PHYSICS PAPER - I

Date : 30.09.2010

Time : 2 Hrs.) **Question Paper : September 2010** (Max. Marks : 40

(Mechanics, Proporties of Matter, Sound and Heat)

Q. 1. Select and write the most appropriate answer from the given alternatives for each sub-question : **(8)**

(i) For the particle performing linear S.H.M. from general position, the state of oscillation of a particle giving its position and direction of motion at a time equal to zero (t = 0) is called .....

(a) phase of S.H.M. (b) final phase of S.H.M.

(c) angular speed of S.H.M. (d) epoch of S.H.M.

(ii) The strain energy per unit volume of the wire under increasing load is .....

(a) $\frac{1}{2} \times (\text{stress})^2 \times \text{strain}$ (b) $\frac{1}{2} \times \text{stress} \times (\text{strain})^2$

(c) $0.5 \times \text{stress} \times \text{strain}$ (d) $0.5 \times (\text{strain})^2 \times \frac{1}{y}$

(iii) When the common salt is dissolved in pure water, the surface tension of a solution is ..... that of pure water.

(a) less than (b) equal to (c) greater than (d) half

(iv) The R. M. S. speed of a gas molecule is directly proportional to .....

(a) its absolute temperature. (b) the square root of its absolute temperature.

(c) the square of its absolute temperature (d) the fourth power of its absolute temperature.

(v) The coefficient of absorption of the body is equal to its coefficient of emission at a given temperature is called .....

(a) Stefan's law. (b) Newton's law.

(c) Kirchhoff's law. (d) Boyle's law.

(vi) The equation of a simple harmonic progressive wave travelling along negative direction of x - axis is .....

(a) $y = a \sin 2\pi\left(\frac{t}{T} - \frac{x}{\lambda}\right)$ (b) $y = a \sin \frac{2\pi}{\lambda}(vt - x)$

(c) $y = a \sin \pi\left(nt + \frac{x}{\lambda}\right)$ (d) $y = a \sin 2\pi\left(\frac{t}{T} + \frac{x}{\lambda}\right)$

(vii) Angular speed of a minute hand of a wrist watch in rad / s is .....

(a) $\frac{\pi}{60}$ (b) $\frac{\pi}{900}$ (c) $\frac{\pi}{1800}$ (d) $\frac{\pi}{3600}$

(viii) Acceleration due to gravity above the earth's surface at a height equal to the radius of the earth is ..... (Given : g = 10 m/s²)

(a) 2.5 m/s² (b) 5 m/s² (c) 9.8 m/s² (d) 10 m/s²

Q. 2. (A) Attempt any ONE :

(1) A stone of mass one kilogram is tied to the one end of a string of length 5 metre and whirled in a vertical circle. What will be the minimum speed required at the lowest position to complete the circle ? **(2)**

(Given : g = 9.8 m/s²) **(2)**

(ii) Moment of inertia of a disc about an axis passing through its centre and prependicular to its plane is 10 kg- m². Find its M. I. about the diameter.

(B) Attempt any TWO : **(6)**

(i) Draw a neat labelled diagram for the fundamental mode of vibrations of air column in a pipe.

(a) open at both the ends. (b) open at one end.

Write formula for the corresponding fundamental frequency in each case.

(ii) State any 'six' assumptions of kinetic theory of gases.

(iii) Derive an expression for the maximum safe speed of the vehicle moving along a banked road.

Q. 3. (A) Attempt any ONE : **(2)**

(i) Explain, why $C_p > C_v$.

(ii) Represent graphically the displacement and acceleration against time when particle in S.H.M. starts from mean position. Write their corresponding equations.

(B) Attempt any TWO : **(6)**

(i) What is the surface energy ? Establish the relation between surface energy and surface tension.

(ii) Define coefficient of absorption, reflection and transmission. Derive relations between them.

(iii) Explain the behaviour of a wire under increasing load.

Q. 4. (A) Attempt any TWO : **(4)**

(i) Define perfectly black body. How can it be realised in practice ?

(ii) State Hooke's law. Give S.I. unit and dimensions of modulus of elasticity.

(iii) What is capillarity ? State any 'two' illustrations of capillarity.

(B) Attempt any ONE : **(4)**

(i) Derive an expression for formation of stationary wave by analytical method. Show that nodes or antinodes are equally spaced.

(ii) Derive an expression for the M. I. of a solid sphere about a diameter, when axis is perpendicular and goes through its centre.

Q. 5. Attempt any TWO : **(8)**

(i) S.H.M. is given by the equation $x = 8 \sin (4\pi t) + 6 \cos (4\pi t)$ cm.
Find its -
(a) amplitude (b) initial phase (c) period (d) frequency

(ii) Find kinetic eneryg, potential energy, total energy and binding energy of an artificial satellite orbiting at a height 3600 km above the surface of the earth.
(Given : mass of the earth = 6×10^{24} kg, radius of the earth = 6400 km,
mass of satellite = 10^3 kg and $G = 6.67 \times 10^{-11}$ S. I. unit.)

(iii) 32 tuning forks are arranged in descending order of frequencies. It any two consecutive tuning forks are sounded together, the number of beats heard is eight per second. The frequency of the first tuning fork is octave that of the last fork. Calculate frequency of the first, last and the 21st fork.