PHYSICS

Roll No.:.....

Total No. of Questions: 22] **Total No. of Printed Pages:** 3

Paper 1

Time: 3 Hours] **[Maximum Marks:** 70

SECTION-A

1 each

1. Choose the correct/most appropriate answer

(i) In case of insulators as the temperature decreases, resistivity:

(A) Increases (B) Decreases

(C) Remains constant (D) Becomes zero

(ii) No force acts on a current carrying conductor in a magnetic field when angle between current and magnetic field is:

(A) Zero (B) $\frac{\pi}{4}$

(C) $\frac{\pi}{2}$ (D) $\frac{3\pi}{4}$

(iii) Torque acting on a magnet held at angle θ with magnetic field is maximum when θ is equal to:

(A) 0° (B) 180°

(C) 360° (D) 90°

(iv) The SI unit of magnetic flux is:

(A) Weber (B) Gauss

(C) Orested (D) Tesla

(v) The dimensions of E/B are same as that of:

(A) Acceleration (B) Velocity

(C) Charge (D) Current

(vi) The velocity of light in vacuum is 3×10^8 ms^{-1}. The velocity of light in a medium of refractive index 1.5 is:

(A) 4.5×10^8 ms^{-1} (B) 3×10^8 ms^{-1}

(C) 2×10^8 ms^{-1} (D) 1.5×10^8 ms^{-1}

(vii) In a compound microscope, the distance between objective lens and eye lens is:

(A) Fixed (B) Variable

(C) Infinite (D) 1 metre

(viii) The series of hydrogen spectrum which lies in visible region is:

(A) Lyman series (B) Paschen series

(C) Balmer series (D) None of these

(ix) 'A' stands for atomic mass number and 'Z' for atomic number. The number of electrons in an atom is:

(A) A - Z (B) A + Z
(C) Z (D) A

(x) What is the order of the forbidden gap in energy bands of silicon?
(A) 0.1 eV (B) 1.1 eV
(C) 2.1 eV (D) 0.7 Ev

SECTION-B

2 each

2. Draw the lines of force due to two equal and similar charges for:
(i) $q_1 = q_2 < 0$ and
(ii) $q_1 = q_2 > 0$
3. An electron is separated from the proton through a distance of 0.53 Å. Calculate the electric field at the location of the electron.
4. State two factors on which the sensitivity of a moving coil galvanometer depends.
5. A magnetic flux of 5 μ Wb is linked with a coil when a current of 1 mA flows through it. What is the self-inductance of coil?
6. State four characteristics of e.m. waves.
7. Write four applications of optical fibers.
8. What are conditions for sustained interference of light?
9. Explain the term stopping potential and threshold frequency.

Or

Is photoelectric emission possible at all frequencies? Give reasons for your answer.

10 What is the de-Broglie wavelength of 0.3kg object moving with a speed of 6 ms^{-1}?

SECTION-C

3 each

12. Calculate the number of electrons moving per second through the filament of a lamp of 100 watt operating at 200 volt.
13. Using Kirchhoff's laws derive the condition for balance of a Wheatstone bridge circuit.

Or

Define drift velocity of electrons and establish relation between drift velocity and electric current.

13 A conducting wire of 100 turns is wound over and near the centre of a solenoid of 100 cm length and 2 cm radius having 600 turns. Calculate mutual inductance of two coils.

14. Using phasor treatment derive an expression for impedance and phase angle of LCR circuit.
15. Explain refraction through prism and show $\delta = (i_1 + i_2)$ - A.
16, Distinguish between excitation potential and ionization potential.
17. What are nuclear forces? Give their important characteristics.
18. What is meant by depletion region in a junction diode? Explain its formation.
19. With the help of a circuit diagram, explain forward characteristics of a. p-n diod

SECTION-D

5 each

20 Using Gauss' theorem derive an expression for electric field due to infinitely long straight wire.

Or

What is electric potential? Derive an expression for electric potential at a distance from a charge +Q.

21. Derive an expression for force acting on a current carrying conductor placed in a uniform magnetic field. Also mention the cases when force is minimum and maximum.

Or

What are dia, para and ferromagnetic substances? Discuss their important properties.

22 State Huygens' principle and prove the laws of refraction on its basis.

Or

Describe an Astronomical telescope. Drive an expression for its magnifying power when image is formed at infinity.

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Paper 2

Time: 3 Hours]

[Maximum Marks: 70

SECTION-A

1 each

1. (i) Potential at any point inside a charged hollow sphere:
   (A) increases with distance (B) is a constant
   (C) decreases with distance from centre
   (D) is zero
   (ii) In a charged capacitor, the energy resides:
   (A) on the positive plate
   (B) on both positive and negative charged plates
   (C) in the field between the plates
   (D) around the edge of the capacitor plates
   (iii) One ampere is equivalent to:
   (A) 1 coulomb second (B) 1 coulomb second^{-1}
   (C) 1 joule second (D) 1 joule second^{-1}
   (iv) The internal resistance of a cell is the resistance of:
   (A) Material used in the cell (B) Electrolyte used in the cell
   (C) Electrodes of the cell (D) Vessel of the cell
   (v) The magnetic permeability is maximum for:
   (A) Paramagnetic (B) Ferromagnetic
   (C) Diamagnetic (D) Non-magnetic
   (vi) A uniform magnetic field is obtained in:
   (A) a bar magnet (B) a horse shoe magnet
   (C) a circular coil carrying a current
   (D) a cylindrical coil carrying a current
   (vii) Which of the following radiations has the least wavelength?
   (A) α-rays (B) β-rays
   (C) γ-rays (D) X-rays
   (viii) If the light propagating along a straight line bends by a small but fixed angle it may be due to:
   (A) Reflection (B) Refraction
   (C) Diffraction (D) Dispersion
   (ix) The de-Broglie wavelength λ of a particle is related to its kinetic energy E as
   (A) $\lambda \alpha \sqrt{E}$ (B) $\lambda \alpha 1/\sqrt{E}$
   (C) $\lambda \alpha E$ (D) $\lambda \alpha 1/E$

(x) The main difference between conductors, semiconductors and insulators is because of:

(A) Binding energy of electrons (B) Work function

(C) Mobility of electrons (D) Width of forbidden energy gap

SECTION-B

2 each

2. What were the important conclusions drawn from α-scattering experiment?
3. State and explain Coulomb's law of force in electrostatics.
4. Find the area of the plates of a 3F parallel plate capacitor, if the separation between the plates is 5 mm.
5. On what factors resistivity of the material depends?
6. A galvanometer has a resistance of 60 Ω and a full scale deflection is produced by 1.0 mA. How will you convert it into an ammeter to read 1 A (full scale).
7. State Lenz's law. What factors do govern the direction of e.m.f.?
8. The instantaneous voltage from an a.c source is given by V = 300 sin 314t. What is the root mean square value of the source?
9. What is displacement current? Explain its cause.
10. Derive the relation between critical angle and refractive index of the medium.

SECTION-C

3 each

11. Using Gauss' theorem, derive an expression for electric field at a point due to a uniformly charged infinite plane sheet.
12. Apply Kirchhoff's laws to obtain the condition of balanced Wheatstone bridge.
13. Define interference of light. Write *four* conditions for obtaining sustained interference.
14. The radii of curvature of the faces of a double convex lens are 10 cm and 12 cm respectively. If the focal length of the lens is 12 cm, find the refractive index of the material of the lens.
15. What is Photoelectric Effect? Derive the Einstein's photoelectric equation.
16. What is Binding Energy? Explain the significance of binding energy per nucleon in the stability of the nucleus.
17. Write three postulates of Bohr's model of atom.
18. Explain the function of *p-n* junction diode as full-wave rectifier by giving a diagram.
19. What are Extrinsic Semiconductors? Describe P-type semiconductor.

SECTION-D

5 each

20. Draw the labelled diagram of a moving coil galvanometer. Describe its principle, construction and working.

Or

Derive an expression for the force per unit length between two long parallel straight current carrying conductors in the same or opposite direction. Hence, define one ampere.

21. Derive an expression for the average power in an ac circuit containing L, C and R.

Or

State Faraday's laws of electromagnetic induction and explain any one method of producing induced e.m.f.

22. State Huygen's principle. Hence derive laws of reflection from it.

Or

Describe construction and working of an astronomical telescope.
Calculate its magnifying power in normal adjustment.

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Paper 3

Time: 3 Hours] [Maximum Marks: 70

SECTION-A

1 each

1. (i) A body can be negatively charged by:
   (A) Giving excess of electrons to it
   (B) Removing some electrons from it
   (C) Giving some protons to it
   (D) Removing some neutrons from it

   (ii) It is possible to have a positively charged body at:
   (A) Zero potential (B) Negative potential
   (C) Positive potential (D) All of these

   (iii) Which of the following relation is called as current density? I >
   (A) I/A (B) A/I
   (C) I^2/A (D) I^3/A^2

   (iv) Which of the following is ferromagnetic?
   (A) Aluminium (B) Quartz
   (C) Nickel (D) Bismuth

   (v) A transformer is used to change
   (A) High voltage d.c. into low voltage d.c.
   (B) High voltage a.c. into low voltage a.c.
   (C) Electrical energy into mechanical energy
   (D) Mechanical energy into electrical energy

   (vi) Which of the following are not electromagnetic wave
   (A) Cosmic rays (B) γ-rays
   (C) β-rays (D) X-rays

   (vii) Which of the following produces a plane wave, front?
   (A) Point source (B) Line source
   (C) Extended source (D) None of these

   (viii) Electron volt is the unit of:
   (A) Charge (B) Momentum
   (C) Potential difference (D) Energy

   (ix) In case of artificial radioactive transformation as given by:
   $_{15}P^{30} \rightarrow {}_{14}Si^{30} + X$
   particle X is :
   (A) Neutron (B) Proton

(C) Electron (D) Positron

(x) The type of bond in a silicon crystal is:

(A) Ionic (B) Metallic

(C) Covalent (D) Van der Waals

SECTION-B 2 each

2. (a) What is an equipotential surface ? Give the direction of electric field with respect to an equipotential surface.

(b) Self induction is called the inertia of electricity. Explain, why.

(c) What is Maxwell's displacement current? Is displacement current, a source of magnetic field?

(d) When does Snell's law of refraction fail?

(e) For glass-air interface, the critical angle is C. Will the critical angle for glass-water interface be greater or less than C? Explain.

(f) A ray of light incident on an equilateral glass prism ($\mu_g = \sqrt{3}$) moves parallel to the base line of the prism inside it. Find the angle of incidence for this ray.

(g) Why do we fail to observe the diffraction from a wide slit illuminated by monochromatic light?

(h) What are nuclear forces? State their three properties.

(i) Write two important significances of binding energy per nucleon curve.

SECTION-C 3 each

3. (a) Derive a relation between e.m.f., potential difference and internal resistance of a cell.

(b) A 10C charge flows through a wire in 5 minutes. The radius of the wire is 1 mm. It contains 5×10^{22} electrons per centimeter^3. Calculate current and drift velocity.

(c) What is an ammeter? How can a galvanometer be converted into an ammeter?

(d) State Lenz's law and show that it does not violate the law of conservation of energy.

(e) A capacitor of 1 μF is connected to source of a.c. having e.m.f. given by equation $E = 200 \cos 120 \pi t$. Find r.m.s. value of current through the capacitor.

(f) Calculate de-Broglie equation for a material particle.

(g) On the basis of Bohr's atomic model, find an expression for radius of nth orbit of a hydrogen atom.

(h) Explain the forward and reverse bias characteristic curve of a *p-n* junction.

(i) Distinguish between intrinsic and extrinsic semiconductors.

SECTION-D 5 each

4. (a) State Gauss's law in electrostatics. Derive an expression for the electric field due to an infinitely long straight charged wire at a point distant r from it. Plot a graph showing the variation of electric field with *r*.

Or

What is a capacitor? Derive an expression for total capacitance when three capacitors of capacitances C_1, C_2 and C_3 are connected in (i) series (ii) parallel.

(b) What is magnetic dipole and magnetic field intensity? Derive an expression for the torque acting on a bar magnet placed in a uniform magnetic field.

Or

Derive an expression for the force per unit length experienced by each of the two long current carrying conductors placed parallel to each other in air. Hence, define one ampere of current.

(c) What is interference of light? Deduce the conditions for constructive and destructive interference in Young's double slit experiment.

Or

What is compound microscope? With the help of ray diagram, explain the working of compound microscope. Find an expression for its magnifying power.

PHYSICS

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Paper 4

Time: 3 Hours] **[Maximum Marks:** 70

SECTION-A

1 each

1. Choose the correct/most appropriate answer

(i) 10° electrons are taken out of a pith ball, the charge on pith ball will be:

(A) 1.6×10^{-19} C (B) 1.6×10^{-13} C

(C) 1.6×10^{-25} C (D) None of these

(ii) The electrostatic potential energy of a charge 5 C at a point in the electrostatic field is 50 J. The potential at that point is:

(A) 10^{-1} V (B) 5 V

(C) 10 V (D) 10^{2} V

(iii) Wheatstone bridge is used to measure:

(A) e.m.f. (B) Potential

(C) Resistance (D) Current

(iv) Which of the following is not the unit of magnetic induction?

(A) Tesla (B) Gauss

(C) Oersted (D) Weber/meter^2

(v) The induced e.m.f. cannot be produced by:

(A) Moving a magnet near a circuit

(B) Moving a circuit near magnet

(C) Changing the current in one circuit placed near other

(D) Maintaining large but constant current in a circuit

(vi) Dimensions of $\frac{1}{\sqrt{\mu_0 \epsilon_0}}$ is:

(A) $[LT^{-1}]$ (B) $[LT^{-2}]$

(C) $[L^{-1}T^{2}]$ (D) $[L^{2}T^{-1}]$

(vii) Interference is obeyed by:

(A) Transverse waves (B) Longitudinal waves

(C) All types of waves (D) None of these

(viii) Moving with same velocity, wavelength of matter waves: which of the following has large wavelength of matter waves:

(A) α-particle (B) Proton

(C) β-particle (D) Neutron

(ix) The value of Rydberg constant is:

(A) 1.097×10^{-7}m (B) 1.097×10^{7} m^{-1}

(C) 1.097×10^{-7} m^{-1} (D) 1.097×10^{7} m

(x) In intrinsic semiconductor at room temperature the number of electrons and holes are:

(A) Equal (B) Zero

(C) Unequal (D) Infinite

SECTION-B

2 each

2. Charges + 20 μc and - 26 μc are separated by a distance of 5 mm. Calculate the magnitude and direction of dipole moment.
3. Find the focal length of combination of two convex lenses of focal length 15 cm and 30 cm held in contact.
4. Calculate the inductive reactance of 1 mH coil for frequency of 50 Hz.
5. What is relation between angle of incidence and emergence prism is in minimum deviation position.
6. Give four properties of e.m. waves.
7. Calculate the speed of light in medium whose critical angle is 45°.
8. For a giver impact parameter '*b*' does the angle of diffraction increase or decrease with increase of energy.
9. What are conditions for sustained interference of light?
10. Derive an expression for radii of Bohr's stationary orbit.

SECTION-C

3 each

11. State Ohm's law. How can you derive it using the concept of drift velocity?
12. The resistance of a conductor at 30°C is 3.25 Ω and at 100°C is 3.95Ω. Calculate the temperature coefficient of resistance of conductor.
13. Using Biot-Savart law, derive an expression for magnetic field induction at the centre of a circular coil carrying current.
14. State and explain Lenz's law.
15. Using Phasor's diagram derive an expression for impedance of LCR circuit.
16. What is nuclear fusion? Give one representive reaction.
17. Explain laws of photoelectric emission on the basis of Einstein's photoelectric equation
18. How does the conductivity of a semiconductor change by doping with pentavalent impurity atom?
19. Using a circuit diagram explain how is a p-n diode used as a full wave rectifier?

SECTION-D

5 ea

20. Derive an expression for the capacitance of a parallel plate capacitor in presen of dielectric slab between its plates. *Or*

State Gauss's law in electrostatics. Hence derive expression for electric field to an infinite line of charge.

21. Discuss the principle, construction and working galvanometer.

Or

What are dia, para and ferromagnetic substances? Discuss their impo properties.

22. State Huygen's principle and prove the laws of refraction on its basis.

Or

Derive the Len's Makers formula for a convex lens.