

DAY — **06**

SEAT NUMBER

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2024	II	27	1100	J-837	(E)
PHYSICS (54)					
Time : 3 Hrs.		(8 Pages)		Max. Marks : 70	

General Instructions :

The question paper is divided into **four** sections :

- (1) **Section A :** Q. No. 1 contains **Ten multiple choice type** of questions carrying **One mark** each.
Q. No. 2 contains **Eight very short answer type** of questions carrying **One mark** each.
- (2) **Section B :** Q. No. 3 to Q. No. 14 contain **Twelve short answer type** of questions carrying **Two marks** each. (Attempt **any Eight**).
- (3) **Section C :** Q. No. 15 to Q. No. 26 contain **Twelve short answer type** of questions carrying **Three marks** each. (Attempt **any Eight**).
- (4) **Section D :** Q. No. 27 to Q. No. 31 contain **Five long answer type** of questions carrying **Four marks** each. (Attempt **any Three**).
- (5) Use of the log table is allowed. Use of calculator is **not** allowed.
- (6) Figures to the right indicate full marks.
- (7) For multiple choice type questions, only the first attempt will be considered for evaluation.

(8) *Physical Constants :*

- (i) Mass of electron $m = 9.1 \times 10^{-31} \text{ kg}$
- (ii) $\epsilon_0 = 8.85 \times 10^{-12} \text{ C}^2 / \text{Nm}^2$
- (iii) $\pi = 3.142$
- (iv) Charge on electron $e = 1.6 \times 10^{-19} \text{ C}$
- (v) $\mu_0 = 4\pi \times 10^{-7} \text{ Wb / Am}$
- (vi) Planck's constant $h = 6.63 \times 10^{-34} \text{ J.s.}$
- (vii) Speed of light $c = 3 \times 10^8 \text{ m/s}$
- (viii) $g = 9.8 \text{ m/s}^2$
- (ix) Rydberg's constant $R_H = 1.097 \times 10^7 \text{ m}^{-1}$
- (x) Stefan's constant $\sigma = 5.67 \times 10^{-8} \text{ J m}^{-2} \text{ s}^{-1} \text{ K}^{-4}$

SECTION – A

Q. 1. Select and write the correct answer for the following multiple choice type of questions : **[10]**

- (i) The moment of inertia (MI) of a disc of radius R and mass M about its central axis is _____.
 - (a) $\frac{MR^2}{4}$
 - (b) $\frac{MR^2}{2}$
 - (c) MR^2
 - (d) $\frac{3MR^2}{2}$
- (ii) The dimensional formula of surface tension is _____.
 - (a) $[L^{-1}M^1T^{-2}]$
 - (b) $[L^2M^1T^{-2}]$
 - (c) $[L^1M^1T^{-1}]$
 - (d) $[L^0M^1T^{-2}]$

- (iii) Phase difference between a node and an adjacent antinode in a stationary wave is _____.
 (a) $\frac{\pi}{4}$ rad (b) $\frac{\pi}{2}$ rad
 (c) $\frac{3\pi}{4}$ rad (d) π rad
- (iv) The work done in bringing a unit positive charge from infinity to a given point against the direction of electric field is known as _____.
 (a) electric flux (b) magnetic potential
 (c) electric potential (d) gravitational potential
- (v) To convert a moving coil galvanometer into an ammeter we need to connect a _____.
 (a) small resistance in parallel with it
 (b) large resistance in series with it
 (c) small resistance in series with it
 (d) large resistance in parallel with it
- (vi) If the frequency of incident light falling on a photosensitive material is doubled, then kinetic energy of the emitted photoelectron will be _____.
 (a) the same as its initial value
 (b) two times its initial value
 (c) more than two times its initial value
 (d) less than two times its initial value
- (vii) In a cyclic process, if ΔU = internal energy, W = work done, Q = Heat supplied then
 (a) $\Delta U = Q$ (b) $Q = 0$
 (c) $W = 0$ (d) $W = Q$

- (viii) The current in a coil changes from 50A to 10A in 0.1 second. The self inductance of the coil is 20H. The induced e.m.f. in the coil is _____.
 (a) 800V (b) 6000V
 (c) 7000V (d) 8000V
- (ix) The velocity of bob of a second's pendulum when it is 6 cm from its mean position and amplitude of 10 cm, is _____.
 (a) $8\pi \text{ cm/s}$ (b) $6\pi \text{ cm/s}$
 (c) $4\pi \text{ cm/s}$ (d) $2\pi \text{ cm/s}$
- (x) In biprism experiment, the distance of 20th bright band from the central bright band is 1.2 cm. Without changing the experimental set-up, the distance of 30th bright band from the central bright band will be _____.
 (a) 0.6 cm (b) 0.8 cm
 (c) 1.2 cm (d) 1.8 cm

Q. 2. Answer the following questions :

[8]

- (i) Define centripetal force.
- (ii) Why a detergent powder is mixed with water to wash clothes?
- (iii) What is the resistance of an ideal voltmeter?
- (iv) Write the formula for torque acting on rotating current carrying coil in terms of magnetic dipole moment, in vector form.

- (v) What is binding energy of a hydrogen atom?
- (vi) What is surroundings in thermodynamics?
- (vii) In a photoelectric experiment, the stopping potential is 1.5V. What is the maximum kinetic energy of a photoelectron?
- (viii) Two capacitors of capacities $5\mu\text{F}$ and $10\mu\text{F}$ respectively are connected in series. Calculate the resultant capacity of the combination.

SECTION – B

Attempt any EIGHT questions of the following :

[16]

- Q. 3. Explain the change in internal energy of a thermodynamic system (the gas) by heating it.
- Q. 4. Explain the construction of a spherical wavefront by using Huygens' principle.
- Q. 5. Define magnetization. State its SI unit and dimensions.
- Q. 6. Obtain the differential equation of linear simple harmonic motion.
- Q. 7. A galvanometer has a resistance of 30Ω and its full scale deflection current is 20 microampere (μA). What resistance should be added to it to have a range 0-10 volt?
- Q. 8. Explain Biot-Savart law.
- Q. 9. What is a Light Emitting Diode? Draw its circuit symbol.

- Q. 10.** An aircraft of wing span of 60 m flies horizontally in earth's magnetic field of $6 \times 10^{-5} \text{ T}$ at a speed of 500 m/s. Calculate the e.m.f. induced between the tips of wings of aircraft.
- Q. 11.** Derive an expression for maximum speed of a vehicle moving along a horizontal circular track.
- Q. 12.** A horizontal force of 0.5N is required to move a metal plate of area 10^{-2} m^2 with a velocity of $3 \times 10^{-2} \text{ m/s}$, when it rests on $0.5 \times 10^{-3} \text{ m}$ thick layer of glycerin. Find the coefficient of viscosity of glycerin.
- Q. 13.** Two tuning forks having frequencies 320 Hz and 340 Hz are sounded together to produce sound waves. The velocity of sound in air is 340 m/s. Find the difference in wavelength of these waves.
- Q. 14.** Calculate the change in angular momentum of electron when it jumps from third orbit to first orbit in hydrogen atom.

SECTION – C

Attempt any EIGHT questions of the following :

[24]

- Q. 15.** A circular coil of wire is made up of 200 turns, each of radius 10 cm. If a current of 0.5A passes through it, what will be the magnetic field at the centre of the coil?
- Q. 16.** Define photoelectric effect and explain the experimental set-up of photoelectric effect.
- Q. 17.** Define the current gain α_{DC} and β_{DC} for a transistor. Obtain the relation between them.

- Q. 18.** Define surface energy of the liquid. Obtain the relation between the surface energy and surface tension.
- Q. 19.** What is an isothermal process? Obtain an expression for work done by a gas in an isothermal process.
- Q. 20.** Derive an expression for equation of stationary wave on a stretched string. Show that the distance between two successive nodes or antinodes is $\lambda/2$.
- Q. 21.** Derive an expression for the impedance of an LCR circuit connected to an AC power supply. Draw phasor diagram.
- Q. 22.** Calculate the wavelength of the first two lines in Balmer series of hydrogen atom.
- Q. 23.** A current carrying toroid winding is internally filled with lithium having susceptibility $\chi = 2.1 \times 10^{-5}$. What is the percentage increase in the magnetic field in the presence of lithium over that without it?
- Q. 24.** The radius of a circular track is 200 m. Find the angle of banking of the track, if the maximum speed at which a car can be driven safely along it is 25 m/sec.
- Q. 25.** Prove the Mayer's relation : $C_p - C_v = \frac{R}{J}$
- Q. 26.** An alternating voltage is given by $e = 8 \sin 628.4t$. Find
- peak value of e.m.f.
 - frequency of e.m.f.
 - instantaneous value of e.m.f. at time $t = 10$ ms.

SECTION – D

Attempt any **THREE** questions of the following :

[12]

- Q. 27.** What is a transformer? Explain construction and working of a transformer. Derive the equation for a transformer.
- Q. 28.** Using the geometry of the double slit experiment, derive the expression for fringe width of interference bands.
- Q. 29.** Distinguish between an ammeter and a voltmeter. (Two points each).

The displacement of a particle performing simple harmonic motion is $\frac{1}{3}$ rd of its amplitude. What fraction of total energy will be its kinetic energy?

- Q. 30.** Draw a neat labelled diagram of Ferry's perfectly black body. Compare the rms speed of hydrogen molecules at 227°C with rms speed of oxygen molecule at 127°C. Given that molecular masses of hydrogen and oxygen are 2 and 32 respectively.
- Q. 31.** Derive an expression for energy stored in a charged capacitor. A spherical metal ball of radius 15 cm carries a charge of $2\mu\text{C}$. Calculate the electric field at a distance of 20 cm from the center of the sphere.

