

**Group 'A'** Attempt all questions.

1. The equation of state for real gas is  $\left(P + \frac{a}{V^2}\right)(V - b) = RT$  where P = pressure, V = volume. The dimensions of constant a is  
a)  $[ML^5T^{-2}]$       b)  $[ML^3T^{-1}]$       c)  $[M^0L^6T^0]$       d)  $[ML^7T^2]$

2. If the sum of two unit vectors is unit vector then magnitude of difference of these two unit vectors is

- a)  $\sqrt{2}$       b)  $\sqrt{3}$       c)  $\sqrt{\frac{1}{2}}$       d)  $\sqrt{5}$

3. Two bodies will be in thermal equilibrium if they have same

- a) temperature      b) specific heat      c) heat energy      d) thermal conductivity

4. A concave mirror of focal length f in air is immersed in water, the focal length of mirror in water will be

- a) f      b)  $\frac{4f}{3}$       c)  $\frac{3f}{4}$       d)  $\frac{7f}{3}$

5. Force between two charges  $1\mu C$  each separated by 1m is

- a)  $9 \times 10^{-4} N$       b)  $9 \times 10^{-3} N$       c)  $9 \times 10^{-5} N$       d)  $9 \times 10^{-2} N$

**Group 'B'** Answer the following questions.

6. a) Do all physical quantities have dimensions. If no, name three physical quantities which are dimensionless. (2)

- b) The density of gold is 19.3 gm/cc. Express its value in S.I. unit using dimensional method. (2)

- c) Write any two limitations of dimensional analysis. (1)

7. a) If two non-zero vectors are acted on a body, in what condition the resultant vector on the body will be zero? (1)

- b) Can  $\vec{A} + \vec{B} = \vec{A} - \vec{B}$ ? (1)

- c) State parallelogram law of vector addition and using it, find the magnitude of the resultant of two vectors  $\vec{P}$  and  $\vec{Q}$  inclined at an angle  $\theta$ . (3)

8. a) Distinguish between real image and virtual image. (2)

- b) Derive the mirror formula for concave mirror when virtual image is formed. (3)

9. a) Define concave mirror and state one daily application of it. (2)

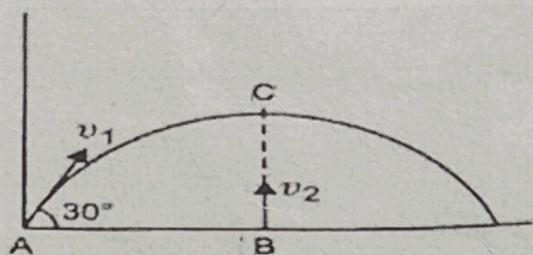
**MMC-GRADE XI**  
**2081 (2024)**  
**Physics**

**Time: 3 hrs.****Attempt All The Questions.****Full marks: 75**

**Group 'A' [11 x 1 = 11]**

Rewrite the correct options of each question in your answer sheet.

1. A body is projected with velocity  $v_1$  from the point A as shown in the figure. At the same time, another body is projected vertically upward from B with velocity  $v_2$ . The Point B lies vertically below the highest point. For both the bodies to collide  $\frac{v_2}{v_1}$  should be



- (a) 2       (b) 0.5      (c)  $\sqrt{\frac{3}{2}}$       (d) 1

2. The vectors  $\vec{A}$  and  $\vec{B}$  are such that  $|\vec{A} + \vec{B}| = |\vec{A} - \vec{B}|$ . The angle between the two vectors is

- (a)  $45^\circ$       (b)  $90^\circ$        (c)  $60^\circ$       (d)  $75^\circ$

3. Which of the following is always conserved in collision?

- (a) Kinetic energy      (b) Angular momentum  
 (c) Linear momentum      (d) Torque

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

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

5. The Temperature of human body is  $98^\circ\text{F}$ . This temperature in degree Celsius is

- (a)  $39.6^\circ\text{C}$        (b)  $36.9^\circ\text{C}$       (c)  $69.4^\circ\text{C}$       (d)  $64.9^\circ\text{C}$

6. The length of edge of a cube increases by 2% when heated by  $50^\circ\text{C}$ . The volume of the cube will be increase by

- (a) 2%      (b) 4%       (c) 6%      (d) 8%

7. The deviation produced by a prism doesn't depend on

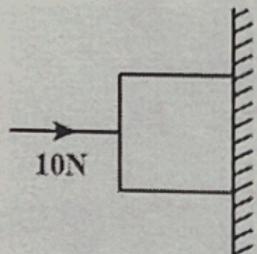
- (a) Angle of prism      (b) material of prism  
 (c) The angle of incidence       (d) Size of the prism

8. If we put the object at the focus of convex lens, the refracted rays are

- (a) Converging      (b) Diverging  
 (c) Both converging and diverging      (d) parallel

9. Force between two charges  $1 \mu\text{C}$  which are separated by 1m is

- (a)  $9 \times 10^{-4} \text{ N}$        (b)  $9 \times 10^{-3} \text{ N}$       (c)  $9 \times 10^{-5} \text{ N}$       (d)  $9 \times 10^{-2} \text{ N}$



10. Holes are majority charge carriers in

- (a) N-type semiconductors      (b) Ionic solids  
 (c) P-type semiconductors      (d) Metals

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

- (a) Quarks      (b) Bosons      (c) Fermions      (d) Hadrons

### Group 'B'

**[8 x 5 = 40]**

12. a) Show that final kinetic energy of a body is equal to the sum of the initial kinetic energy and work done on the body. [3]

b) A person whose mass 50 kg runs up a flight of stairs in 5 sec. as shown in the figure. Calculate the rate at which work is done against the force of gravity. [2]

**OR**

a) Define unit vector. [1]

b) The resultant of two forces

equal in magnitude at right angles to each other is 1414 N. Find the magnitude of each force. [2]

c) A student writes an expression of the force causing a body of mass (m) to move in a circular motion with a velocity (v) as  $F = mv^2$ . Use the dimensional method to check its correctness. [2]

13. a) Two bodies made of the same material have the same external dimensions and appearance, but one is solid and the other is hollow. When they are heated, is the overall volume expansion the same or different? Explain. [2]

b) A copper vessel with a volume of exactly  $100 \text{ m}^3$  at a temperature of  $15^\circ\text{C}$  is filled with glycerine. If the temperature rises to  $25^\circ\text{C}$ , how much glycerine will spill out? [Given: cubical expansivity of glycerine =  $4.9 \times 10^{-6} \text{ K}^{-1}$ , cubical expansivity of copper =  $5.1 \times 10^{-5} \text{ K}^{-1}$ ]  $[0.0461 \text{ m}^3]$  [3]

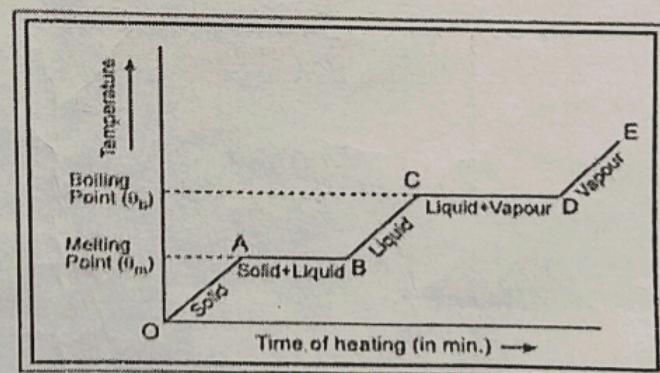
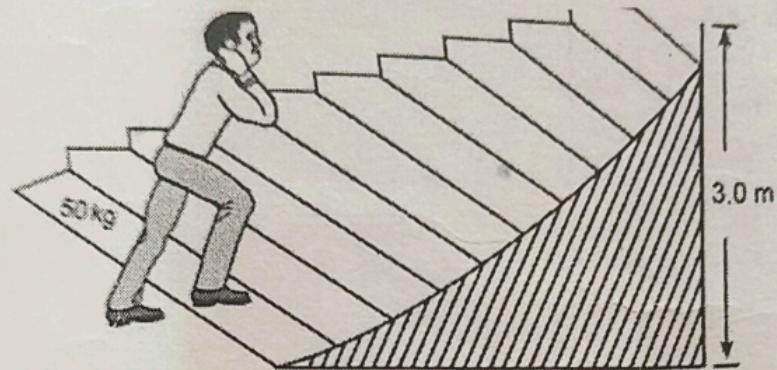
14. a) Figure shows the time of heating of certain mass of substance versus temperature.

i. Explain why there is no rise in temperature of substance in the region AB and CD? [1]

ii. Why time of heating is more in region CD than the region AB? [1]

b) Describe Searle's method to determination of thermal conductivity of a good conductor. [3]

15. a) What physical concept is provided by universal gas constant? Write its unit. [2]



b) The root mean square (rms) speed of a gas molecule is 600 m/s at  $500^{\circ}\text{C}$ . Calculate the rms speed of the gas at  $100^{\circ}\text{C}$ . [3]

16. a) What is angular dispersion? Write the expression for angular dispersion in terms of deviation. [2]

b) Calculate the value of angular dispersion, dispersive power and refractive index of prism ( $\mu_r$ ) for red colour using the given diagram. [Given  $\mu_v = 1.52$ ] [3]

**OR**

The diagram shows how a convex lens forms an image of an object.

a) What is the nature of the image? [1]

b) What would be the focal length of the lens if object distance is 15cm and image distance is 30cm in the opposite side of the lens? [2]

c) What is the size of the image if size of the object is 25cm? [2]

17. a) How will you arrange 3 capacitors each having the capacity of  $2 \mu\text{F}$  to get a capacitor of capacity  $3 \mu\text{F}$ ? Explain. [2]

b) Find an expression for the energy stored in a charged capacitor. [3]

18. a) Define potential gradient. [1]

b) Derive a relation between potential gradient and electric field intensity. [2]

c) Observe the figure and

answer the questions:

(i) If the electric potential at point L is  $+3\text{V}$ , find the magnitude of charge Q. [1]

(ii) Show the electric potential at point N due to the charge is  $+1\text{ V}$ .

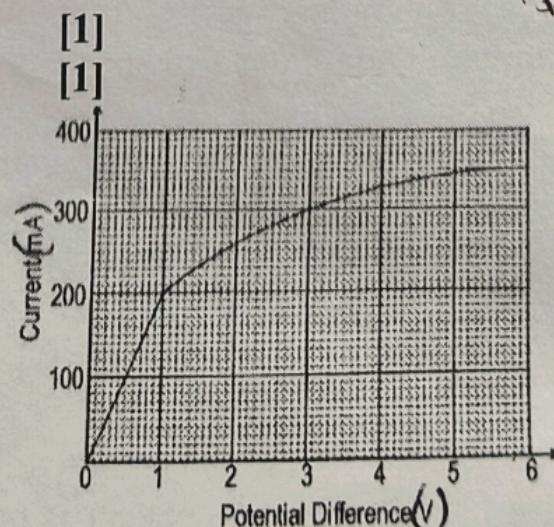
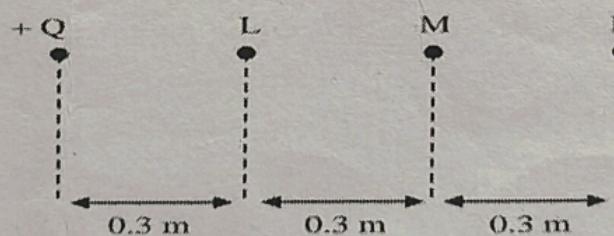
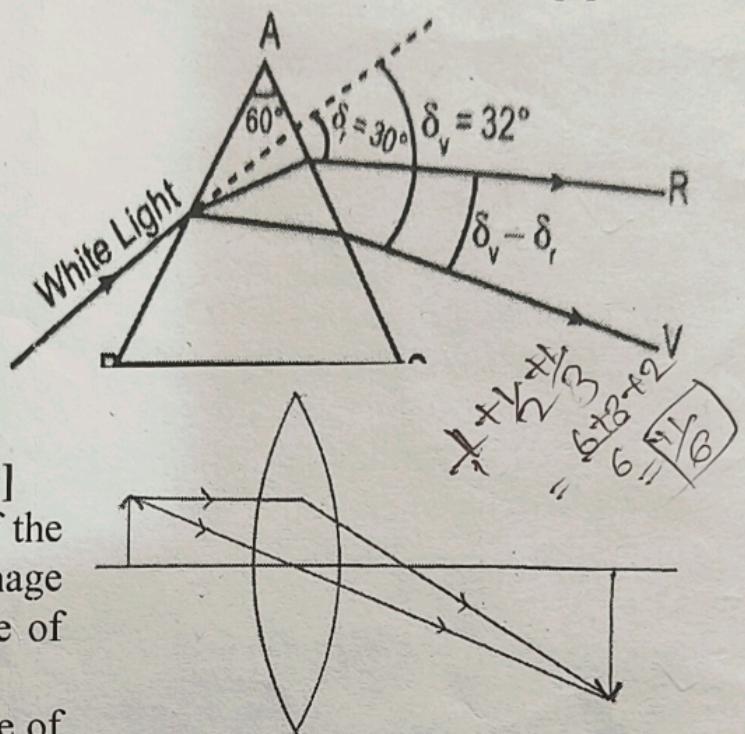
19. a) State Ohm's law.

b) The graph shows the  $(I - V)$  characteristic of a  $350\text{ mA}, 6\text{ V}$  filament lamp

(i) State how the graph shows that the filament lamp does not obey Ohm's law. [1]

(ii) Calculate the resistance of the lamp for current  $200\text{ mA}$ . [1]

(iii) The filament of the lamp is a wire of



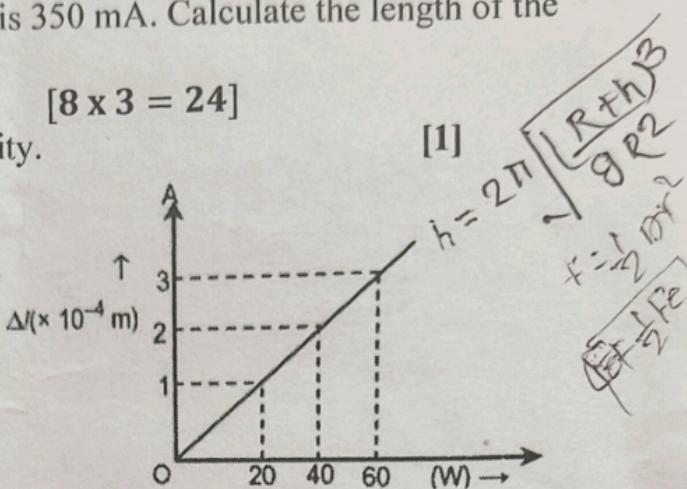
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constant radius  $8 \times 10^{-6}$  m, made from tungsten. The resistivity of the tungsten is  $3.5 \times 10^{-7} \Omega\text{m}$ . The current in the lamp is 350 mA. Calculate the length of the filament in the lamp. [2]

**Group 'C'** [8 x 3 = 24]

20. a) Define Young's modulus of elasticity.

b) The graph shows the extension ( $\Delta l$ ) of a wire of length 1 m suspended from the top of the roof at one end with a load W (in newton) connected to the other end. If the cross section of the wire is  $10^{-6} \text{ m}^2$ . Calculate the Young's modulus of the wire. [2]



c) Steel is more elastic than rubber.

Explain. [2]

d) Derive a relation of energy stored in a stretched wire in terms of stress and strain. [3]

21. a) At what height above the surface of the earth, the value of acceleration due to gravity is reduced to one fourth of its value on the surface of the earth? [2]

b) What is orbital velocity of a satellite? Derive an expression for it. [3]

c) An artificial satellite revolves round the earth in 3 hours in a circular orbit. Find the height of the satellite above the earth assuming earth as a sphere of radius 6370 km. [3]

**OR**

a) What is meant by angular velocity? [1]

b) Explain the significance of banking of a curved road. [2]

c) Discuss the motion of a vehicle round a banked circular track and obtain an expression for the banking angle in terms of speed of the vehicle. [3]

d) At what angle should a circular road be banked so that a car running at 50km/hr be safe to go round the circular turn of 200 m radius? [2]

22. a) All nuclei have nearly equal density. Why? [2]

b) What is physical significance of binding energy per nucleon? [1]

c) The most common isotope of uranium  $^{238}_{92}\text{U}$ , has atomic mass 238.050783 u. Calculate the mass defect, binding energy and binding energy per nucleon. (mass of proton = 1.007825 u, mass of neutron = 1.008665 u) [3]

d) What are the differences between intrinsic and extrinsic semiconductors? [2]

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What do you mean by black body?

State and explain Stefan law.