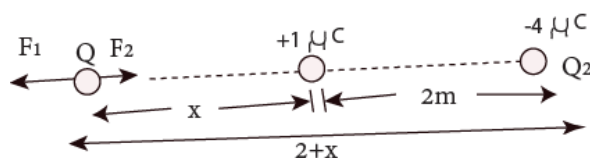
- b) How much heat is required to convert 10 gm of ice at -10°C into steam at 100°C ?
(Specific heat capacity of ice is $0.5 \text{ Cal/g}^{\circ}\text{C}$, latent heat of vaporization ($L_v = 540 \text{ Cal/g}$). 3
- c) When you come out of swimming pool, you feel cold. Why? 1
- 3) a) Write any three differences between real gas and ideal gas. 3
- b) What is the numerical value of R. also write its physical significance. 2
- 4) a) What is thermal conductivity? 1
- b) One end of a metal bar 0.001 m^2 in cross section and 0.5 m long is in contact with steam at atmospheric pressure. The other end is in contact with ice at 0°C if ice melts at the rate of 13.8 g per minute. Find the thermal conductivity of the metal. 3
- c) Eskimos make double walled houses of blocks of ice. Why? 1
- 5) a) What does the given curve represent? Define it. 1



- b) What are the conditions for minimum deviation? 2
- c) Prove that: $\mu = \frac{\sin\left(\frac{\delta_{\min} + A}{2}\right)}{\sin\frac{A}{2}}$ 2

OR

- a) Define convex mirror and state its application. 2
- b) Draw the diagram of Lateral Shift with angle of incidence. 2
- c) Why does the clear pool of water appears to be shallower than it actually is? 1
- 6) a) Two charges $+1\mu\text{C}$ and $-4\mu\text{C}$ are separated by a distance of 2m as shown in figure below. Determine the position of null point. 3



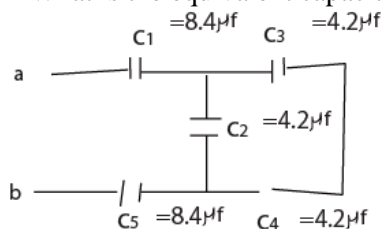
- b) Where should the third charge be placed and also define null point. 2

7)

- a) What are the factors in which capacitance of parallel plate capacitor depends. 2

- b) In the given capacitors circuit, applied potential difference a and b is 220 V.

What is the equivalent capacitance of the network between a and b? 3



8)

- a) What do you mean by power of heater 4 kW? 1

- b) Calculate the resistance of above mentioned heater when it is connected to 200 V source. 2

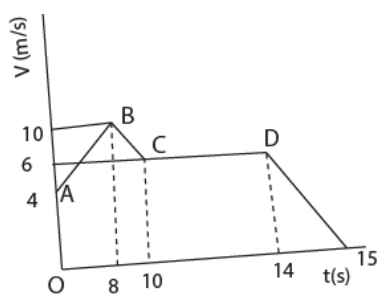
- c) What must be done in order to increase heat to the heater? Explain. 2

Group C

Give long answer to the following questions

(3 × 8 = 24)

- 9) The adjacent graph shows velocity time for motion of a body in straight line. Study it and answer the following questions.



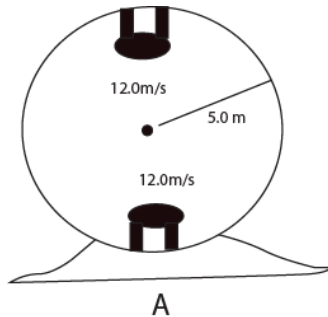
- a) State the interval where body is (a) accelerating and retarding in which interval the velocity is uniform? 2+1=3

- b) What is the initial velocity of the body? What is the maximum velocity attained by it during its motion. 2

- c) How much distance does the body cover in time interval $t = 5$ sec to $t = 9$ sec? 3

10)

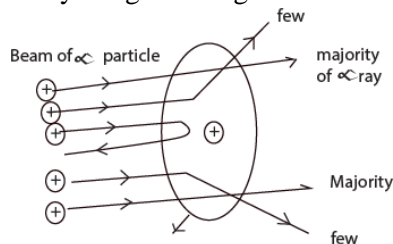
- a) Moon is accelerating towards the earth. Why is not it is getting close to the earth? 2
- b) A small car of mass 0.800 kg travels at a constant speed in the inside of a track that is a vertical, circle of radius 5.00 m as shown in figure below:



- i) Although the speed is constant why is it accelerating? 2
- ii) If the normal force exerted by the track on the car when it is at the top of track (at point B) is 6.00 N, what is the normal on the car when it is at the bottom of the track (at point A)? 2+2

OR

- a) What is escape velocity? Under what condition rocket will escape from the earth's gravitational pull? Show that denser planets have greater escape velocity. 3
- b) The radius of the earth is 6.4×10^6 m and the acceleration due to gravity at its surface is 9.8 m/s^2 . Calculate the escape velocity for a body on its surface. 3
- c) Moon has no atmosphere. Why? What is the escape velocity from a 300 km diameter asteroid with density of 2500 kg/m^3 ? 2
- 11) Study the given diagram and answer the questions:



- a) Which experiment is represented in the given figure? What conclusion can be drawn from this experiment? 3
- b) Write any three properties of nucleus. Also show that Nuclear density is independent of mass number. 3
- c) What is Binding energy? Draw Binding energy curve and write its significance. 3

Model Questions 2078 - 10

Attempt all questions:

Group A

Circle the best alternative to the following questions:

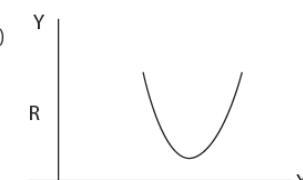
11X1=11

- 1) If the force, length and time are taken as fundamental units, the dimensions of mass are
 a) $F^1 L^{-1} T^2$ b) $F^0 L^0 T^2$ c) $F^1 L^2 T^{-2}$ d) $F^1 L^1 T^{-2}$

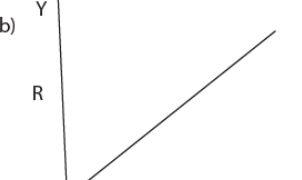
- 2) A solid spherical ball rolls on a table. Ratio of rotational KE to total KE is
 a) $\frac{2}{7}$ b) $\frac{5}{7}$ c) $\frac{1}{2}$ d) $\frac{7}{10}$

- 3) The graph of range of projectile (on y-axis) as plotted against velocity of projection (x – axis) will be:-

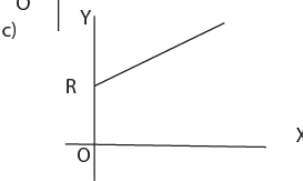
a)



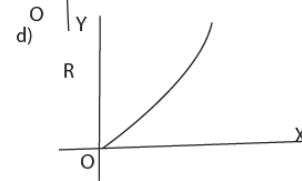
b)



c)



d)



- 4) The total energy of just escaping body from surface of earth is
 a) positive b) negative
 c) zero d) positive or negative depending on direction

- 5) A shearing stress is related in
 a) length b) volume c) shape d) area

- 6) A concave mirror of focal length F is immersed in water $\left(\mu_w = \frac{4}{3} \right)$. The focal length of mirror inside water is

- a) more than f b) less than f c) f d) $\frac{4}{3}f$
- 7) Critical angle of light passing from glass to air is minimum for:
a) red b) green c) yellow d) violet
- 8) The principle of which of the following is based on deviation without dispersion.
a) chromatic doublet b) achromatic doublet
c) spectrometer d) direct vision spectroscope
- 9) A convex lens of focal length 40 cm is in contact with a concave lens of focal length 25 cm. The power of the combination is:
a) -1.5D b) -6.5 D c) 6.5 D d) 6.67 D
- 10) The length of a conductor is halved, its specific resistance is:
a) doubled b) halved c) quadrupled d) unchanged
- 11) When a particle and its antiparticle are annihilated the energy released is E . what is the mass of each particle?
a) $\frac{E}{C^2}$ b) $\frac{E}{2C}$ c) $\frac{E}{2C^2}$ d) $\frac{E}{C}$

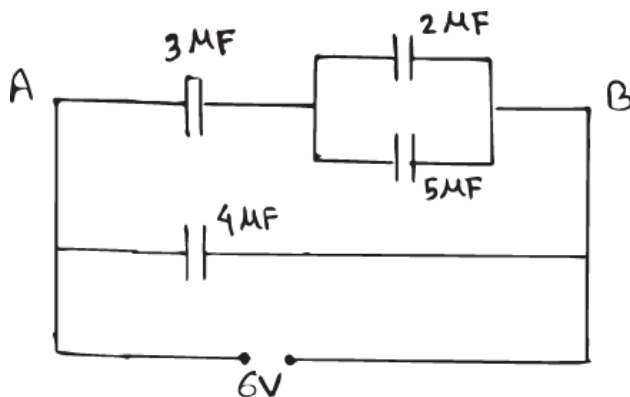
Group B

Write short answer to the following questions.

8X5=40

- 1)
- a) State and explain Newton's law of motion with example. 2
 - b) If action and reaction are always equal and opposite, why don't they always cancel each other and leave no force for acceleration of the body? 2
 - c) Do forces of action and reaction act on the same body? 1
- OR**
- a) What is Poisson's ratio? 2
 - b) A uniform steel wire of density 7800 kg/m³ and weight 16 g is 250 cm long. It lengthens by 1.2 mm when stretched by force of 80 N. calculate Young's modulus for steel and energy stored in the wire? 3
- 2)
- a) Pendulum clocks generally go fast in winter and slow in summer. Why? 2
 - b) A blanket which keeps us warm in the winter is able to protect ice from melting. Explain. 2
 - c) Define absolute zero. 1

- 3)
- What is the physical significance of Universal gas constant? Write down its value. 1+1
 - Determine the amount of heat required to convert 1 kg of ice at -10°C to steam at 100°C .
 Specific heat of ice = $2100 \text{ J kg}^{-1} \text{ K}^{-1}$
 Specific latent heat of ice = $3.36 \times 10^5 \text{ J kg}^{-1}$
 Specific latent heat of steam = $2.26 \times 10^6 \text{ J kg}^{-1}$ 3
- 4)
- State the law of equipartition of energy. 1
 - The filament of a particular electric lamp can be considered as a 90% black body radiator. Calculate the energy per second radiated when its temperature is 2000 K if its surface area is 10^{-6} m^2 . [Stefan constant = $5.7 \times 10^{-8} \text{ W m}^{-2} \text{ K}^{-4}$]. 2
 - Which has more atoms a kilogram of hydrogen or a kilogram of iron? 2
- 5)
- What is difference between converging and diverging lenses? 2
 - The image obtained with a converging lens is erect and three times the length of the object. The focal length of the lens is 20 cm . calculate
 - Object distance
 - Image distance 2+1
- OR**
- What do you mean by grazing incidence and grazing emergence? 2
 - The refractive index of a glass prism is 1.66 and the angle of prism is 60° . Find the minimum deviation. 3
- 6)
- State Gauss's theorem. 1
 - Use Gauss's Theorem to determine the electric field intensity due to line charge. 3
 - What is the magnitude of an electric field which will balance the weight of an electron on the surface of earth? 1
- 7)
- Is it possible to charge a capacitor to any desired potential? Explain. 2
 - Find the equivalent capacitance of the following circuit. Also find the charge on $5\mu\text{F}$ capacitor. 3



8)

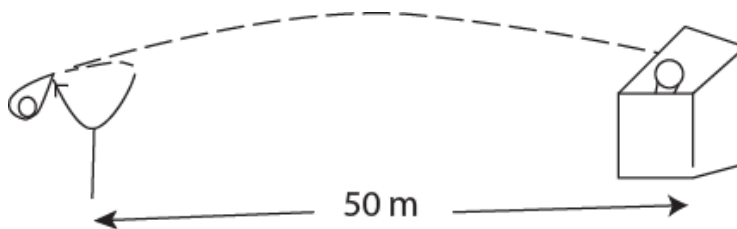
- When the resistance connected in series with a cell is exactly halved, the current is not exactly doubled. Explain why. 1
- Water boils in an electric kettle in 15 minutes after being switched on. Using the same main supply: should the length of the heating element be increased or decreased if the water is to boil in 10 minutes? Explain. 2
- Calculate the time taken by a 2 KW heater to raise the temperature of 1 Kg of water by 40°C. (Specific heat of water = 4200 J Kg⁻¹°C⁻¹). 2

Group C

Give long answer to the following questions

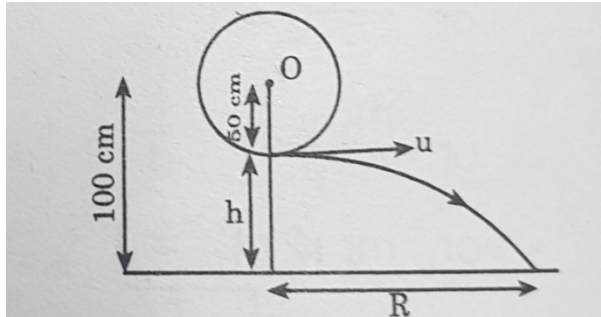
(3 × 8 = 24)

- A fairground game requires the player to catapult a ball towards a target to some points. The ball is required to reach a target at horizontal distance of 50 m. away at the same vertical height, as shown.



- The time taken by the ball to reach the target is 2.0 seconds. Calculate the angle to the horizontal at which the ball is launched. 2
- During another launch, the catapult exerts a force on the ball of 90 N at 40° to the horizontal at the time of release. Draw a labeled vector diagram to determine the resultant force acting on the ball at the time of release. Weight of ball = 2.0 N. 3
- Find the magnitude of resultant force if an angle between 9.0N and 2.0 N is 30°. 3

- 10) A stone of mass 500 gm is attached to a string of length 50 cm which will break if the tension in it exceeds 20 N. The stone is whirled in a vertical circle, the axis of rotation being at a height of 100 cm above the ground. The angular speed is very slowly increased until the string breaks.



- In what position is the break mostly like to occur and what is its angular velocity? 2
- Determine its linear velocity .1
- Illustrate the motion drawing vertical circle and locate the position from which it detaches. 2
- Where will the stone hits the ground? 3

OR

A preliminary stage of spacecraft Apollo 11's journey to the moon was to place it in an earth parking orbit. The orbit was circular, maintaining almost a constant distance of 189 km from the earth's surface.



Assuming the gravitational field strength in this orbit is 9.4 N/Kg , calculate:

- Speed of the aircraft in this orbit. 2
- Time to complete one orbit. (Radius of the earth = 6370km) 2
- Work done during its orbital motion around the earth. 1

- d) Will the astronauts inside the spacecraft experience the weightlessness? Explain. 2
- e) If the spacecraft somehow stops its orbital motion, what will happen to it? 1
- 11)
- a) Distinguish between nuclear fission and fusion. 2
- b) Show how in both these processes energy is released. 2
- c) Calculate the energy release in MeV in the deuterium-tritium fusion reaction. 4
- $${}_1\text{H}^2 + {}_1\text{H}^3 \rightarrow {}_2\text{He}^4 + {}_0\text{n}^1$$
- Using the data $m({}_1\text{H}^2) = 2.014102\text{u}$,
 $m({}_1\text{H}^3) = 3.016049\text{u}$
 $m({}_2\text{He}^4) = 4.002603\text{u}$, $m_n = 1.008665\text{u}$
 $1\text{u} = 931.5\text{MeV}$

NEB Final Examination - 2078

Time: 3 hrs

Full marks: 75

Pass marks: 27

*Candidates are required to give their answers in their own words as far as practicable.
The figures in the margin indicate full marks.*

Attempt All Questions.

Group 'A'

Choose the best alternative to the following questions:

(11×1=11)

1. If p is the momentum of an object of mass m , the expression p^2/m has base unit identical to
a. Energy b. Force c. Power d. velocity
2. The figure shows displacement – time graph of a particle moving on the X-axis.

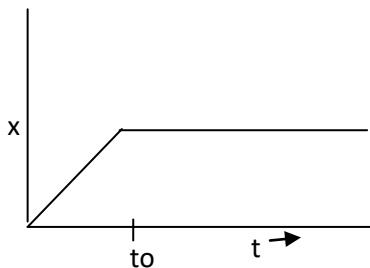
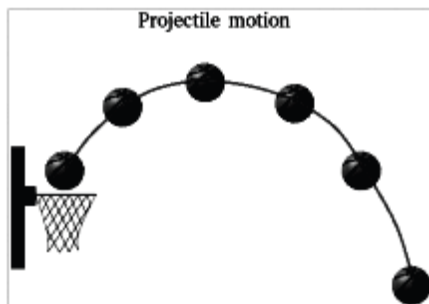


Figure 1

Which of the following statement is true?

- a) The particle is continuously going to +ve x direction.
 - b) The particle is at rest.
 - c) The velocity increases upto a time t and then becomes constant.
 - d) The particle moves at a constant velocity upto a time t_0 and then stops.
3. A basketball player throws a basketball towards the net from a distance and the path of the ball is shown. Which one of the following statements is true about the basketball's trajectory?



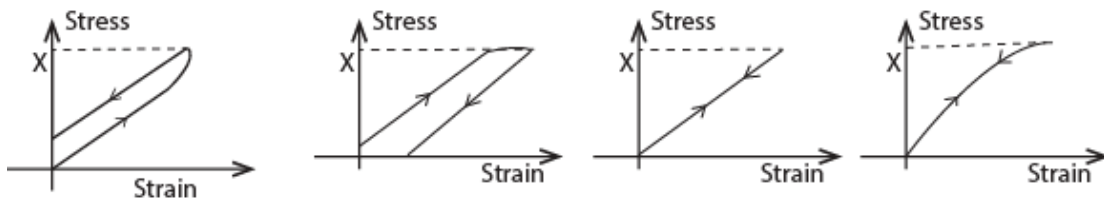
- (a) It has a constant upward acceleration followed by a constant downward acceleration.
- (b) It has a constant horizontal velocity and constant downward acceleration.

- (c) It has a constant horizontal and vertical velocities,
 (d) It has a constant upward velocity followed by a constant downward velocity
4. A power station has an efficiency of 40% and generates 1000 MW of electric power.

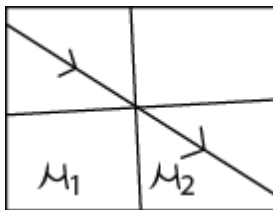
What is the input power and the wasted power?

	Input power/MW	Wasted power/ MW
A	1000	600
B	1000	400
C	1400	400
D	2500	1500

5. A metal wire is gradually loaded until it passes the elastic limit to the point where the stress is x . The load is taken off gradually, which graph represents the stress against strain.

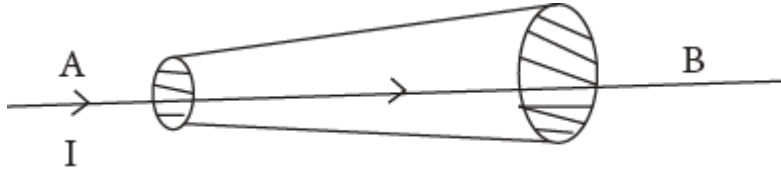


6. A light ray is passed from one medium of refractive index μ_1 to another medium of refractive index μ_2 as shown in figure. The correct relation between μ_1 and μ_2 is:



- a) $\mu_1 > \mu_2$
 b) $\mu_1 < \mu_2$
 c) $\mu_1 = \mu_2$
 d) No relation between μ_1 and μ_2
7. In the Sun's spectrum, there are several visible and invisible spectrums. If blue and green light are passed through a transparent prism, then deviation of green light will be:
- a) Equal so that they will form achromatic condition.
 b) Greater than that of blue light.
 c) Smaller than that of blue light.
 d) Can't be predicted.

8. The two thin lenses of focal length +60 cm and - 20 cm are placed in contact. The focal length of combination is
 a. + 5 cm b. - 15 cm c. + 30 cm d. - 30 cm
9. If the refractive index of diamond is 2.4, the velocity of light in diamond is
 a. $1.25 \times 10^8 \text{ m/s}$ b. $2.5 \times 10^8 \text{ m/s}$ c. $1.5 \times 10^8 \text{ m/s}$ d. $2.0 \times 10^8 \text{ m/s}$
10. A wire has a non-uniform cross-section. It carries a current “i”. Then the drift velocity of electron:



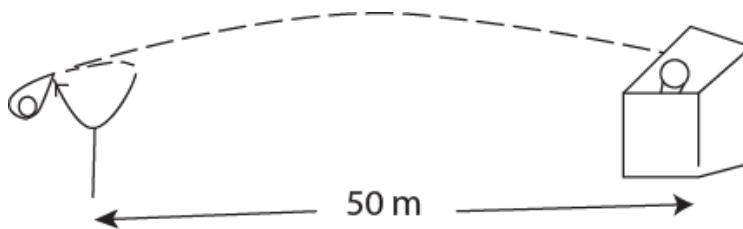
- a) Remains constant from A to B.
 b) Decreases on moving from A to B.
 c) Increases on moving from A to B.
 d) First decreases and then becomes constant.
11. Which is the particle antiparticle pair?
 a. Electron and proton b. Electron and positron
 c. Proton and neutron d. Neutron & electron.

Group 'B'

Write short answer to the following questions.

(8× 5=40)

1. A fair ground game requires the player to catapult a ball towards a target to some points. The ball is required to reach a target at horizontal distance of 50 m away at the same vertical height, as shown in figure.

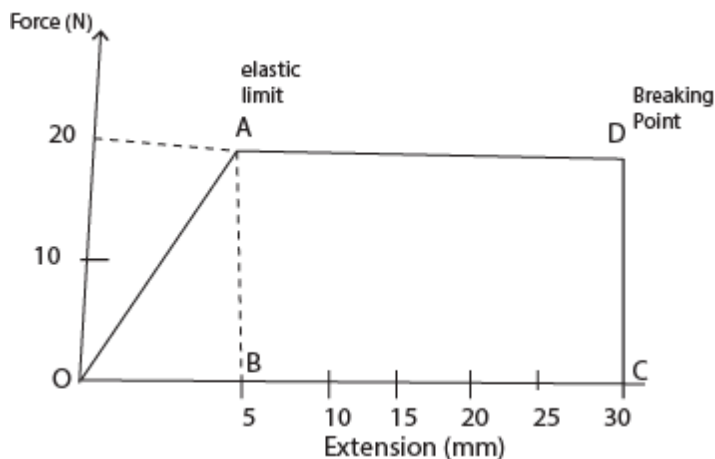


- a) The time taken by the ball to reach the target is 2.0 seconds. Calculate the angle to the horizontal at which the ball is launched. 3
- b) During another launch, the catapult exerts a force on the ball of 90 N at 40° to the horizontal at the time of release. Draw a labeled vector diagram to determine the resultant force acting on the ball at the time of release. Weight of ball = 2.0 N. 2

Or

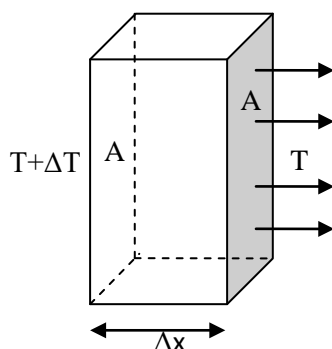
- a) State Hooke's law and write down the expression for energy stored in a stretched wire

2



b. Figure shows a simplified version of a force - extension graph for a piece of metal. Find

- i) The strain energy (energy stored) when the metal is stretched to its elastic limit.
 - ii) Work done must be done to break the metal.
2. Consider the slab as shown in figure. Suppose that $\Delta x = 24.9$ cm, $A = 1.8$ m² and the material is of copper. If $T = -12.0$ °C and $\Delta T = 136$ °C and steady state is reached, then

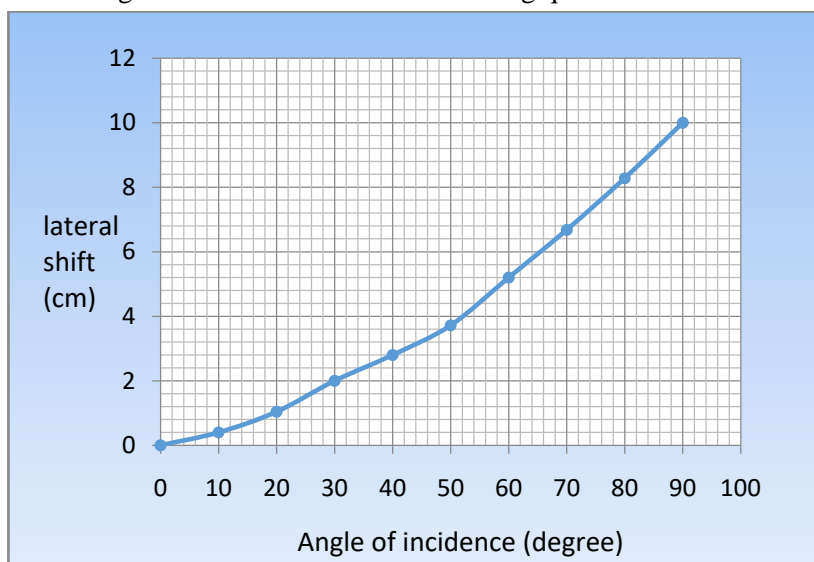


- (a) Find the temperature gradient, 1.5
 - (b) The rate of heat transfer and 1.5
 - (c) The temperature at point 11.0 cm from the high- temperature end. (thermal conductivity of copper is: 401 W/mK) 2
 3. a) What is meant by specific heat capacity of a solid? 2
 - b) A block of aluminium has a mass of 0.50 kg. It is heated using a 36W heater for 3 minutes and its temperature increases by 12°C. Calculate the specific heat capacity of aluminium. 3
 4. What is the difference between average speed and root mean square (rms) speed of gas molecules? 1
- The atmosphere of Mars is mostly CO₂ (molar mass 44 g/mol) under a pressure of 650 Pa, which we shall assume constant. In many places the temperature varies from

0.0 °C in summer to -100 °C in winter. Over the course of a Martian year, what are the ranges of

- the rms speeds of CO₂ molecules and 2
- the density (in mol/m³) of the atmosphere? 2

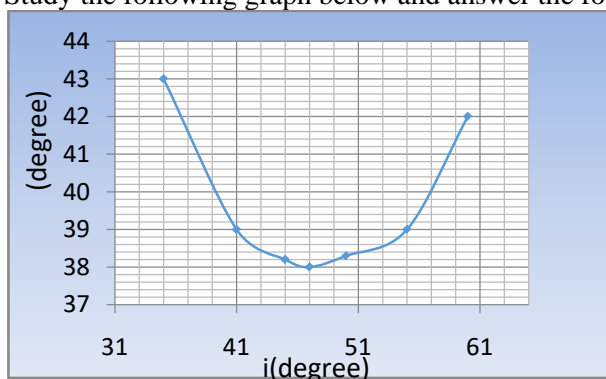
5. Study the following graph showing variation of lateral shift with angle of incidence on a glass slab and answer the following questions.



- What is the thickness of glass slab used? 1
- What are the values of lateral shift at angle of incidences 10° and 80°? 1
- Calculate the value of angle of refraction when angle of incidence is 30°. 2
- Use the value of angle of refraction obtained in (c) to calculate the refractive index of the glass. 1

Or

Study the following graph below and answer the following questions



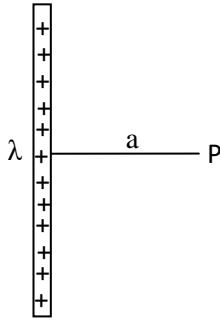
The figure shows i-D curve for some glass prism

- What does the graph indicate? 1
- List out any two angles of incidences for which the angle of deviation is equal. 1
- Find the angle of prism. 1

- d) What is the angle of minimum deviation and at what angle of incidence the deviation is minimum? 2

6. a) State Gauss's law in electrostatics. What is the physical significance of the term 'permittivity' of medium? 2

b) The figure shows a long straight conductor uniformly charged with positive charges. If λ is the linear charge density, what is the amount of charges per unit length of the conductor? We are interested to calculate the electric field at point P which is 'a' distance away from the conductor. Now, draw a Gaussian surface enclosing the charge and find the magnitude of electric field at point P. 3



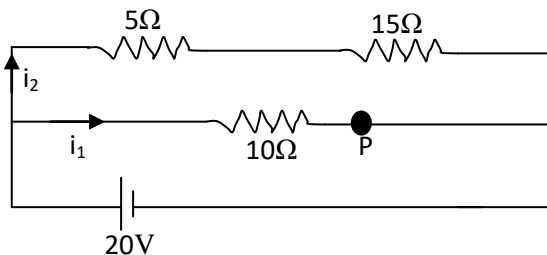
7. a) Define capacitance of a parallel plate capacitor and state one application of it in electric circuit. 2

b) A parallel plate capacitor consists of the square plates each of side 25 cm, 3.0 mm apart. If a p. d. of 200V is applied, calculate the charge on the plates with

i) Air, and

ii) Paper of relative permittivity 2.5, filling the space between them, ($\epsilon_0 = 8.9 \times 10^{-12} \text{ Fm}^{-1}$) 3

8. Consider the given circuit and answer the questions



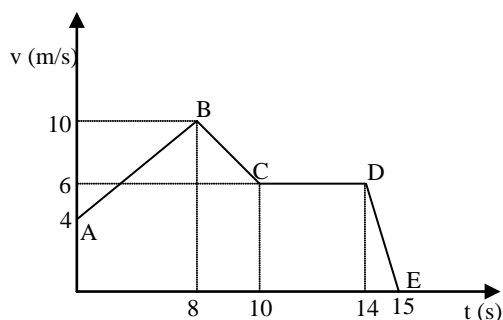
- a) Calculate the currents i_1 and i_2 . 1.5
 b) What are p.d. across 5Ω and 10Ω resistors? 1.5
 c) If the connection is broken at point P, what is the value of current through 5Ω resistor and p.d. across 15Ω resistor? 2

Group 'C'

Give long answer to the following questions:

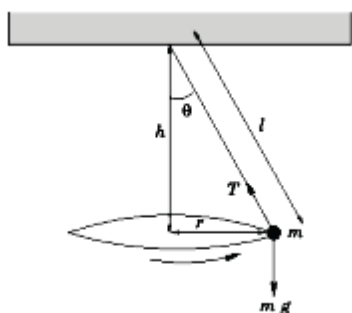
(3×8=24)

9. The adjacent graph shows velocity-time graph for the motion of a body in straight line. Study it and answer the following questions.



- State the intervals where the body is (a) accelerating and (b) retarding 1
- What is the initial velocity of the body? What is the maximum velocity attained by it during its motion? 1
- What is the total time taken by the body to come at rest from beginning? 1
- At which interval the velocity is uniform? 1
- Calculate the distance covered by body during its motion in time $t = 8$ sec to $t = 10$ sec. 2
- What is the total distance covered by body during entire the motion? 2

10. The given figure is of a conical pendulum.



The circle has a radius of 0.8 m and length of the thread of pendulum is 1m. The object travels around the path with a constant speed.

- Explain why the object is accelerating, even though it is travelling at a constant speed. 2
- The object has a mass of 2 kg. Calculate the tension in the thread. Also calculate the time period of revolution 3
- Calculate the angular velocity, translational velocity and the centripetal force. 3

Or

Juno is a NASA orbiter with a mission to survey Jupiter. It is in an elliptical orbit around Jupiter as shown in the figure below.



The gravitational potential at point A in the orbit of Juno is $-1.70 \times 10^9 \text{ J kg}^{-1}$

(a) State what is meant by a gravitational potential at point A is $-1.70 \times 10^9 \text{ J kg}^{-1}$ 2

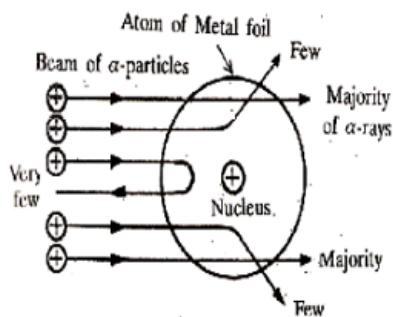
(b) At point B, Juno is $1.69 \times 10^8 \text{ m}$ from the centre of Jupiter. If the mass of Jupiter is $1.90 \times 10^{27} \text{ kg}$, calculate the gravitational potential at point B. 3

(c) The mass of Juno is $1.6 \times 10^3 \text{ kg}$. Determine the change in gravitational potential energy if

Juno moves from Point A to Point B.

3

11. Study the given diagram and answer the questions.



a) Which experiment is represented in the given figure? 1

b) In this experiment, majority of alpha particles are found to pass undeflected. What conclusion can be drawn from this observation? 1

c) What is the reason behind the deflection of very few particles by an angle of 180° as shown in the figure? 2

d) In the figure, r_0 is the distance between point A and center of a nucleus (also called distance of closed approach). Let 'Z' is the atomic number of element used and 'E' is the K.E. of incident alpha particle. The charge of an alpha particle is equal to ' $2e$ ' (e = charge of an electron). Show that,

$$r_0 = \frac{1}{4\pi\epsilon_0} \frac{2Ze^2}{E} \quad 2$$

e) Write Rutherford model of an atom. 2