2025 | **VI** | **28**   **1100**   **J-339**   **(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 <u>first attempt</u> will be considered for evaluation.

(8) *Physical Constants :*

  (i) $h = 6.63 \times 10^{-34}$ Js

  (ii) $c = 3 \times 10^8$ m/s

  (iii) $\pi = 3.142$

  (iv) $g = 9.8$ m/s^2

  (v) $\varepsilon_0 = 8.85 \times 10^{-12}$ C^2/Nm^2

  (vi) $\mu_0 = 4\pi \times 10^{-7}$ Wb/Am

  (vii) mass of electron $m_e = 9.11 \times 10^{-31}$ kg

  (viii) mass of proton $m_p = 1.672 \times 10^{-27}$ kg

  (ix)   Stefan's constant, $\sigma = 5.67 \times 10^{-8}$ Jm^{-2}s^{-1}k^{-4}

  (x)   Rydberg's constant, $R_H = 1.097 \times 10^7$m^{-1}

SECTION – A

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

  (i)   For which of the following bodies, the principle of perpendicular axes is applicable?

    (a) Spherical   (b) Conical

    (c) Cylindrical   (d) Laminar

  (ii)   Which of the following equation represents a simple harmonic progressive wave travelling along the negative X-direction?

    (a) $Y = a \sin (kx - \omega t)$

    (b) $Y = a \sin (kx + \omega t)$

    (c) $Y = a \sin (ky - \omega t)$

    (d) $Y = a \sin (ky + \omega t)$

(iii) In a cyclotron final kinetic energy of a particle revolving in a circular path of radius 'R'exit is :

(a) $K.E. \propto R_{exit}$

(b) $K.E. \propto R^2_{exit}$

(c) $K.E. \propto \dfrac{1}{R_{exit}}$

(d) $K.E. \propto \dfrac{1}{R^2_{exit}}$

(iv) For which of the following metals, photoelectric effect is possible for visible radiation?

(a) Zinc   (b) Cadmium

(c) Magnesium   (d) Sodium

(v) The gyromagnetic ratio of electron is _____.

(a) $\dfrac{2m_e}{e}$ (b) $\dfrac{2m_e}{e^2}$

(c) $\dfrac{e}{2m_e}$ (d) $\dfrac{e^2}{2m_e}$

(vi) Two capillary tubes of radii 0.3 cm and 0.6 cm are dipped in the same liquid, the ratio of heights to which the liquid will rise in the tubes is _____.

(a) $1 : 2$ (b) $2 : 1$

(c) $1 : 4$ (d) $4 : 1$

(vii) Kirchhoff's Voltage Law applied to a loop deals with the conservation of _____.

(a) momentum   (b) mass

(c) energy   (d) charge

(viii) How many times the intensity of an unpolarized light wave reduces after passing through a polarizer?

(a) $\dfrac{1}{2}$ (b) $\dfrac{1}{4}$

(c) $\dfrac{1}{6}$ (d) $\dfrac{1}{8}$

(ix) If pressure of gas contained in a closed vessel is increased by 0.4% when heated by 1°C, its initial temperature must be _____.

(a) 200°C (b) 250°C

(c) 300°C (d) 350°C

(x) The wavelength and power of the incident light is 4000 Å and 0.1W respectively. The number of incident photons is _____.

(a) 2.011×10^{17} (b) 3.011×10^{17}

(c) 4.011×10^{17} (d) 5.011×10^{17}

Q. 2. **Answer the following questions :** [8]

(i) What is the velocity of a particle performing linear SHM, at extreme position?

(ii) What happens to the ferromagnetic substance when it is heated above Curie temperature?

(iii) What is the coefficient of transmission for athermanous materials?

(iv) In a photodiode, on which property the dark current depends?

(v)   Define mutual inductance.

(vi)   What is magnetization?

(vii)   A metal ring of radius 20 cm is rotating about a transverse axis passing through its centre. What will be its radius of gyration about the same axis?

(viii) In a hydraulic lift, area of pistons are A_1 and A_2 respectively ($A_2 \gg A_1$). If force F_1 is applied on piston 1, then what is the force exerted on piston 2?

SECTION – B

Attempt any EIGHT questions of the following :   **[16]**

Q. 3. Obtain an expression for moment of inertia of a uniform disc of mass 'M' and radius 'R' rotating about an axis passing through its centre and perpendicular to its plane.

Q. 4. What is the effect of impurities on surface tension of a liquid?

Q. 5. Explain the thermodynamics of adiabatic process to obtain adiabatic constant for rigid diatomic molecule of a gas?

Q. 6. Draw a neat labelled diagram of variation of kinetic energy and potential energy with displacement in S.H.M.

Q. 7. Assuming an equation of magnetic force due to arbitrarily shaped wire, obtain an expression for force on a closed circuit in a uniform magnetic field.

Q. 8. Distinguish between diamagnetic and paramagnetic substances.

Q. 9. State Faraday's laws in electromagnetic induction.

Q. 10. In a purely resistive circuit a source of e.m.f. having e = 140sin(3142t) is connected across a pure resistor. If value of rms current is 1.98A, calculate the value of resistance.

Q. 11. The differential equation of linear S.H.M. in SI units is $\dfrac{d^2x}{dt^2} = -36x$. Calculate its frequency and periodic time.

Q. 12. Two tuning forks having frequencies 160 Hz and 170 Hz are sounded together to produce sound waves. The velocity of sound in air is 326.4 ms^{-1}. Calculate the difference between wavelengths of these waves.

Q. 13. What must be the ratio of the slit width to the wavelength for a single slit to have the first diffraction minimum at 45°?

Q. 14. A potential gradient of a wire is 0.5V/m. If the e.m.f. of a cell balances against 216 cm of this potentiometer wire, calculate e.m.f. of the cell.

SECTION – C

Attempt any EIGHT questions of the following : **[24]**

Q. 15. Obtain an expression for torque acting on a rigid body rotating with constant angular acceleration.

Q. 16. Define the terms –
(a) Cohesive force
(b) Range of molecular force
(c) Sphere of influence

Q. 17. Show that only odd harmonics are present in the vibrations of air column in a pipe closed at one end.

Q. 18. Obtain an expression for the electric intensity at a point outside a uniformly charged spherical shell.

Q. 19. With the help of neat labelled circuit diagram explain the use of metre bridge to determine unknown resistance.

Q. 20. Derive an expression for the magnetic field produced at the centre of a circular arc of a wire carrying current I.

Q. 21. Derive the decay law of radioactivity and state SI unit of 'activity.'

Q. 22. Find the shortest and longest wavelengths in the Lyman series of hydrogen atom.

Q. 23. The de-Broglie wavelengths associated with an electron and proton are same. Calculate the ratio of their momentum and kinetic energies.

Q. 24. A parallel plate capacitor is maintained at potential of 400V. If area of plates is 40 cm^2 and separation between plates is 40 mm, calculate displacement current in 1μs.

Q. 25. A 120 watt filament lamp loses all its energy by radiation from its surface. The emissivity of the surface is 0.6. The area of the surface is 3.53×10^{-3}m^2. Calculate the temperature of the filament.

Q. 26. A Carnot engine receives 4000J of heat from a reservoir at 500K, does some work, rejects 2000J heat to reservoir at 200K.
(a) How much work does it do?
(b) What is its efficiency?

SECTION – D

Attempt any THREE questions of the following : [12]

Q. 27. Define isothermal process. Obtain an expression for work done during isothermal process. Draw P–V diagram.

Q. 28. Using phasor diagram for a series LCR circuit, obtain an expression for impedance. Define admittance.

Q. 29. Obtain an expression for motional e.m.f. in a rotating bar with constant angular velocity 'ω' in uniform magnetic field perpendicular to plane of rotation.

The mutual inductance (M) of the two coils is 1.5H. The self inductances of the coils are 5H and 4H. Calculate the coefficient of coupling between the coils.

Q. 30. Define logic gate and explain why NOT gate is called an inverter.

The transistor is in the common emitter configuration. Its DC current gain is 50. If collector current is 3mA, calculate the base current.

Q. 31. State the four conditions for obtaining well defined and steady interference pattern.

Light incident at angle 52.5° on a bucket filled with water be completely polarised after reflection. Calculate the refractive index of the water.

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