

# ARYAN INSTITUTE

## CLASS-11<sup>TH</sup> SUBJECT-PHYSICS SAMPLE PAPER -04

Time Allowed :3 Hr

Max. Marks :70

### General Instructions:

1. All questions are compulsory. There are 37 questions in all.
2. This question paper has four sections: Section A, Section B, Section C and Section D.
3. Section **A** contains twenty questions of one mark each, Section **B** contains seven questions of two marks each, Section **C** contains seven questions of three marks each, and Section **D** contains three questions of five marks each.
4. There is no overall choice. However, internal choices have been provided in two questions of one mark each, two questions of two marks, one question of three marks and three questions of five marks weightage. You have to attempt only one of the choices in such questions.
5. Use of Calculation is not permitted. However, you may use log tables if necessary.
6. You may use the following values of physical constants wherever necessary:

$$\text{Boltzmann's constant } K = 1.381 \times 10^{-23} \text{ J K}^{-1}$$

$$\text{Avogadro's number } N_A = 6.022 \times 10^{23} / \text{mol}$$

$$\text{Radius of Earth} = 6400 \text{ km}$$

$$1 \text{ atmospheric pressure} = 1.013 \times 10^5 \text{ Pa}$$

$$g = 9.8 \text{ m/s}^2$$

$$R = 8.3 \text{ J mol}^{-1} \text{ K}^{-1}$$

### SECTION-A

- Q1.** If the error in the measurement of radius of a sphere is 2% then the error in the determination of volume of the sphere will be- 1  
(a) 4%                      (b) 6%                      (c) 8%                      (d) 2%
- Q2.** The displacement of particle is given by  $x = (t - 2)^2$ , where  $x$  is in metres, and  $t$  in seconds. The distance covered by the particle in first 4 seconds is- 1  
(a) 4 m    (b) 8 m  
(c) 12 m    (d) 16 m
- Q3.** If  $|\vec{A} \times \vec{B}| = |\vec{B} \times \vec{A}|$ , then the angle between  $\vec{A}$  and  $\vec{B}$  is 1  
(a)  $\frac{\pi}{2}$                       (b)  $\frac{\pi}{3}$                       (c)  $\pi$                       (d)  $\frac{\pi}{4}$

- Q4.** The average force necessary to stop a bullet of mass 20 g, moving with a speed of  $250 \text{ m s}^{-1}$ , as it penetrates into the wood for a distance of 12 cm is- **1**  
 (a)  $2.2 \times 10^3 \text{ N}$  (b)  $3.2 \times 10^3 \text{ N}$   
 (c)  $4.2 \times 10^3 \text{ N}$  (d)  $5.2 \times 10^3 \text{ N}$
- Q5.** A body moves a distance of 10 m along a straight line under the action of force of 5 N. If the work done is 25 J, the angle which the force makes with the direction of motion of the body is- **1**  
 (a)  $0^\circ$  (b)  $30^\circ$  (c)  $60^\circ$  (d)  $90^\circ$
- Q6.** A child is standing with folded hands at the centre of a platform rotating about its central axis. The kinetic energy of the system is K. The child now stretches his arms so that the moment of inertia of the system doubles. The kinetic energy of the system now is - **1**  
 (a)  $2K$  (b)  $\frac{K}{2}$  (c)  $\frac{K}{4}$  (d)  $4K$
- Q7.** A wire elongates by 1 mm when a load W is hanged from it. If the wire goes over a pulley and two weights W each are hung at the two ends, the elongation of the wire will be (in mm) **1**  
 (a)  $l$  (b)  $2l$  (c) zero (d)  $\frac{l}{2}$
- Q8.** Two simple harmonic motions are represented by the equations : **1**  
 $y_1 = 0.1 \sin \left( 100\pi t + \frac{\pi}{3} \right)$  and  $y_2 = 0.1 \cos \pi t$ . The initial phase difference of the velocity of particle 1 with respect to the velocity of particle 2 is-  
 (a)  $-\frac{\pi}{3}$  (b)  $\frac{\pi}{6}$  (c)  $-\frac{\pi}{6}$  (d)  $\frac{\pi}{3}$
- Q9.** Three vectors  $\vec{A}$ ,  $\vec{B}$  and  $\vec{C}$  satisfy the relation  $\vec{A} \cdot \vec{B} = 0$  and  $\vec{A} \cdot \vec{C} = 0$ . The vector  $\vec{A}$  is parallel to **1**  
 (a)  $\vec{B}$  (b)  $\vec{C}$  (c)  $\vec{B} \cdot \vec{C}$  (d)  $\vec{B} \times \vec{C}$
- Q10.** The first law of thermodynamics is concerned with the conservation of **1**  
 (a) momentum (b) energy  
 (c) mass (d) temperature
- Q11.** As per law of orbits all planets move in .....orbits with the sun situated at..... **1**
- Q12.** Value of Boltzmann's constant  $k_B$  is..... **1**
- Q13.** The longitudinal strain in a metal bar is 0.05. If the Poisson's ratio for the metal is 0.25, the lateral strain is..... **1**
- Q14.** In uniform circular motion acceleration vector is directed..... **1**
- Q15.** Rise of a liquid in a capillary tube is .....proportional to its internal diameter. **1**

**OR**

A mercury barometer always reads slightly..... than the true value of atmospheric pressure.

- Q16.** Write the name of strongest fundamental force in nature. **1**
- Q17.** Read the statement given below carefully and state, with reason, if it is true or false: “The acceleration vector of a particle in uniform circular motion averaged over one cycle is a null vector”. **1**
- Q18.** Give an example in which work done is negative. **1**
- Q19.** Why are spokes provided in a bicycle wheel? **1**
- Q20.** What is the nature of sound waves? **1**

**OR**

Give three examples of transverse waves.

**SECTION-B**

- Q21.** The length and breadth of a rectangle are measured as  $(a \pm \Delta a)$  and  $(b \pm \Delta b)$  respectively. Find (i) relative error, and (ii) absolute error in the measurement of area. **2**
- Q22.** If in a case of motion, displacement is directly proportional to the square of the time elapsed, what do you think about its acceleration *i. e.*, constant or variable? Explain. **2**

**OR**

An object is in uniform motion along a straight line. What will be the position-time graph for the motion of the object, if:

- (a)  $x_0 = +ve$  and  $v = -ve$ .  
(b)  $x_0 = -ve$  and  $v = +ve$ .

- Q23.** Briefly explain why there is practically no atmosphere on the surface of the moon. **2**
- Q24.** A man weighing 60 kg supports a load of 40 kg on his head. What is the work done by him when he moves over a distance of 200 m up an incline rising 1 in 10? **2**
- Q25.** Explain why should the beams used in construction of bridge have large depth and small breadth? **2**
- Q26.** One mole of an ideal gas requires 207 J heat to rise the temperature by 10 K when heated at constant pressure. Find the amount of heat required to heat the same gas to raise the temperature by same 10 K under constant volume conditions. Give  $R = 8.3 J \text{ mol}^{-1} \text{ K}^{-1}$ . **2**

**OR**

In a test experiment on a model aeroplane in a wind tunnel, the flow speeds on the upper and lower surfaces of the wing are  $70 \text{ m s}^{-1}$  and  $63 \text{ m s}^{-1}$ , respectively. What is the lift on the wing if its area is  $2.5 \text{ m}^2$ ? Take the density of air to be  $1.3 \text{ kg m}^{-3}$ .

- Q27.** Show that in a simple harmonic motion particle velocity is ahead in phase by  $\frac{\pi}{2}$  radian as compared to its displacement and acceleration is further ahead in phase by  $\frac{\pi}{2}$  as compared to velocity. **2**

### SECTION-C

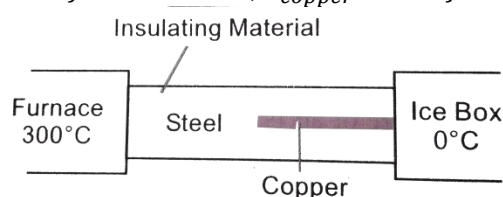
- Q28.** On a two-lane road, car A is travelling with a speed of  $36 \text{ km h}^{-1}$ . Two cars B and C approach car A in opposite directions with a speed of  $54 \text{ km h}^{-1}$  each. At a certain instant, when the distance AB is equal to AC both being 1 km, B decides to overtake A before C does. What minimum acceleration of car B is required to avoid an accident? **3**
- Q29.** A body is projected with velocity 'u' at an angle  $\theta$  upward from horizontal. Deduce the expression for (i) maximum height attained, and (ii) horizontal range time of flight, velocity at any time (t). **3**
- Q30.** A bullet of mass  $0.012 \text{ kg}$  and horizontal speed  $70 \text{ m s}^{-1}$  strike a block of wood of mass  $0.4 \text{ kg}$  and instantly comes to rest with respect to block. The block is suspended from the ceiling by means of thin wire. Calculate the height to which the block rises. **3**

### OR

State and prove Kepler's second law of planetary motion.

- Q31.** What is the temperature of the steel-copper junction in the steady state of the system shown in figure? The area of cross-section of steel rod is twice that of the copper rod. Give that **3**

$$K_{\text{steel}} = 50.2 \text{ J s}^{-1} \text{ m}^{-1} \text{ K}^{-1}, K_{\text{copper}} = 385 \text{ J s}^{-1} \text{ m}^{-1} \text{ K}^{-1}$$



- Q32.** State law of equipartition of energy. Using this law, determine the values of  $C_v$ ,  $C_p$  and  $\gamma$  for a diatomic gas. **3**
- Q33.** Show that for small oscillations the motion of a simple pendulum is simple harmonic. Derive an expression for its time period. Does it depend on the mass of the bob? **3**
- Q34.** What are beats? Prove that the number of beats produced per second by the two sound source is equal to the difference between their frequencies. **3**

### SECTION-D

- Q35.** (a) Define angle of friction and angle of repose. Show that both are numerically equal. **5**  
(b) Determine the maximum acceleration of the train in which a box lying on the floor remains stationary. Given that the coefficient of static friction between the box and the floor of the train is 0.15. Take  $g = 10 \text{ m s}^{-2}$ .

**OR**

- (a) Two masses  $m_1$  and  $m_2$  (where  $m_1 > m_2$ ) are connected together by a light, inextensible string passing over a smooth, light pulley. Find the magnitude of acceleration of the system. Also find the tension in the string.  
(b) Two billiard balls each of mass 0.05 kg moving in opposite directions with speed  $6 \text{ m s}^{-1}$  collide and rebound with the same speed. What is the impulse to each ball due to the other?

- Q36.** (a) What is torque? Give its SI unit. Show that it is equal to the product of force and perpendicular distance of its line of action from the axis of rotation. **5**  
(b) A solid cylinder of mass 12 kg and radius 0.4 m is rotating about its own axis of symmetry at a rate of  $30 \text{ rad s}^{-1}$ . Find the kinetic energy associated with it.

**OR**

- (a) State and explain the theorem of parallel axes.  
(b) The moment of inertia of a uniform solid circular disc about its own axis of rotation is  $\frac{1}{2}MR^2$ . What is its moment of inertia about a tangent of the disc parallel of its axis of rotation?  
(c) Will two spheres of same mass and same radii but one solid and the other hollow have equal moments of inertia? Give reason for your answer.

- Q37.** Derive an expression for ascent formula for rise of liquid in a capillary tube. Explain what happens when the length of capillary tube is less than the height up to which the liquid may rise in it? **5**

**OR**

- (a) State and prove the equation of continuity for steady flow of an ideal fluid.  
(b) Water is flowing with a speed of  $2.0 \text{ m s}^{-1}$  in a horizontal pipe with cross-sectional area decreasing from  $2 \times 10^{-2} \text{ m}^2$  to  $1 \times 10^{-2} \text{ m}^2$  at pressure  $4 \times 10^4 \text{ Pa}$ . What will be the pressure at smaller cross-section?