

DAY — 05

SEAT NUMBER

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2018 II 26

1100

J - 236

(E)

PHYSICS (54)

Time : 3 Hrs.

(8 Pages)

Max. Marks : 70

- Note :**
- (i) All questions are compulsory.
 - (ii) Neat diagrams must be drawn wherever necessary.
 - (iii) Figures to the right indicate full marks.
 - (iv) Use of only logarithmic table is allowed.
 - (v) All symbols have their usual meaning unless otherwise stated.
 - (vi) Answers to both sections must be written in the same answer book.
 - (vii) Answer to every question must be written on a new page.

SECTION – I

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

[7]

- (i) In stationary wave, the distance between a node and its adjacent antinode is _____.

(a) λ

(b) $\frac{\lambda}{4}$

(c) $\frac{\lambda}{2}$

(d) 2λ

- (ii) If the source is moving away from the observer, then the apparent frequency ____.
- (a) will increase (b) will remain the same
(c) will be zero (d) will decrease
- (iii) A particle of mass m performs vertical motion in a circle of radius r . Its potential energy at the highest point is ____.
(g is acceleration due to gravity)
- (a) $2 mgr$ (b) mgr
(c) 0 (d) $3 mgr$
- (iv) The compressibility of a substance is the reciprocal of ____.
- (a) Young's modulus (b) bulk modulus
(c) modulus of rigidity (d) Poisson's ratio
- (v) If the particle starts its motion from mean position, the phase difference between displacement and acceleration is ____.
- (a) 2π rad (b) $\frac{\pi}{2}$ rad
(c) π rad (d) $\frac{\pi}{4}$ rad
- (vi) The kinetic energy per molecule of a gas at temperature T is ____.
- (a) $\left(\frac{3}{2}\right)RT$ (b) $\left(\frac{3}{2}\right)K_B T$
(c) $\left(\frac{2}{3}\right)RT$ (d) $\left(\frac{3}{2}\right)\left(\frac{RT}{M}\right)$

(vii) A thin ring has mass 0.25 kg and radius 0.5m. Its moment of inertia about an axis passing through its centre and perpendicular to its plane is _____.

(a) 0.0625 kg m^2 (b) 0.625 kg m^2

(c) 6.25 kg m^2 (d) 62.5 kg m^2

Q. 2. Attempt Any SIX :

[12]

- (i) State Kepler's law of orbit and law of equal areas.
- (ii) State any 'four' assumptions of kinetic theory of gases.
- (iii) Define moment of inertia. State its SI unit and dimensions.
- (iv) Distinguish between centripetal and centrifugal force.
- (v) In Melde's experiment, when tension in the string is 10 g wt then three loops are obtained. Determine the tension in the string required to obtain four loops, if all other conditions are constant.
- (vi) Calculate the work done in increasing the radius of a soap bubble in air from 1 cm to 2 cm. The surface tension of soap solution is 30 dyne / cm. ($\pi = 3.142$)
- (vii) A flat curve on a highway has a radius of curvature 400 m. A car goes around a curve at a speed of 32 m/s. What is the minimum value of coefficient of friction that will prevent the car from sliding? ($g = 9.8 \text{ m/s}^2$)
- (viii) A particle performing linear S. H. M. has maximum velocity of 25 cm/s and maximum acceleration of 100 cm/s^2 . Find the amplitude and period of oscillation. ($\pi = 3.142$)

Q. 3. Attempt any THREE :

[9]

- (i) Derive Laplace's law for a spherical membrane.
- (ii) State and prove principle of conservation of angular momentum.
- (iii) Calculate the strain energy per unit volume in a brass wire of length 3 m and area of cross-section 0.6 mm^2 when it is stretched by 3 mm and a force of 6 kgwt is applied to its free end.
- (iv) What is the decrease in weight of a body of mass 500 Kg when it is taken into a mine of depth 1000 Km?
(Radius of earth $R = 6400 \text{ km}$, $g = 9.8 \text{ m/s}^2$)

Q. 4. State the differential equation of linear simple harmonic motion.

[7]

Hence obtain the expression for acceleration, velocity and displacement of a particle performing linear S. H. M.

A body cools from 80°C to 70°C in 5 minutes and to 62°C in the next 5 minutes. Calculate the temperature of the surroundings.

OR

What is meant by harmonics? Show that only odd harmonics are present as overtones in the case of an air column vibrating in a pipe closed at one end.

The wavelengths of two sound waves in air are $\frac{81}{173} \text{ m}$ and $\frac{81}{170} \text{ m}$. They produce 10 beats per second. Calculate the velocity of sound in air.

SECTION – II

Q. 5. Select and write the most appropriate answer from the given alternatives for each sub-question : **[7]**

- (i) The reflected waves from an ionosphere are _____.
(a) ground waves (b) sky waves
(c) space waves (d) very high frequency waves
- (ii) In interference pattern, using two coherent sources of light; the fringe width is _____.
(a) directly proportional to wavelength.
(b) inversely proportional to square of the wavelength.
(c) inversely proportional to wavelength.
(d) directly proportional to square of the wavelength.
- (iii) Electric intensity outside a charged cylinder having the charge per unit length ' λ ' at a distance r from its axis is _____.
(a) $E = \frac{2\pi \epsilon_0 \lambda}{Kr^2}$ (b) $E = \frac{\epsilon_0 \lambda}{2\pi Kr^2}$
(c) $E = \frac{\lambda}{2\pi \epsilon_0 Kr}$ (d) $E = \frac{4\pi \epsilon_0 \lambda}{Kr^2}$
- (iv) SI unit of potential gradient is _____.
(a) V cm (b) $\frac{V}{cm}$
(c) V m (d) $\frac{V}{m}$

(v) The momentum associated with photon is given by _____.

- (a) $h\nu$ (b) $\frac{h\nu}{c}$
(c) hE (d) $h\lambda$

(vi) A pure semiconductor is _____.

- (a) an extrinsic semiconductor
(b) an intrinsic semiconductor
(c) p-type semiconductor
(d) n-type semiconductor

(vii) Glass plate of refractive index 1.732 is to be used as a polariser, its polarising angle is _____.

- (a) 30° (b) 45°
(c) 60° (d) 90°

Q. 6. Attempt any SIX :

[12]

- (i) State the conditions to get constructive and destructive interference of light.
- (ii) State and explain Ampere's circuital law.
- (iii) Draw a neat and labelled block diagram of a receiver.
- (iv) Define magnetization. Write its SI unit and dimensions.
- (v) The electron in the hydrogen atom is moving with a speed of 2.3×10^6 m/s in an orbit of radius $0.53 \text{ \AA}$. Calculate the period of revolution of electron. ($\pi = 3.142$)
- (vi) A capacitor of capacitance $0.5 \mu\text{F}$ is connected to a source of alternating e.m.f. of frequency 100 Hz. What is the capacitive reactance? ($\pi = 3.142$)

- (vii) Calculate the de-Broglie wavelength of an electron moving with one fifth of the speed of light. Neglect relativistic effects. ($h = 6.63 \times 10^{-34}$ J.s., $c = 3 \times 10^8$ m/s, mass of electron = 9×10^{-31} kg)
- (viii) In a cyclotron, magnetic field of 1.4 Wb/m^2 is used. To accelerate protons, how rapidly should the electric field between the Dees be reversed?
 ($\pi = 3.142$, $M_p = 1.67 \times 10^{-27}$ kg, $e = 1.6 \times 10^{-19}$ C)

Q. 7. Attempt any THREE :

[9]

- (i) Explain with a neat circuit diagram how will you determine unknown resistance 'X' by using meter bridge.
- (ii) What is Zener diode? How is it used as a voltage regulator?
- (iii) In a biprism experiment, light of wavelength $5200 \text{ \AA}$ is used to get an interference pattern on the screen. The fringe width changes by 1.3 mm when the screen is moved towards biprism by 50 cm . Find the distance between two virtual images of the slit.
- (iv) The refractive indices of water and diamond are $\frac{4}{3}$ and 2.42 respectively. Find the speed of light in water and diamond.
 ($c = 3 \times 10^8$ m/s)

Q. 8. Prove theoretically the relation between e.m.f. induced in a coil and rate of change of magnetic flux in electromagnetic induction. A parallel plate air condenser has a capacity of $20 \mu\text{F}$. What will be the new capacity if :

[7]

- (a) the distance between the two plates is doubled?
- (b) a marble slab of dielectric constant 8 is introduced between the two plates?

OR

Draw a neat and labelled energy level diagram and explain Balmer series and Brackett series of spectral lines for hydrogen atom.

The work function for a metal surface is 2.2 eV . If light of wavelength $5000 \text{ \AA}$ is incident on the surface of the metal, find the threshold frequency and incident frequency. Will there be an emission of photoelectrons or not?

($c = 3 \times 10^8 \text{ m/s}$, $1 \text{ eV} = 1.6 \times 10^{-19} \text{ J}$, $h = 6.63 \times 10^{-34} \text{ J.s.}$)

