

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

GROUP 'A'

## Multiple choice questions

[11×1=11]

1. The ~~acceleration~~ <sup>Velocity</sup>  $v$  of a particle is given in terms of time  $t$  by the following relation,  
 $v = \frac{b}{t+c}$ , the dimensions of  $b$  and  $c$  are [a]  $b = T, c = LT$  [b]  $b=LT, c=L$   
 [c]  $b = L, c=T$ . [d]  $b=LT, c=T^2$
2. If the error in the measurement of the radius of a sphere is 2 %, then the maximum possible error in the measurement of its volume is [a] 6% [b] 3% [c]  $\frac{1}{2}$  % [d]  $\frac{4}{3} \pi$  %
3. If  $\vec{A}$ ,  $\vec{B}$ ,  $\vec{C}$  vectors have magnitude 6, 8 & 10 respectively,  $\vec{A} + \vec{B} = \vec{C}$ , angle between  $A$  &  $B$  is : [a]  $0^\circ$  [b]  $90^\circ$  [c]  $45^\circ$  [d]  $180^\circ$
4. If the magnitude of the difference between two unit vectors is  $\sqrt{3}$ , then the magnitude of the sum of the two vectors is : [a]  $\frac{1}{2}$  [b] 1 [c] 2 [d] 3
5. The resultant of two forces 8N and 6N is -[a] 1N [b] 10N [c] 15N [d] 20N
6. A difference of temperature of  $25^\circ\text{C}$  is equivalent to difference of Kelvin scale:  
 (a) 45 K (b) 248 K (c) 298 K (d) 25 K
7. A hole is there in a metal plate. Upon heating the plate diameter of hole would:  
 (a) increases (b) decrease (c) remains the same (d) may increase or decrease
8. If a bimetallic strip is heated it will: (a) towards the metal with lower thermal expansion coefficient (b) bend towards the metal with higher thermal expansion coefficient (c) twist itself into a helix (d) have no bending
9. What is the dimensional formula of permittivity of free space? (a)  $[M^{-1}L^{-3}T^4A^2]$   
 (b)  $[M^{-1}L^{-3}T^3A^{-2}]$  (c)  $[M^{-1}L^{-2}T^3A^2]$  (d)  $[M^{-1}L^{-2}T^{-3}A^2]$



10. Two charged particles are at a distance  $R$  exert  $F$  force on each other. If the medium of dielectric constant 64 is placed between them, then the distance at which the same force is: (a)  $R$  (b)  $8R$  (c)  $\frac{R}{8}$  (d)  $\frac{R}{64}$
11. The number of electrons in one coulomb of charge will be: (a)  $1.667 \times 10^{19}$  (b)  $6.25 \times 10^{18}$  (c)  $6.023 \times 10^{23}$  (d)  $6.25 \times 10^{19}$

### GROUP 'B'

Short answers questions.

[8×5 = 40]

12. (a) Convert 50 joule into erg by using the dimensional method. [2]
- (b) In Vander Waals equation,  $\left(P + \frac{a}{V^2}\right)(V - b) = RT$  where  $P$  be the pressure,  $V$  be the volume,  $T$  be the temperature and  $R$  be the universal gas constant. What are the dimensions of the constants 'a' and 'b'? [3]
13. (a) Determine the area of the parallelogram whose adjacent sides are  $2\hat{i} + \hat{j} + 3\hat{k}$  and  $\hat{i} - \hat{j}$ . [2]
- (b) A spelunker is surveying a cave. She follows a passage 180 m straight west, then 210 m in a direction  $45^\circ$  east of south, and then 280 m at  $30^\circ$  east of north. After a fourth unmeasured displacement, she finds herself back where she started. Use a scale drawing to determine the magnitude and direction of the fourth displacement. [3]
14. (a) What do you mean by linear expansivity? Does it depend on the original length? Explain. [2]
- (b) A glass flask of volume  $600 \text{ cm}^3$  is just filled with mercury at  $10^\circ \text{C}$ . How much mercury overflows when the temperature of the system is raised to  $90^\circ \text{C}$ ? (Linear expansivity for glass =  $4 \times 10^{-6} / \text{K}$  and cubical expansivity for mercury =  $18 \times 10^{-5} / \text{K}$ ) [3]
15. (a) Force of attraction between two-point charges at a distance  $x$  is  $F$ . What distance should they be kept in the same medium so that the net force between them is  $\frac{F}{4}$ ? [2]
- (b) Define point of action. State and explain coulomb's law in electrostatics. [3]



16. (a) Two identical particles are charged and held at a distance of 1m from each other. They are found to be attracting each other with a force of 0.027 N. Now, they are connected by a conducting wire so that charge flows between them. When the charge flow stops, they are found to be repelling each other with a force of 0.009 N. Find the initial charge on each particle. [3]
- (b) Why is repulsion sure test for testing a charged body? [2]
17. (a) What are differences between real and virtual image? [2]
- (b) Derive the mirror formula for a convex mirror. [3]
18. (a) Derive the relation  $f = \frac{R}{2}$  for concave mirror with appropriate sign convention. [2]
- (b) A spherical concave shaving mirror has a radius of curvature of 32 cm. What is the magnification of a person's face when it is 12 cm to the left of the vertex of the mirror? [3]
19. (a) What do you mean by tangential acceleration? Derive an expression for maximum velocity with which vehicle can take safe turn on a leveled road. [1+2]
- (b) At what angle should a circular road be banked so that a car running at 72 km/hr be safe to go around in the circular turn of 200 m radius? [2]

OR

- (a) What do you mean by young modulus of elasticity? Does it depend on area of the wire? [2]
- (b) A 5 m long aluminum wire ( $Y = 7 \times 10^{10} \text{ Nm}^{-2}$ ) of diameter 3 mm supports a 40 kg mass. In order to have the same elongation in the copper wire ( $Y = 12 \times 10^{10} \text{ Nm}^{-2}$ ) of the same length under the same weight. What should be the diameter of copper wire? [3]

### GROUP 'C'

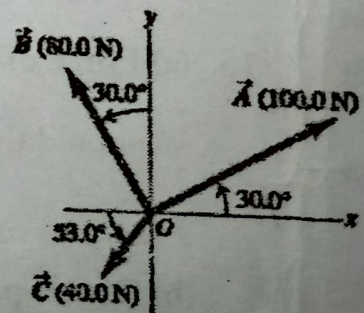
#### Long answers questions

[3×8 = 24]

20. (a) State parallelogram law of vector addition. Obtain an expression for the resultant of two vectors  $\vec{A}$  and  $\vec{B}$  inclined at an angle  $\theta$ . [1+3]

- (b) What is a condition to get the minimum value of the resultant? [1]

- (c) Three horizontal ropes pull on a large stone in the ground, producing the vector forces  $\vec{A}$  (100 N),  $\vec{B}$  (80 N) and  $\vec{C}$  (40 N) as shown in fig. Find the magnitude and direction of the fourth force on the stone that will make the vector sum of the four forces zero. [3]





21. (a) Derive an expression for the elastic energy stored in a uniform stretch. [2]
- (b) Two wires have equal lengths and are made up of the same material. If the diameter of one wire is twice another wire, which one has a greater extension for a load? [2]
- (c) The rubber catapult has a cross-sectional area  $1 \text{ mm}^2$  and a total unstretched length of 10 cm. It is stretched to 12 cm and then released to project a missile of mass 5 gm. Calculate the velocity of the projection. (Young's modulus of elasticity of rubber  $Y = 5 \times 10^8 \text{ N/m}^2$ ) [3]

OR

- (a) What do you mean by tangential acceleration and radial acceleration? [2]
- (b) Show that the period of oscillation of conical pendulum is given by
- $$T = 2\pi \sqrt{\frac{l \cos \theta}{g}}, \text{ where symbols have their usual meanings.} \quad [3]$$
- (c) An object of mass 8 kg is whirled around a vertical circle of radius 2 m with a constant speed of 6 m/s. Calculate the maximum tension in the string. [3]
22. (b) A circular piece is cut from a flat metal sheet. The sheet is then placed in a furnace. Will the size of the hole become larger or smaller? Explain. [2]
- (b) How can you determine the linear expansivity of a solid in the laboratory? Can cubical expansivity be derived from this value? [3]
- (c) A clock which has a brass pendulum beats seconds correctly when the temperature of the room is  $45^\circ\text{C}$ . How many seconds will it lose or gain per day when the temperature of the room falls to  $15^\circ\text{C}$ ? [ $\alpha$  for brass  $= 1.9 \times 10^{-5}/\text{K}$ ] [3]

**Best Of Luck**