

Time : 1 Hour]

PART - A

[Total Marks : 50

- ❖ Select the following questions with proper alternative and answer it :
- 1) A bar magnet is of length (size) l . The ratio of its equatorial field and axial field for the same distance r (where $r \gg l$) is
[March - 2022]
(A) 0 (B) 2 (C) 0.5 (D) 1
 - 2) A conducting coil having number of turns N and cross section area A is kept in such a way that its plane remains perpendicular to the uniform magnetic field B . Now, if the number of turns of the coil is made double then the magnetic flux linked with coil =
[March - 2022]
(A) $2NBA$ (B) $\frac{NBA}{2}$ (C) N^2BA (D) NBA
 - 3) Current in a circuit falls from 5 A to 0 A in 0.1 s. If an average emf of 200 V induced, the self-inductance of the circuit would be H.
[March - 2022]
(A) 4 (B) 2 (C) 3 (D) 1
 - 4) Faraday's law gives of induced emf.
[March - 2022]
(A) only magnitude
(B) only direction
(C) both magnitude and direction
(D) none of the above
 - 5) An impedance of LC circuit is
(Where $X_C > X_L$) [March - 2022]
(A) $Z = \left(\frac{1}{\omega C}\right)^2 - (\omega L)^2$ (B) $Z = \frac{1}{\omega C} - \omega L$
(C) $Z = \sqrt{\left(\frac{1}{\omega C}\right) - \omega L}$ (D) $Z = \omega C + \frac{1}{\omega L}$
 - 6) If P_o is an output power and P_i is an input power of a real step-up transformer then,
[March - 2022]
(A) $P_o = \sqrt{2} P_i$ (B) $P_o > P_i$
(C) $P_o < P_i$ (D) $P_o = P_i$
 - 7) The power factor at the time of resonance is [March - 2022]
(A) 0.5 (B) 1 (C) ∞ (D) 0
 - 8) An inductive reactance of an inductor is [March - 2022]
(A) $\frac{1}{\omega L}$ (B) ωC (C) $\frac{1}{\omega C}$ (D) ωL
 - 9) current is obtained due to change in the electric field. [March - 2022]
(A) Conduction (B) Eddy
(C) Displacement (D) Unidirectional
 - 10) For navigation in sea, waves are useful.
(A) radio (B) infrared
(C) UV (D) microwave
 - 11) Which one of the following electromagnetic wave is of minimum wavelength? [March - 2022]
(A) Gamma rays (B) Ultraviolet rays
(C) X-rays (D) Infrared
 - 12) The refractive index of medium-3 with respect to medium-2 $n_{32} = \dots\dots$ [March - 2022]
(A) $n_{13} \times n_{21}$ (B) $\frac{n_{31}}{n_{12}}$
(C) $\frac{n_{12}}{n_{31}}$ (D) $n_{31} \times n_{12}$
 - 13) A magician during a show makes a glass lens with refractive index $n = 1.5$ disappear in a trough of liquid. The refractive index of liquid = [March - 2022]
(A) 0.15 (B) 3.0 (C) 0.75 (D) 1.5
 - 14) The focal length of objective lens and eyepiece is f_o and f_e respectively. Magnifying power of the telescope = [March - 2022]
(A) $\frac{f_e}{f_o}$ (B) $f_o - f_e$ (C) $\frac{f_o}{f_e}$ (D) $f_o + f_e$
 - 15) A small bulb is placed at the bottom of a tank containing water to a depth of 80cm. What is the area of the surface of water through which light from the bulb can emerge out? Refractive index of water is 1.33. (Consider the bulb to be a point source.)
(A) 2.8 m^2 (B) 2.7 m^2 (C) 2.6 m^2 (D) 2.5 m^2

- 16) An object is placed at 15 cm in front of a concave mirror of radius of curvature 20 cm. The image distance would be cm.
[March - 2022]
(A) -32 (B) -28 (C) -30 (D) -22
- 17) In the Young's experiment, when a plate of thickness λ and refractive index of 1.5 is introduced in path of beam the intensity at the position where central maximum occurred previously remained unchanged. The minimum thickness of glass plate is
(A) 2λ (B) λ (C) $\frac{\lambda}{3}$ (D) $\frac{2\lambda}{3}$
- 18) The number of interference fringes occurring in the broad diffraction peak depends on the ratio
[March - 2022]
(A) $\frac{a^2}{d}$ (B) $\frac{a}{d}$ (C) $\frac{d^2}{a}$ (D) $\frac{d}{a}$
Where d = distance between two slits, a = width of slit.
- 19) Unpolarised light is incident on a plane glass surface. For an angle of incidence the reflected and refracted rays are perpendicular to each other? Refractive index of glass = 1.5.
[March - 2022]
(A) 67° (B) 47° (C) 57° (D) 37°
- 20) Which one of the following sentence is false?
[March - 2022]
(A) Interference fringes are of equal thickness.
(B) The central diffraction fringe is of maximum intensity.
(C) All bright interference fringes are of equal intensities.
(D) Diffraction fringes are of equal thickness.
- 21) Width of a slit is a . The focal length of the lens kept just along with the slit is f . The light of wavelength λ is made normally incident on the slit. The size of the central maximum on the screen is
[March - 2022]
(A) $\frac{f\lambda}{a}$ (B) $\frac{\lambda a}{f}$ (C) $\frac{fa}{\lambda}$ (D) $\frac{a}{f\lambda}$
- 22) The slope of the graph of the stopping potential (V_0) \rightarrow frequency (ν) for the photoelectric effect is equal to
[March - 2022]
(A) $\frac{h}{2\pi}$ (B) $\frac{h}{e}$ (C) $\frac{e}{h}$ (D) h
- 23) If Δx and Δp are the uncertainties in the specification of the position and the momentum of an electron respectively, then according to Heisenberg's uncertainty principle $\Delta x \cdot \Delta p = \dots\dots$ [March - 2022]
(A) $\frac{h}{2\pi}$ (B) $\frac{h}{e}$ (C) $\frac{2\pi}{h}$ (D) h
- 24) Photons are electrically. [March - 2022]
(A) positively charged
(B) neutral
(C) negatively charged
(D) some time positively charged and some time negatively charged
- 25) The dimensions of $\frac{me^4}{8\epsilon_0^2 h^3 c}$ is
[March - 2022]
(A) $[M^{-1} L^0 T^0]$ (B) $[M^0 L^1 T^0]$
(C) $[M^0 L^{-1} T^0]$ (D) $[M^0 L^0 T^0]$
- 26) The energy required to excite an electron of the hydrogen atom from its ground state to second excited state is eV. [March - 2022]
(A) 3.40 (B) 12.09 (C) 13.6 (D) 10.2
- 27) Which one of the following spectral line lies in Ultraviolet region? [March - 2022]
(A) Lyman series (B) Paschen series
(C) Balmer series (D) Pfund series
- 28) The radius of the nucleus of ${}_{13}^{27}\text{Al}$ is
[March - 2022]
(A) R_0^3 (B) $R_0^{1/3}$ (C) $3R_0$ (D) R_0
- 29) Nuclear force is acting between [March - 2022]
(A) only proton-proton
(B) only neutron-proton
(C) only neutron-neutron
(D) all the nucleons
- 30) Binding energy per nucleon in maximum.
(A) ${}^4_2\text{He}$ (B) ${}^{56}_{26}\text{Fe}$ (C) ${}^{141}_{56}\text{Ba}$ (D) ${}^{235}_{92}\text{U}$
- 31) If n_e = number of free electrons, n_h = number of holes then for pure semi conductors [March - 2022]
(A) $n_e = n_h^2$ (B) $n_h > n_e$
(C) $n_e = n_h$ (D) $n_e > n_h$

- 32) When p-n junction is kept in forward bias
[March - 2022]
(A) barrier potential increases
(B) current due to majority charge carrier decreases
(C) barrier potential decreases
(D) none of the given choices
- 33) If a body contains n_1 electrons and n_2 protons, the total amount of charge on the body is
[March - 2022]
(A) $(n_2 - n_1)e$ (B) $(n_1^2 + n_2^2)e$
(C) $(n_2 + n_1)e$ (D) $(n_1^2 - n_2^2)e$
- 34) A uniformly charged conducting sphere of 2.4 m diameter has a surface charge density of $80 \mu\text{C m}^{-2}$. The charge on the sphere is mC.
[March - 2022]
(A) 45.1 (B) 5.41 (C) 1.45 (D) 4.51
- 35) An electric field line is a curve drawn in such a way that the tangent drawn at any point on the curve gives at that point.
[March - 2022]
(A) magnitude of the electric field
(B) direction of the electric field
(C) both magnitude and direction of electric field
(D) none of the given choices
- 36) The dimensions of $\frac{ke^2}{Gm_e m_p}$ is
[March - 2022]
(A) $[M^1 L^{-1} T^0 A^{-2}]$ (B) $[M^0 L^1 T^0 A^1]$
(C) $[M^0 L^{-1} T^{-1} A^{-2}]$ (D) $[M^0 L^0 T^0 A^0]$
- 37) The number of electric field lines coming out of charge kept in a vacuum is 1.13×10^{11} [$\epsilon_0 = 8.85 \times 10^{-12} \text{C}^2\text{N}^{-1}\text{m}^{-2}$]
[March - 2022]
(A) 1C (B) 1 mC (C) 2C (D) 2 mC
- 38) The electric potential at a distance due to the charge $4 \times 10^{-7} \text{C}$ is $4 \times 10^4 \text{V}$.
[March - 2022]
(A) 9 m (B) 9 mm (C) 9 cm (D) 9 μm
- 39) The electric potentials at two points (0, 3) mm and (0, 4) mm in the region in which electric field $\vec{E} = 20\hat{i} \text{NC}^{-1}$ are V_A and V_B respectively then,
[March - 2022]
(A) $V_A > V_B$ (B) $V_A < V_B$
(C) $V_A = V_B$
(D) none of the given choices
- 40) An electron is accelerated by a potential difference of $\Delta V = 2$ volts. The energy gained by it would be eV.
[March - 2022]
(A) 0.5 eV (B) 1 eV (C) 1.5 eV (D) 2 eV
- 41) Two capacitors when connected in series, their equivalent capacitance is $3 \mu\text{F}$ and when they are connected in parallel their equivalent capacitance is $16 \mu\text{F}$. Their values are respectively μF and μF .
[March - 2022]
(A) 4, 12 (B) 8, 16 (C) 8, 8 (D) 16, 1
- 42) Which of the following physical quantity has unit $\text{m}^2\text{V}^{-1}\text{s}^{-1}$?
[March - 2022]
(A) drift velocity (B) mobility
(C) electric field (D) resistivity
- 43) The value of the temperature co-efficient of resistivity (α) is for metals.
[March - 2022]
(A) negative (B) zero
(C) positive (D) negative
- 44) A steady current flows in a metallic conductor of non-uniform cross-section. Which of the following quantities is constant along the conductor?
[March - 2022]
(A) current (B) electric field
(C) current density (D) drift speed
- 45) For which of the following dimensions of wire, its resistance will be maximum? Where L is length and D is a diameter of wire.
(A) $\frac{L}{2}, 2D$ (B) L, D (C) $2L, \frac{D}{2}$ (D) $2L, 2D$
- 46) A solenoid has 1000 turns wrapped on a 40 cm length. It carries a current of 10 A. The magnetic field in the middle of the solenoid is
(Que. Bank - 2024)
(A) 0.0314 T (B) 0.0628 T
(C) 0.0924 T (D) 0.1256 T
- 47) Magnitude of the field at the center of the ring having radius a is
(A) $\frac{\mu_0 I}{2x}$ (B) $\frac{\mu_0 NI}{2}$ (C) $\mu_0 nI$ (D) $\frac{\mu_0 NI}{2a}$
- 48) A solenoid of length 0.5 m has a radius of 1 cm and is made up of 1000 turns. It carries a current of 5 A. The magnitude of the magnetic field inside the solenoid is T.
[March - 2022]
(A) $4\pi \times 10^{-3}$ (B) $2\pi \times 10^{-3}$
(C) $3\pi \times 10^{-3}$ (D) $\pi \times 10^{-3}$

- 49) Direction of magnetic dipole moment of a magnet is
 (A) from north pole to south pole.
 (B) from south pole to north pole.
 (C) possible in any direction.
 (D) not decided.
- 50) A short bar magnet placed with its axis at 30° with a uniform external magnetic field of 0.25 T experiences a torque of magnitude equal to $4.5 \times 10^{-2} \text{ J}$. The magnitude of magnetic moment of the magnet is JT^{-1} .
 [March - 2022]
 (A) 0.54 (B) 0.18 (C) 0.72 (D) 0.36

[Total Marks : 50]

Time : 2 Hours]

PART - B

Section - A

❖ Answer any 8 of the following given question 1 to 12 : (Each carries 2 marks) [16]

- 1) Write any four properties of electric field lines. [March - 2022]
- 2) Derive an expression for capacitance of the parallel plate capacitor. [March - 2022]
- 3) Write only two statements for Kirchhoff's Rules. [March - 2022]
- 4) Explain Biot-Savart law in brief. [March - 2022]
- 5) Explain hard ferromagnetic and soft ferromagnetic materials.
- 6) Explain in brief the phenomenon of self-induction. Derive the formula for self-induced emf. [March - 2022]
- 7) A 44 mH inductor is connected to 220 V , 50 Hz ac supply. Determine the rms value of the current in the circuit. [March - 2022]
- 8) Write any four characteristics of electromagnetic wave. [March - 2022]
- 9) Explain Malus law and write it.
- 10) Write any four points for photon picture of electromagnetic radiation. [March - 2022]
- 11) Explain the process of thermonuclear fusion as a source of energy in the Sun and stars.
- 12) Explain n and p -type semiconductor based on band theory.

Section - B

❖ Answer any 6 of the following given questions 13 to 21 : (Each carries 3 marks) [18]

- 13) Derive an expression for the electric field due to an infinitely long straight uniformly charged wire. [March - 2022]

- 14) A heating element using nichrome connected to a 230 V supply draws an initial current of 4.6 A which settles after a few seconds to a steady value of 2.3 A . What is the steady temperature of the heating element if the room temperature is 27°C . [$\alpha = 1.7 \times 10^{-4} \text{ }^\circ\text{C}^{-1}$] [March - 2022]
- 15) Two long and parallel straight wires A and B carrying currents of 8 A and 5 A in the same direction are separated by a distance of 4 cm . Estimate the force on a 10 cm section of wire A. [March - 2022]
- 16) A circular coil of radius 8 cm and 20 turns is rotated about its vertical diameter with an angular speed of 50 rad s^{-1} in a uniform horizontal magnetic field of magnitude $3 \times 10^{-2} \text{ T}$. Obtain the maximum and average emf induced in the coil. If the coil forms a closed loop of resistance 10Ω calculate the maximum value of current in the coil. [March - 2022]
- 17) (a) The radii of curvature of the faces of a double convex lens are 10 cm and 15 cm . Its focal length is 12 cm . What is the refractive index of glass ?
 (b) A convex lens has 15 cm focal length in air. What is focal length in water ?
 (Refractive index of air-water = 1.33 and Refractive index of air-glass = 1.5)
 [March - 2022]
- 18) A beam of light consisting of two wavelengths 6000 \AA and 4000 \AA is used to obtain interference fringes in a Young's double-slit experiment.
 (a) Find the distance of the third dark fringe on the screen from the central maximum for wavelength 6000 \AA .
 (b) What is the least distance from the central maximum where bright fringes due to both the wavelengths coincide ? [March - 2022]
 (Distance between two slits = 0.1 mm
 Take $D = 100 \text{ cm}$)

- 19) (a) For what Kinetic Energy of a neutron will the associated de-Broglie wavelength be 1.40×10^{-10} m
 (b) Find the de-Broglie wavelength of a neutron in thermal equilibrium with matter, having an average Kinetic Energy of $\frac{3}{2} K_B T$ at 300 K. [$K_B = 1.38 \times 10^{-23}$ SI unit]

[March - 2022]

- 20) Obtain the binding energy (in MeV) of a nitrogen nucleus (${}^{14}_7\text{N}$), given $m({}^{14}_7\text{N}) = 14.00307 u$

- 21) Draw the circuit diagram of a full-wave rectifier. Explain full-wave rectification in brief. Also draw input-output waveforms. [March - 2022]

Section - C

- ◆ Answer any 4 of the following given questions from 22 to 27 : (Each carries 4 marks) [16]

- 22) Derive an electric potential at a distance r ($r \gg a$) due to an electric dipole. Also write

potential on the axis and in the equatorial plane. [March - 2022]

- 23) Explain cell, emf and internal resistance. Derive relation between potential difference emf and internal resistance.

- 24) In the case of an AC voltage applied to an inductor, derive formula for an electric current i at time t . Also, derive an expression for an average power over a complete cycle. [March - 2022]

- 25) Derive $i + e = A + \delta$ for a triangular glass prism. Also write the condition for the angle of minimum deviation. Derive the formula for the refractive index of the material of the prism. [March - 2022]

- 26) What is nuclear energy ? Explain how nuclear energy is released from curve of binding energy?

- 27) Which characteristics of photoelectric effect are not explained by the wave nature of light. Explain Einsteins' explanation. [March - 2022]

