

Time : 1 Hour]

PART - A

[Total Marks : 50

- ❖ Select the following questions with proper alternative and answer it :
- In optical fiber, the refractive index of the material of the core is that of the cladding.
[March - 2020]
(A) higher than (B) less than
(C) equal to (D) half
 - A magician during a show makes a glass lens with $n = 1.47$ disappear in a trough of liquid. What is the refractive index of the liquid ?
[March - 2020]
(A) zero
(B) ∞
(C) equal to refractive index of water
(D) 1.47
 - The amplitude of a wave is proportional to the of the intensity of the wave.
(A) square (B) cube
(C) square root (D) cube root
 - In a Young's double slit experiment, the width of the source slit is increased then
[March - 2020]
(A) instead of interference, diffraction appears.
(B) fringe pattern gets more and more sharp.
(C) angular distance between fringes increased.
(D) fringe pattern gets less and less sharp.
 - Condition for maximum diffraction is
(A) $\frac{\lambda}{a} = 1$ (B) $\frac{\lambda}{a} = 0$
(C) $\frac{\lambda}{a} = \infty$ (D) $\frac{\lambda}{a} = \frac{1}{2}$
 - Light appears to travel in a straight line, because
(A) it is not absorbed by surrounding.
(B) it is reflected by surrounding.
(C) its wavelength is very small.
(D) its velocity is very large.
 - Unpolarised light is incident on a plane glass surface. What should be the angle of incidence so that the reflected and refracted rays are perpendicular to each other ? [March - 2020]
(A) 33° (B) 37° (C) 53° (D) 57°
 - Work function of is the lowest.
[March - 2020]
(A) caesium (B) platinum
(C) nickel (D) copper
 - By applying electric field of the order of Vm^{-1} to a metal, electrons can be pulled out of the metal.
[March - 2020]
(A) 10^5 (B) 10^6 (C) 10^8 (D) 10^2
 - Value of stopping potential depends on of incident light.
[March - 2020]
(A) frequency (B) intensity
(C) momentum (D) velocity
 - Monochromatic light of frequency 6×10^{14} Hz is produced by laser. Each photon has an energy =
[March - 2020]
(A) 4×10^{-19} (B) 6×10^{14}
(C) 4×10^{-20} (D) 6×10^{-14}
 - 13.6 eV energy is required to separate a hydrogen atom into a proton and an electron. Compute the orbital radius of corresponding electron.
[March - 2020]
(A) 10.6×10^{-11} m (B) 5.3×10^{-11} m
(C) 2.65×10^{-11} m (D) 1.33×10^{-11} m
 - To excite the hydrogen atom from its ground state to second excited state eV energy is required.
[March - 2020]
(A) 3.4 (B) 12.09
(C) 1.51 (D) 13.6
 - According to the classical electromagnetic theory, calculate the initial frequency of the light emitted by the electron revolving around a proton in hydrogen atom.
(A) 0.66×10^{15} Hz (B) 6.6×10^{15} Hz
(C) 0.66×10^{17} Hz (D) 6.6×10^{16} Hz

- 5) In case of head on collision, when the impact parameter is minimum, $\theta = \dots$ rad (where $\theta =$ scattering angle for α -particle)
[March - 2020]
(A) $\frac{\pi}{2}$ (B) 0 (C) $\frac{\pi}{4}$ (D) π
- 6) Given the mass of iron nucleus as 55.85μ and $A = 56$, find the nuclear density. ($R_0 = 1.2 \text{ fm}$)
(A) $2.29 \times 10^{16} \text{ kgm}^{-3}$
(B) $2.92 \times 10^{16} \text{ kgm}^{-3}$
(C) $4.59 \times 10^{15} \text{ kgm}^{-3}$
(D) $2.29 \times 10^{17} \text{ kgm}^{-3}$
- 7) The binding energy per nucleon is almost constant for the nuclei having atomic mass number
[March - 2020]
(A) $30 < A < 170$ (B) $30 < A < 240$
(C) $170 < A < 230$ (D) $156 < A < 192$
- 8) During interaction of a photon with other particles, the law of conservation of
(A) energy is only obeyed.
(B) momentum is only obeyed.
(C) energy and momentum are obeyed.
(D) none of the above
- 19) In an n-type silicon, which of the following statement is true :
[March - 2020]
(A) Electrons are minority carriers and pentavalent atoms are the dopants.
(B) Electrons are majority carriers and trivalent atoms are the dopants.
(C) Holes are minority carriers and pentavalent atoms are the dopants.
(D) Holes are majority carriers and trivalent atoms are the dopants.
- 20) When a forward bias is applied to a p-n junction, it
[March - 2020]
(A) raises the potential barrier.
(B) reduces the majority carrier current to zero.
(C) lowers the potential barrier.
(D) none of the above
- 21) In half wave rectification, what is the output frequency if the input frequency is 50 Hz.
[March - 2020]
(A) 100 Hz (B) 0
(C) 50 Hz (D) 25 Hz
- 22) as a impurity, when added in Si or Ge P-type semiconductor is obtained.[March - 2020]
(A) Arsenic (B) Antimony
(C) Phosphorus (D) Boron
- 23) The charge equivalent to 6×10^{18} electrons is
[March - 2020]
(A) 1 C (B) -1 C
(C) 1 mC (D) -1 mC
- 24) The ratio of electric force and gravitational force between a proton and an electron at a certain distance is
[March - 2020]
(A) 10^{41} (B) 2.4×10^{41}
(C) 2.4×10^{39} (D) 3.9×10^{24}
- 25) Unit of surface charge density (σ) is
[March - 2020]
(A) $\frac{\text{C}}{\text{m}^2}$ (B) $\frac{\text{C}}{\text{m}^3}$ (C) $\frac{\text{C}}{\text{m}}$ (D) Cm
- 26) Electric field due to dipole at large distance (r) falls off as
[March - 2020]
(A) $\frac{1}{r^2}$ (B) $\frac{1}{r}$ (C) $\frac{1}{r^3}$ (D) $\frac{1}{r^4}$
- 27) Value of dielectric strength for air is Vm^{-1} .
[March - 2020]
(A) 3×10^4 (B) 3×10^6
(C) 6×10^3 (D) 4×10^3
- 28) Three capacitors of 2 pF, 3 pF and 4 pF are connected in parallel. What is the total capacitance of a network ?
[March - 2020]
(A) 9 pF (B) $\frac{12}{13}$ pF (C) $\frac{13}{12}$ pF (D) $\frac{1}{9}$ pF
- 29) Equipotential surface through a point is to the electric field at that point. [March - 2020]
(A) parallel
(B) normal
(C) at an angle of 45°
(D) at an angle of 30°
- 30) According to Ohm's law ($R = \frac{V}{I}$), as current flowing through a conductor increases, resistance of conductor
[March - 2020]
(A) decreases (B) increases
(C) remains constant (D) nothing can be said

- 31) Kirchoff's junction rule represents
[March - 2020]
(A) conservation of linear momentum.
(B) conservation of energy.
(C) conservation of angular momentum.
(D) conservation of charge.
- 32) Two resistors when connected in series net resistance is 5Ω and when they are connected in parallel net resistance is 1.2Ω . What are these resistors ?
[March - 2020]
(A) 2Ω , 3Ω (B) 1Ω , 4Ω
(C) 0.6Ω , 0.6Ω (D) 1Ω , 0.2Ω
- 33) A straight wire of mass 200 g and length 1.5 m carries a current of 2 A . To suspend it in a air by a uniform horizontal magnetic field, value of required magnetic field is T. [March - 2020]
(A) 6.5 (B) 0.45 (C) 0.65 (D) 4.5
- 34) SI unit of torsional constant of a spring is
(A) $\frac{\text{Jrad}}{\text{m}}$ (B) $\frac{\text{Nm}}{\text{rad}}$
(C) Nm (D) $\frac{\text{Jm}}{\text{rad}}$
- 35) Current sensitivity of galvanometer is inversely proportional to [March - 2020]
(A) number of turns (B) torsional constant
(C) area (D) magnetic field
- 36) Frequency of cyclotron is independent of
[March - 2020]
(A) radius of its trajectory
(B) charge of a particle
(C) applied magnetic field
(D) mass of a particle
- 37) A circular coil of a wire consisting 100 turns each of radius 2 cm carries a current of 0.20 A . The magnetic field at the centre of the coil is T.
[March - 2020]
(A) $2\pi \times 10^{-4}$ (B) $\pi \times 10^{-4}$
(C) $3\pi \times 10^{-4}$ (D) 10^{-4}
- 38) If bar magnet is divided into two equal part perpendicular to its length then which of the following is not correct ?
(A) Each part will act as independent magnet.
(B) Dipole moment of each part will be equal to that of original dipole moment.
(C) Dipole moment of each part will be equal to that half of $\left(m' = \frac{m}{2}\right)$ original dipole moment.
(D) Pole strength of each part will be equal to original pole strength q_m .
- 39) 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 $4.5 \times 10^{-2} \text{ J}$. The magnitude of the magnetic moment of the magnet will be J T^{-1} .
(A) 0.18 (B) 0.36 (C) 0.54 (D) 0.72
- 40) Meissner effect is observed in substances.
[March - 2020]
(A) ferromagnetic
(B) paramagnetic
(C) superconducting
(D) permanent magnetic
- 41) Dimensional formula of mutual inductance is
[March - 2020]
(A) $M^1 L^2 T^{-2} A^{-2}$ (B) $M^1 L^2 T^{-2} A^{-1}$
(C) $M^1 L^{-2} T^2 A^2$ (D) $M^{-1} L^{-2} T^2 A^{-1}$
- 42) The magnitude of the induced emf is equal to the time rate of change of [March - 2020]
(A) magnetic force (B) electric flux
(C) magnetic flux (D) electric force
- 43) One magnet is moved towards a coil, first speedily and then slowly. Then amount of electric charge induced would be
(A) equal in both the cases.
(B) more in first case.
(C) more in second case.
(D) zero in both the case.
- 44) A $15 \mu\text{F}$ capacitor is connected to a 220 V , 50 Hz a.c. source. Value of capacitive reactance is Ω .
[March - 2020]
(A) 106 (B) 424 (C) 212 (D) 21.2
- 45) Unit of ωC is
(A) H (B) Ω (C) V (D) Faraday
- 46) With resistance of $\pi\sqrt{3}\Omega$ value, inductor of what value should be connected in series so that at 50 Hz , frequency phase difference between voltage and current become 30° ?
(A) 0.5 H (B) 0.03 H
(C) 0.05 H (D) 0.01 H

- 7) A power transmission line feeds input power at 3300 V to a step down transformer with its primary windings having 2000 turns. What should be the number of turns in the secondary in order to get output power at 330 V ? [March - 2020]
(A) 400 (B) 200 (C) 33 (D) 40
- 48) Dimension of $\frac{1}{\mu\epsilon}$ is same as dimension of (Where μ = magnetic constant, ϵ = dielectric) [March - 2020]
(A) square of velocity (B) velocity
(C) acceleration (D) momentum
- 49) Frequency of FM radio band is from [March - 2020]
(A) 88 MHz to 108 MHz
(B) 88 kHz to 108 kHz
(C) 54 MHz to 890 MHz
(D) 54 kHz to 890 kHz
- 50) To destroy cancer cells are used. [March - 2020]
(A) X-rays
(B) Gamma rays
(C) Ultraviolet rays
(D) Infrared rays

Time : 2 Hours]

PART - B

[Total Marks : 50

Section - A

- ❖ Answer any 8 of the following given question 1 to 12 : (Each carries 2 marks) [16]
- 1) Derive expression for the capacitance of the parallel plate capacitor. [March - 2020]
- 2) Write a note on Mobility. [March - 2020]
- 3) The resistance of the platinum wire of a platinum resistance thermometer at the ice point is $5\ \Omega$ and at steam point is $5.23\ \Omega$. When it is inserted in a hot bath, the resistance of the wire is $5.795\ \Omega$. Calculate the temperature of the bath. [March - 2020]
- 4) Derive an expression for magnetic potential energy $U_m = -\vec{m} \cdot \vec{B}$ for a magnetic dipole kept in a uniform magnetic field. [March - 2020]
- 5) What is called self-inductance ? Derive an expression for self-induced emf. [March - 2020]
- 6) A plane electromagnetic wave of frequency 25 MHz travels in free space along x -direction. At a particular point in space and time, $\vec{E} = 6.3\hat{j}\text{Vm}^{-1}$. What is \vec{B} at this point ? [March - 2020]
- 7) Derive $i + e = A + \delta$ for a triangular glass prism. [March - 2020]
- 8) Summarise the photon picture of electromagnetic radiation (any four). [March - 2020]

- 9) Find the minimum wavelength of X-rays produced by 30 kV electrons.
- 10) A nucleus with mass number $A = 240$ and binding energy per nucleon = 7.6 MeV breaks into two fragments each of $A = 120$ with binding energy per nucleon = 8.5 MeV. Calculate the released energy.
- 11) Give reason : "If net flux associated with closed surface is zero, then net charge enclosed by that surface is zero."
- 12) Can we take one slab of p -type semiconductor and physically join it to another n -type semiconductor to get p - n junction ?

Section - B

- ❖ Answer any 6 of the following given questions 13 to 21 : (Each carries 3 marks) [18]
- 13) An electron falls through a distance of 1.5 cm in a uniform electric field of magnitude $2 \times 10^4\ \text{NC}^{-1}$. The direction of the field is reversed keeping its magnitude unchanged and a proton falls through the same distance. Compute the time of fall in each case. [March - 2020]
- 14) A 600 pF capacitor is charged by a 200 V supply. It is then disconnected from the supply and is connected to another uncharged 600 pF capacitor. How much electrostatic energy is lost in the process ? [March - 2020]
- 15) Derive an expression for the magnetic field at any point on the axis of a circular current loop. [March - 2020]

- 16) A horizontal power line carries a current of 90 A in east to west direction. What is the magnitude and direction of the magnetic field due to the current 1.5 m below the line ? [March - 2020]
- 17) A light bulb is rated at 100W for a 220V supply. Find
 (a) the resistance of the bulb;
 (b) the peak voltage of the source; and
 (c) the rms current through the bulb.
- 18) Describe Young's double slit experiment.
- 19) In accordance with the Bohr's model, find the quantum number that characterises the Earth's revolution around the Sun in an orbit of radius 1.5×10^{11} m with orbital speed 3×10^4 ms⁻¹. (Mass of the Earth = 6×10^{24} kg) [March - 2020]
- 20) Write briefly on *n*-type semiconductor.
- 21) Explain the barrier potential and depletion barrier in *p-n* junction diode.
- 23) Derive an expression for current *i* passing through an AC circuit containing only inductor *L*. Draw a Phasor diagram and graph of *v* and *i* versus ωt . Explain instantaneous power and the average power. [March - 2020]
- 24) An early model for an atom considered it to have a positively charged point nucleus of charge *Ze*, surrounded by a uniform density of negative charge up to a radius *R*. The atom as a whole is neutral. For this model, what is the electric field at a distance *r* from the nucleus ?
- 25) Derive lensmaker's formula for thin lens. [March - 2020]
- 26) The distance between the two slits in Young's experiment is 0.1 mm. The perpendicular distance between the slits and the screen is 1.5 m. The wavelength of the incident light is 6000 Å. Calculate the distance between third bright and fifth dark fringes obtained on the screen. [March - 2020]
- 27) Explain the concept of the hole in the semiconductor. Explain with diagram, how current flows due to electron and hole in pure semiconductor.

Section - C

- ❖ Answer any 4 of the following given questions from 22 to 27 : (Each carries 4 marks) [16]
- 22) Determine the current in each branch of the given network.

