



**(English Version)**

- General Instructions :**
1. All Parts from A to D are compulsory.
  2. For Part – A questions, only the first written answers will be considered for evaluation.
  3. Answers without relevant diagram / figure / circuit wherever necessary will not carry any marks.
  4. Direct answers to numerical problems without relevant formula and detailed solutions will not carry any marks.

**PART – A**

- I. Pick the correct option among the four given options for **all** of the following questions : **(15 × 1 = 15)**

- 1) Which one of the following charge cannot exist on a body?
  - a)  $2e$
  - b)  $3e$
  - c)  $3.5e$
  - d)  $-4e$
  
- 2) The equipotential surfaces of an isolated point charge are :
  - a) Coaxial cylindrical surfaces
  - b) Plane surfaces parallel to each other
  - c) Concentric spherical surfaces centred at the charge
  - d) Spherical surfaces but not centred on the charge



- 3) Consider the following statements about a balanced Wheatstone's bridge.

Statement-I : The current through the galvanometer is zero.

Statement-II : If the positions of the galvanometer and the battery are interchanged in the circuit, the current in the galvanometer will be zero.

Among the above two statements :

- a) Only Statement-I is true
  - b) Only Statement-II is true
  - c) Both the Statements are wrong
  - d) Both the Statements are true
- 4) The path traced by a charged particle moving perpendicular to a uniform magnetic field is :
- a) circle
  - b) straight line
  - c) helix
  - d) ellipse
- 5) A magnetic dipole of magnetic moment  $\vec{m}$  is placed in a uniform magnetic field  $\vec{B}$  such that the angle between  $\vec{m}$  and  $\vec{B}$  is  $\theta$ . If the magnetic dipole is in stable equilibrium position, then :
- a)  $\theta = 0^\circ$
  - b)  $\theta = 90^\circ$
  - c)  $\theta = 180^\circ$
  - d)  $\theta = 45^\circ$
- 6) The working principle of an A.C. generator is :
- a) mutual induction
  - b) eddy currents
  - c) self induction
  - d) electromagnetic induction



- 7) Power factor of a series LCR circuit is maximum when :
- a)  $X_L = X_C$
  - b)  $X_C = 0$
  - c)  $X_L > X_C$
  - d)  $X_L < X_C$
- 8) Displacement current is produced due to :
- a) Constant electric field
  - b) Constant magnetic field
  - c) Changing electric field
  - d) Changing magnetic field
- 9) For total internal reflection of light :
- a) light should be travelling from rarer medium to denser medium
  - b) light should be travelling from denser medium to rarer medium
  - c) light should be incident along the normal
  - d) angle of incidence should be equal to  $90^\circ$
- 10) The angle of minimum deviation of a prism depends on :
- (i) refractive index of the material of the prism
  - (ii) refractive index of surrounding medium
  - (iii) refracting angle of the prism
- a) Only option (i)
  - b) Only option (ii)
  - c) Only option (iii)
  - d) All (i), (ii) and (iii)



- 11) According to Huygen's principle, speed of the secondary wavelets is :
- a) twice that of the wave      b) zero  
c) same as that of the wave      d) infinite
- 12) An  $\alpha$ -particle, a proton, an electron and a neutron are moving with the same velocity. Then the particle having longest de Broglie wavelength is :
- a) proton      b) electron  
c) neutron      d)  $\alpha$ -particle
- 13) Let  $K$  be the kinetic energy,  $U$  be the potential energy and  $E$  be the total energy of an electron revolving around the nucleus in a hydrogen atom, then which of the following is correct?
- a)  $K > 0, U > 0, E > 0$   
b)  $K > 0, U < 0, E < 0$   
c)  $K > 0, U > 0, E < 0$   
d)  $K < 0, U < 0, E < 0$
- 14) An example for isobars is :
- a)  ${}^2_1\text{H}$  and  ${}^3_1\text{H}$   
b)  ${}^2_1\text{H}$  and  ${}^4_2\text{He}$   
c)  ${}^{198}_{80}\text{Hg}$  and  ${}^{197}_{79}\text{Au}$   
d)  ${}^3_1\text{H}$  and  ${}^3_2\text{He}$
- 15) Which of the following pairs are elemental semiconductors?
- a) Silicon and aluminium      b) Silicon and germanium  
c) Germanium and cadmium      d) Aluminium and cadmium



II. Fill in the blanks by choosing appropriate answer from the given options for **all** the following questions : (5 × 1 = 5)

(photons, diffraction, polarity, monopoles, greater than unity, less than unity)

- 16) According to Gauss's law in magnetism, magnetic \_\_\_\_\_ are not known to exist.
- 17) Lenz's law gives the \_\_\_\_\_ of induced emf.
- 18) For a step-down transformer, the ratio of primary current to secondary current is \_\_\_\_\_.
- 19) The bending of light around the corners and entering into the geometric shadow region is called \_\_\_\_\_.
- 20) In interaction with matter, light behaves as if it is made up of packets of energy called \_\_\_\_\_.

**PART – B**

III. Answer **any five** of the following questions : (5 × 2 = 10)

- 21) Write any two properties of electric field lines.
- 22) What is electrostatic shielding? Mention one use of it.
- 23) How does the resistivity of a semiconductor vary if its temperature is increased? Also show the variation graphically.



- 24) A thin long straight wire carries a current of 5 A. Calculate the magnitude of the magnetic field at a distance of 0.25 m from the wire.  
( $\mu_0 = 4\pi \times 10^{-7} \text{ Hm}^{-1}$ )
- 25) Write the expression for the motional emf induced in a straight conductor moving perpendicular to a uniform magnetic field. Explain the terms.
- 26) Name the electromagnetic waves used in :
- the radar systems of aircrafts.
  - the laser assisted eye surgery (LASIK).
- 27) Define impact parameter. What is the angle of scattering of an  $\alpha$ -particle for zero impact parameter?
- 28) List out two differences between p-type and n-type semiconductors.

### PART - C

IV. Answer **any five** of the following questions :

(5 × 3 = 15)

- 29) Give Coulomb's law in vector form and explain the terms. Define SI unit of charge.
- 30) What is a capacitor? Mention any two factors on which capacitance of a parallel plate capacitor depends.
- 31) With the help of a circuit diagram, explain how to convert a galvanometer into a voltmeter.
- 32) Differentiate between diamagnetic and ferromagnetic materials.



- 33) Obtain the expression for energy stored in an inductor.
- 34) A refracting telescope has an objective lens of focal length 144 cm and the length of the tube is 150 cm. Calculate the magnification due to the telescope.
- 35) Write the experimental observations of photoelectric effect.
- 36) List three conclusions drawn from observations of binding energy per nucleon versus mass number curve.

**PART – D**

V. Answer **any three** of the following questions : **(3 × 5 = 15)**

- 37) Arrive at the expression for the electric field at a point due to an infinitely long uniformly charged straight wire using Gauss's law.
- 38) Obtain the expression for equivalent emf and equivalent internal resistance of two cells of different emfs and different internal resistances connected in series.
- 39) Derive the expression for the magnitude of the magnetic field at a point on the axis of a circular loop carrying current.
- 40) Derive mirror equation  $\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$  for a concave mirror.
- 41) What is half wave rectifier? Describe with a circuit diagram, the working of a semiconductor diode as a half wave rectifier. Draw input and output waveforms.



(2 × 5 = 10)

VI. Answer **any two** of the following questions :

- 42) Two charges  $5 \times 10^{-8} \text{ C}$  and  $-3 \times 10^{-8} \text{ C}$  are located 16 cm apart in vacuum. Find the positions along the line passing through the two charges at which the electric potential is zero.
- 43) The power dissipated across a wire of length 0.5 m and area of cross-section  $0.2 \times 10^{-6} \text{ m}^2$  is 10 W when a steady current flows through it. Calculate the following quantities :
- (Given : resistivity of the material of the wire is  $1 \times 10^{-6} \Omega \text{ m}$ )
- Resistance of the wire ;
  - The current flowing through the wire ;
  - The current density for the wire.
- 44) An inductor and a resistor are connected in series with 200 V, 50 Hz a.c. source. The current in the circuit is 2 A and voltage leads the current by  $\frac{\pi}{3}$ . Calculate the inductance of the inductor.
- 45) A beam of light consisting of two wavelengths 500 nm and 600 nm is used to obtain interference fringes in Young's double slit experiment. Distance between the slits is 1 mm and the screen is placed at a distance of 1.2 m from the slits.
- Find the least distance between the central maximum and the point where the bright fringes due to both the wavelengths coincide.
  - Find the distance of the third dark fringe from the central bright fringe for the first wavelength.