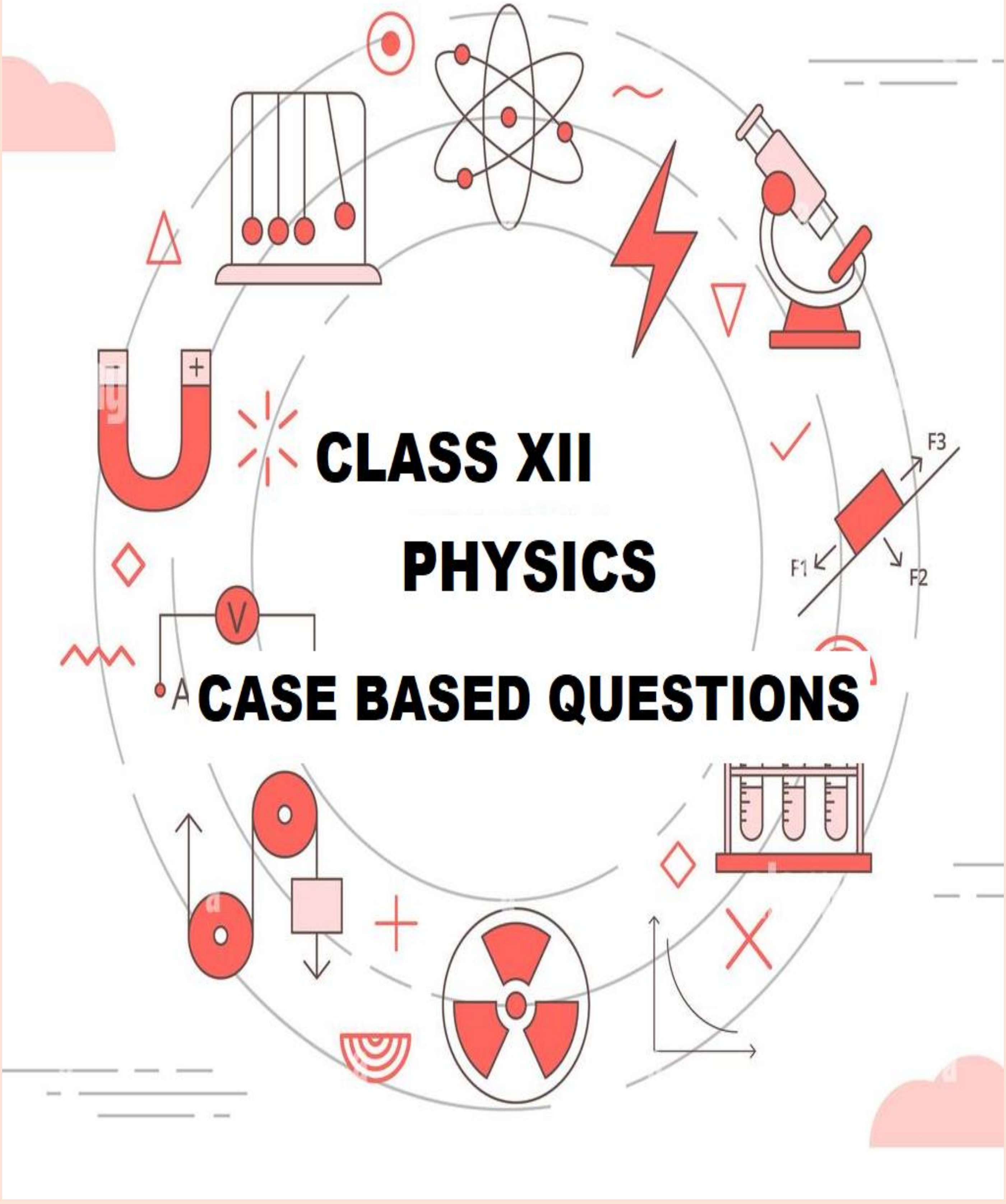
CLASS XII

PHYSICS

CASE BASED QUESTIONS



DIRECTOR'S MESSAGE……

It is with profound delight and utmost pride that we present the Competency Based Assessment question bank for **CLASS XII** which was prepared by PGT(Physics) of the feeder regions during the 03 – day workshop on "**Competency Based Assessment in Physics: Design of test items**" It's my firm belief that access to quality education should know no boundaries, transcending social and economic constraints. Our collective vision is to empower all students and teachers with the tools for success and intellectual growth.

With their steadfast dedication, the PGT(Physics) from the feeder Regions namely Bangalore, Chennai, Ernakulam and Hyderabad have invested their knowledge and expertise in preparation of the CBA test items.

It is with pleasure that I place on record my commendation for the commitment and dedication of the team of PGT(Physics) from the four Regions, Shri. Mathew Abraham, Principal KV konni, Ernakulam Region & Associate Course Director, the Resource person Mr Randheer Vannery PGT(Physics)KV No. 1 Palakkad and Mr. Dinesh Kumar, Training Associate (Physics) from ZIET Mysore who has been the Coordinator of this assignment.
Wishing you all the very best in your academic journey!

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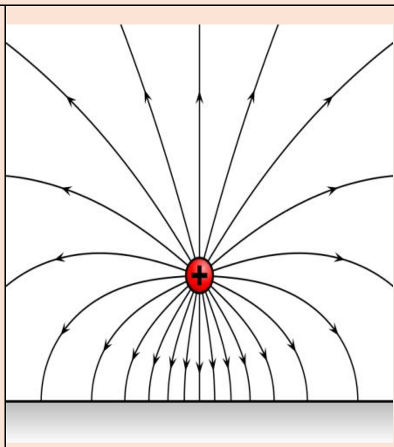
INDEX

ELECTRIC CHARGES AND FIELD

CASE BASED QUESTIONS

1. ELECTRIC FIELD

An electric field is the physical field that surrounds electrically charged particles. Charged particles exert attractive forces on each other when their charges are opposite, and repulse each other when their charges are the same. Because these forces are exerted mutually, two charges must be present for the forces to take place. The electric field of a single charge (or group of charges) describes their capacity to exert such forces on another charged object. These forces are described by Coulomb's law, which says that the greater the magnitude of the charges, the greater the force, and the greater the distance between them, the weaker the force. The Coulomb force on a charge of magnitude q at any point in space is equal to the product of the charge and the electric field at that point. **F = qE**. Also the electric field due to a point charge is given by **E** = $\frac{q}{4\pi r^2 \epsilon_0}$.

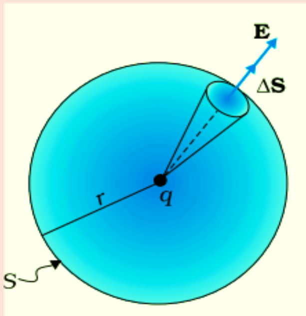


i	The electric field required to keep a water drop of mass 'm' to remain suspended, when charged with one electron is: A. mg B. mg/e C. emg D. em/g	1 mark
ii	Two charges +5 μC and +10 μC are placed 20 cm apart. The electric field at the midpoint between the two charges is: A. 4.5 x 10^6 N/C towards +5 μC B. 13.5 x 10^6 N/C towards +5 μC C. 4.5 x 10^6 N/C towards +10 μC D. 13.5 x 10^6 N/C towards +10 μC	1 mark
iii	Two point charges placed in a medium of dielectric constant 5 are at a distance r between them, experience an electrostatic force F between them. Force in vacuum at the same distance r will be: A. 5 F B. F C. F/2 D. F/5	1 mark

iv	There is an electric field in the X-direction. If the work done in moving a charge of 0.2 C through a distance of 2m along a line making an angle of 60^0 with X-axis is 4 J, then what is the value of E? A. √3 N/C B. 4 N/C C. 5 N/C D. 20 N/C OR A particle of mass 'm' and charge 'q' is placed at rest in a uniform electric field 'E' and then released, the kinetic energy attained by the particle after moving a distance 'x' will be: A. q^2Ex B. qEx C. qE^2y D. qEy^2	1 mark

2. ELECTRIC FLUX

Electric flux is the property of electric field. It is measured as the number of electric field lines passing perpendicular to the surface. It is equal to the product of the surface area and the perpendicular component of electric field. Gauss Theorem states that the total electric flux passing through a closed surface is equal to $\frac{1}{\epsilon_0}$ times the total charge enclosed by the closed surface. Gauss' law is valid for any closed surface irrespective of its shape or size.



1	A charge 'q' is first kept inside a sphere of radius 5 cm and then kept inside a cube of side 5 cm. The electric flux will be: A. More in the case of sphere B. More in the case of cube C. Will be same in both cases D. Zero in both cases	1 mark
2	A charge 'Q' is kept inside a cube of side 'a'. What will be the electric flux through any one face of the cube? A. $\frac{Q}{\epsilon_0}$ B. $\frac{Q}{6\epsilon_0}$ C. $\frac{Q}{24\epsilon_0}$ D. Zero	1 mark

3	What is the SI unit of electric flux? A. $NM^{-2}C$ B. $NM^{2}C^{-1}$ C. $N^{-1}M^{2}C$ D. $NM^{2}C^{1}$	1 mark
4	The electric flux through the surface of a sphere is 50 units. If the radius of the sphere is doubled, what will be the new flux through the sphere? A. 50 units B. 100 units C. 25 units D. Zero OR An electric dipole consisting of charges +10 μC and -10 μC separated by a distance 2 cm is placed inside a sphere of radius 10 cm. If the radius of the sphere is doubled, the new electric flux will be: A. Zero B. 20 units C. 100 units D. Cannot be determined.	1 mark

3. ELECTRIC DIPOLE

An electric dipole is a system of two equal and opposite charges separated by a small distance. Every electric dipole has an electric dipole moment. It is measured as the product of one of the charges and the distance between the charges. When an electric dipole of dipole moment $\vec{P}$ is placed in a uniform electric field $\vec{E}$, the net force acting on it will be zero but a torque will be acting on the dipole which is given by $\vec{\tau} = \vec{P} \times \vec{E}$.

1	What is the SI unit of electric dipole moment? A. $C\text{-}m^{-1}$ B. $C^{-1}m$ C. C-m D. None of these	1
2	2 C and -2 C are two equal charges separated by a distance of 10 cm, is placed in a uniform electric field of strength 10 NC^{-1} with its axis making an angle of 90^{0} with the field. What is the torque acting on it? A. 200 N-m B. 20 N-m C. 2 N-m D. 0.2 N-m	1

3	On which among the following factors does dipole moment depend? A. Length only B. Length and charge of a dipole C. Dielectric constant and charge of the medium D. Charge only	1
4	If a force F is acting on a point charge that is kept on the axis of an electric dipole, and if the distance of the point charge is tripled from the dipole, what will be the amount of force? A. 20F B. F/27 C. F/25 D. F/40 OR ……………will act on an electric dipole if it is placed in a non-uniform electric field. A. Force only B. Both torque and force C. No force but torque D. None of these	1

4. **PROPERTIES OF ELECTRIC CHARGES**

Electric Charge is a scalar quantity. Charge transfer from one body to another which means they are movable. Like charges repel each other and unlike charges attract each other. Charge is always linked with mass. The SI unit of electric charge is Coulomb (C). The charge on a body is an integral multiple of the basic unit of charge of an electron or proton. Electric charge is neither created nor destroyed, but can be transferred from one body to another. Conductors allow charges to flow easily through them, while insulators do not. Surface charge density is measured as the charge per unit area of the surface.

1	Which of the following is not the property of charge? A. Charge is additive B. A charge is self-destructive C. Quantization of charge D. Charge is conserved	1
2	Which among the following is the safest place during lightning? A. Under a tree B. High wall C. House with lightning arrester D. Under a light post	1

3	What is the SI unit of surface charge density? A. C B. Cm^{-2} C. Cm^{-1} D. Cm^{-3}	1
4	If a system is having four charged particles with charges -2 C, +3 C, -1 C and -5 C, what is the total charge of the system? A. -4 C B. - 5 C C. +2 C D. +5 C OR Identify the Correct statement: A. On giving negative charge to an object, its mass increases B. On giving positive charge to an object, its mass remains constant C. An object gets negatively charged when electrons are removed from it D. It is possible to charge an object by 2×10^{-19} C.	1

ELECTRIC CHARGES AND FIELD

CASE BASED QUESTIONS - ANSWER KEY

Q. NO	SUB QUESTION	ANSWER
1	i	B
	ii	A
	iii	A
	iv OR	D B
2	i	C
	ii	B
	iii	B
	iv	A
	OR	A
3	i	C
	ii	C
	iii	B
	iv OR	B B
4	i	B
	ii	C
	iii	B
	iv OR	B A

CLASS : XII

Chapter–2

ELECTROSTATIC POTENTIAL AND CAPACITANCES

CASE BASED QUESTIONS

SL NO	QUESTION	Marks
1	1. Consider a system of two point charges +4μC and -4μC and , placed 20 cm apart in a vacuum. The charges are fixed at points A and B respectively along the x-axis, with A at x= -10cm and B at x =+10 cm The electric field and equipotential surfaces generated by these charges are symmetric about the midpoint between the two charges. Equipotential surfaces are surfaces on which the potential at every point is the same. Near the charges, these surfaces are nearly spherical, and at greater distances, the surfaces become elongated along the axis connecting the charges. At the midpoint between the charges, the potential is zero. However, the electric field at this point is not zero, as the electric fields due to the individual charges add up in magnitude but point in opposite directions. A small test charge is moved from a point at infinity to different positions in the vicinity of the charges, including points on equipotential surfaces.	
i)	At the midpoint between the two charges (the origin), what is the electric potential? (A) Zero (B) Maximum positive (C) Maximum negative (D) Depends on the path taken	1
ii)	Which of the following statements about equipotential surfaces is correct? (A) Equipotential surfaces are always parallel to the electric field lines. (B) Equipotential surfaces are perpendicular to electric field lines. C) The work done by the electric field in moving a test charge between two points on the same equipotential surface is not zero. (D) Equipotential surfaces do not exist near charges.	1
iii)	If the test charge is moved from a point on an equipotential surface at 10 cm from the origin to another point at 15 cm from the origin, what is the work done by the electric field? (A) Positive (B) Negative (C) Zero (D) Depends on the charge type	1
	In the case of an electric dipole, the equipotential surfaces at points far from the dipole become: A) Spherical and centered on the dipole axis B) Spherical and centered midway between the charges C) Planar and perpendicular to the dipole axis D) Planar and parallel to the dipole axis	1

	OR What can be concluded if the electric potential difference between two points is zero? A) The points are on the same equipotential surface B) The electric field is zero C) The electric charge is zero D) The electric current is zero	
2	The parallel plate capacitor consists of two parallel metal plates X and Y each of area A, separated by a distance d, having a surface charge density σ as shown in figure. The medium between the plates is air. A charge +q is given to the plate X. It induces a charge –q on the upper surface of earthed plate Y. When the plates are very close to each other, the field is confined to the region between them. The electric lines of force starting from plate X and ending at the plate Y are parallel to each other and perpendicular to the plates. The capacitance is directly proportional to the area (A) of the plates and inversely proportional to their distance of separation (d). The capacitance (C) of the parallel plate capacitor is given by C= ϵ_0 A/d. if the region between the two plates is filled with dielectric like mica or oil. Its capacitance increased by ϵ_r times of the medium.	
i)	(i) If Q is magnitude of charge on each plate of area A separated by a distance d Then potential difference between the two plates of a parallel plate capacitor is (a)$Qd/(\varepsilon_o A)$ (b) $d\varepsilon_o/AQ$ (c) $Ad/(\varepsilon_o Q)$ (d) $QA/d\varepsilon_o$	1
ii)	(ii) A capacitor is charged by a battery and the charging battery is disconnected and a dielectric slab is inserted in it. Then for the capacitor (a) Charge remains constant (b) Charge increases (c) Potential difference remains constant (d) Potential difference increases	1
iii)	(iii) Capacitance of a parallel plate capacitor does not depend on: (a) Area of the plates (b) Type of metal used for plates (c) Separating distance between the plates (d) Dielectric constant of the medium between the plates	1
iv)	A parallel plate capacitor has a capacitance of 10 μF. If the distance between two plates is doubled then the new capacitance will be 20 μF (b) 15 μF (c) 10 μF (d) 5 μF OR A parallel plate capacitor has a capacitance of 8 μF with a dielectric of relative permittivity 2. If the dielectric is removed, what will be the new capacitance? A) 4 μF B) 8 μF C) 16 μF D) 2 Mf	1

3	A physics lab experiment was done by a student on rotating a dipole, consisting of two charges (+q and -q) separated by distance d, in a uniform magnetic field (B). The initial orientation was perpendicular to the magnetic field. To rotate the dipole, a torque (τ) was applied. The work done (W) in rotating the dipole was measured for various angles (θ) between the dipole and magnetic field	
i)	A electric dipole of dipole moment p is placed in an electric field E. If the dipole is rotated through an angle of 90^{0}, the work done is: A) 0 B) −p E C) P E D)−2p E	1
ii)	work done to turn a dipole from stable equilibrium to unstable equilibrium is A) PE B)PE C)+2PE D)ZERO	1
iii)	Why does the work done become zero at 0° and 180°? A) Magnetic field is zero B) Dipole moment is zero C) Torque is zero D) Potential energy is minimum	1
iv)	What would happen if the magnetic field strength increases? A) Work done decreases B) Work done increases C) Angle of rotation decreases D) Dipole moment remains constant Or How does the dipole's orientation affect the magnetic force? A) Increases with angle B) Decreases with angle C) Remains constant D) Changes direction	1
4	A metal sphere is placed in a uniform electric field. Initially, the sphere is neutral, but as it is exposed to the electric field, free electrons within the conductor are influenced by the field. These electrons move toward the side of the sphere that is opposite to the direction of the electric field, causing one side of the sphere to become negatively charged while the opposite side becomes positively charged.Once the sphere is grounded, additional electrons flow from the ground into the sphere until the potential of the sphere matches the surrounding electric field. The grounding is then removed, and the sphere is left in the electric field. After this process, the sphere retains a net negative charge, demonstrating the fundamental principles of electrostatics in conductors.	
i)	What happens to the free electrons in the metal sphere when exposed to the electric field? A)They are destroyed. B) They move toward the direction of the electric field. C)They move opposite to the direction of the electric field. D)They remain stationary	1
ii)	What is the purpose of grounding the sphere during the experiment? A) To provide a path for excess charge to flow. B)To increase the electric field strength.	1

	B) To neutralize the charge on the sphere. D)To heat the sphere.	
iii)	Which of the following best describes the electrostatic behavior of conductors? A) Charge can exist only on the inside of a conductor. B) Electric field inside a conductor is zero in electrostatic equilibrium. C) Conductors can accumulate charge only when they are grounded. D) Charges in conductors can only move under the influence of magnetic fields.	1
iv)	What occurs at the surface of the conductor when it is placed in an electric field? A) The charges redistribute uniformly. B) There is a net positive charge on the surface. C) The charges remain stationary. D) The charges redistribute until the electric field inside is zero. **Or** What happens to the potential of the sphere after it is grounded? A)It increases indefinitely. B)It becomes equal to that of the ground. C)It remains constant. D)It becomes zero.	1

ANSWER KEY

QUESTION NO (1)

1. (A) 2. (B) 3. (C) 4. (C) OR (A)

QUESTION NO (2)

1. (A) 2. (A) 3(B) 4(D) OR (A)

QUESTION NO (3).

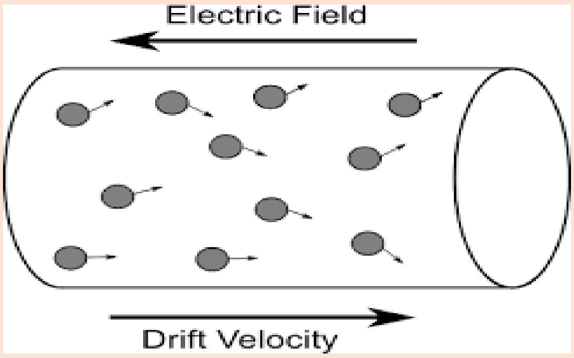
1. (B) 2.(C) 3.(C) 4.(B)OR (B)

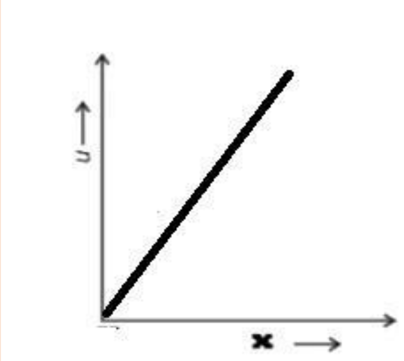
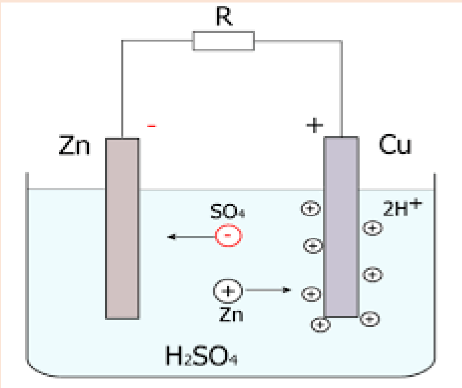
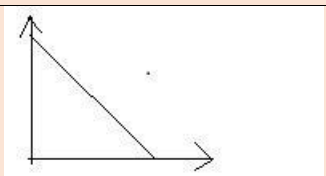
QUESTION NO (4).

1. C) 2.(A) 3. (B) 4(D) OR (B)

Chapter–3: Current Electricity

CASE BASED QUESTIONS

S.NO	QUESTION	MARKS
1	Drift velocity is the average velocity of electrons in a conductor material due to an electric field. In a conducting material, it is also proportional to the magnitude of an external electric field.  Choose the correct option in the following.	
i)	The drift velocity of electrons in a conductor is 0.8 mm/s. The potential difference across a conducting wire is doubled keeping other factors constant. What is the value of new drift velocity? (a) 0.4mm/s (b) 0.64 mm/s (c) 1.6 mm/s (d) 0.2 mm/s	**1**
ii)	How would be the current density of a conductor get affected when the potential difference is tripled keeping other factors constant. (a) Doubled (b) halved (c) no change (d) tripled	**1**
iii)	Two conducting wires of the same material, radii in the ratio 1:2 and lengths in the ratio 2:3 are connected in series to a battery of emf 5V. What is the ratio of the drift velocities of electrons in the two wires? (a) 4:1 (b) 1:3 (c)2:3 (d) 4:3	**1**
iv)	A current of 3.2 A flows through a conducting wire of number density 10^{28} m^{-3} and cross sectional area 10^{-6} m^2. The drift velocity of electrons in the wire is (a) 4 mm/s (b) 2 mm/s (c) 1mm/s (d) 0.5 mm/s **OR** The following is the graph between a drift velocity of electrons in a conductor and a physical quantity X. Identify the quantity.	**1**

	 (a) current (b) Area of cross section (c) number density (d) length of conductor	
2	Electro motive force is the work done per unit charge by a battery in open circuit. When the circuit is closed the work done per unit charge is called terminal potential difference. EMF is independent of resistance.  	
i)	A cell sends a current of 0.6A through a resistance of 3 Ω and a current of 0.3A through a resistance of 9 Ω . What is the internal resistance of the cell? **a)** 1 Ω (b) 2 Ω (c) 3 Ω (d) 4 Ω	**1**
ii)	A cell of emf 2V and internal resistance 2 Ω is connected to 10 Ω and 8 Ω in series. What is the potential difference across the 8 Ω resistor? (a) 0.8V (b) 1V (c) 0.5V (d) 1.5V	**1**
iii)	 A cell of internal resistance r is connected in series to an external resistance R. The above graph shows the variation of (a) V with R (b) V with r (c) V with I (d) E with R	**1**
iv)	Five identical cells of emf 4V are connected in parallel. Net emf across the battery is (a) 20V (b) 5V (c) 0V (d) 4V OR A cell of emf 4V, when short circuited gives a current of 2A. The internal resistance of the cell is (a) 8Ω (b) 2Ω (c) 6Ω (d) 1Ω	**1**

ANSWER KEY

1.	i) c	
	ii) d	
	iii) a	
	iv) b or a	
2	i) c	
	ii) a	
	iii) c	
	iv) d or b	

CHAPTER 4 : MOVING CHARGES AND MAGNETISM

CASE STUDY BASED

1) Moving coil galvanometer operates on Permanent Magnet Moving Coil (PMMC) mechanism and was designed by the scientist Darsonval. Its working is based on the fact that when a current carrying coil is placed in a magnetic field, it experiences a torque. This torque tends to rotate the coil about its axis of suspension in such a way that the magnetic flux passing through the coil is maximum.

(i) To increase the current sensitivity of a moving coil galvanometer, we should decrease

(a) strength of magnet (b) torsional constant of spring

(c) number of turns in coil (d) area of coil

(ii) The deflection in a moving coil galvanometer is

(a) directly proportional to torsional constant of spring

(b) directly proportional to the number of turns in the coil

(c) inversely proportional to the area of the coil

(d) inversely proportional to the current in the coil

(iii) To make the field radial in a moving coil galvanometer.

(a) number of turns of coil is kept small

(b) magnet is taken in the form of horse-shoe

(c) poles are of very strong magnets

(d) poles are cylindrically cut

(iii) In a moving coil galvanometer, having a coil of N-turns of area A and carrying current I is placed in a radial field of strength B.The torque acting on the coil is

(a) NA^2B^2I

(b) $NABI^2$

(c) N^2AB

(d) NABI

2) A magnetic field can be produced by moving, charges or electric currents. The basic equation governing the magnetic field due to a current distribution is the Biot-Savart law.

Finding the magnetic field resulting from a current distribution involves the vector product, and is inherently a calculas problem when the distance from the current to the field point is continuously changing.

Biot -Savart law has certain similarities as well as difference with Coloumbs law for electrostatic field e.g., there is an angle dependence in Biot-Savart law which is not present in electrostatic case.

(i) The direction of magnetic field $d\vec{B}$ due to a current element $Id\vec{l}$ at a point of distance $\vec{r}$ from it, when a current I passes through a long conductor is in the direction

(a) of position vector $\vec{r}$ of the point

(b) of current element $\vec{dl}$

(c) perpendicular to both $\vec{dl}$ and $\vec{r}$

(d) perpendicular to $\vec{dl}$ only

(ii) In biot savart law equation **dB**=(μo/4π)I($\vec{dl} \times \vec{r}$)/r3, what does μo indicate?

(a) Permittivity of medium

(b) Permittivity of free space

(c)permeability of free space

(d) Relative permeability

(iii) The magnetic field due to a current in a straight wire segment of length L at a point on its perpendicular bisector at a distance r (r >> L)

(a) decreases as 1/r

(b) decreases as $1/r^2$

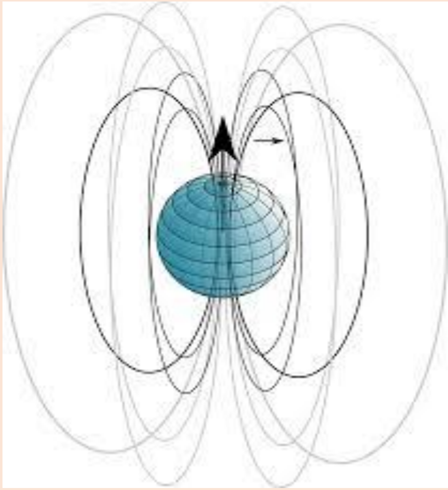
(c) decreases as $1/r^3$

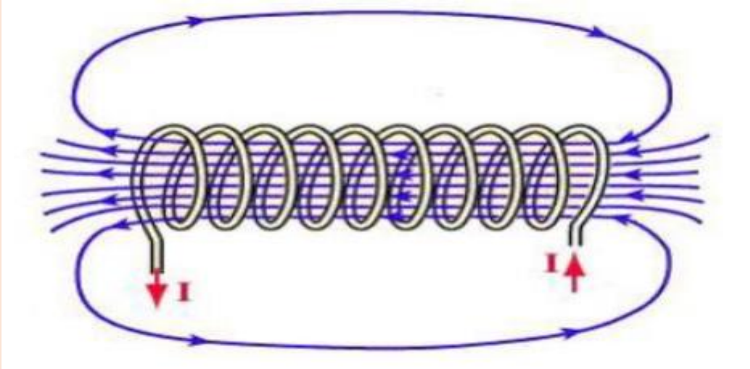
(d) approaches a finite limit as $r \to \infty$

(iv) Biot-Savart law can be expressed alternatively as

(a) Coulomb's Law
(b) Ampere's circuital law
(c) Ohm's Law
(d) Gauss's Law

CHAPTER-5 MAGNETISM AND MATTER

S. NO	QUESTION	MARKS
1	During our childhood, we all have been marvelled by the properties of a bar magnet. It attracts tiny pieces of iron scraps and nails and repels another magnet when oriented in a particular manner. A bar magnet is a rectangular piece of an object, made up of iron, steel or any other ferromagnetic substance or ferromagnetic composite, that shows permanent magnetic properties. It has two poles, a north and a south pole such that when suspended freely, the magnet aligns itself so that the northern pole points towards the magnetic north pole of the earth. And Pole strength is defined as the strength of a magnetic pole to attract magnetic materials towards it. Pole strength is a scalar quantity.  Magnetic moment, also known as magnetic dipole moment, is the measure of the object's tendency to align with a magnetic field. "Magnetic Moment is defined as magnetic strength and orientation of a magnet or other object that produces a magnetic field." The magnetic moment is a vector quantity. The objects have tendency to place themselves in such a way that the magnetic moment vector becomes parallel to the magnetic field lines. The direction of the magnetic moment points from the south to the north pole of a magnet. The magnetic field created by a magnet is directly proportional to the magnetic moment. A Magnetic Dipole comprises two unlike poles of equivalent strength and parted by a small distance. The needle of a compass, a bar magnet, etc. are magnetic dipoles. A current loop works as a magnetic dipole and magnetic moment is given by M = NIA. (i) Identify the direction in which a thin long piece of magnet comes to rest when suspended freely. a) East-west b) North-south c) Northeast-southeast d) Northwest-southwest (ii) Which of the following is not a basic property of magnets? a) Magnet exists as a monopole b) Directive property c) Attractive property d) Like poles repel and unlike poles attract (iii) A magnetic dipole of length 10 cm has pole strength of 2 Am. Find the magnetic moment of the dipole. a) 2 Am^2 b) 200 Am^2 c) 0. 2 Am^2 d) 0.2 Am^2 (iv) The magnetic dipole moment of a revolving electron is. a) ½ evr b) 2ev/r c) 2er/v d) 2rv/e OR (v) A bar magnet of the magnetic moment 50 Am^2 has poles 20 cm apart. Calculate the pole strength. a) 250 Am b) 4 Am c) 100 Am d) 25 A	4*1= 4

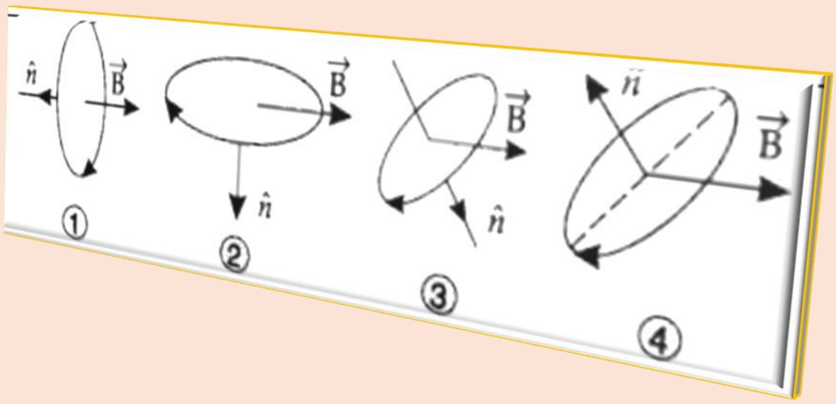
2	As shown in figure a solenoid where the wire is coiled around a cylinder, each wire loop in this coil acts as if it was a separate circular wire carrying the same current I, the current in the coiled wire and the dense enough array of such loops may be approximated by a cylindrical current sheet with the current density K = I × (N/L) = I × L (loops) /solenoid length. For simplicity, let's  assume a long solenoid (length ≫ diameter) which we approximate as infinitely long. For a long solenoid (compared to its diameter), the magnetic field inside the solenoid is approximately uniform and approximately parallel to the axis, except near the ends of the solenoid. Outside the solenoid, the magnetic field looks like the field of a physical dipole, with the North pole at one end of the solenoid and the South pole at the other end and is approximately negligible. **i**. Which of the following material can be used to make loops around the cylindrical core of Solenoid ? (a)Plastic (b) Glass (c) Quartz (d) copper **ii.** The magnetic field inside the solenoid is (a) Non-Uniform and parallel to the axis (b) Uniform and parallel to the axis (c) Non-uniform and perpendicular to the axis (d) Uniform and perpendicular to the axis **iii**. A proton is moving from left to right direction and outside the solenoid, then what is the direction of force on the proton? (a) upwards (b) downwards (c) proton will not deflect (d) inwards **iv.** How the magnetic field inside the solenoid depends upon the number of turns? (a) inversely proportional (b) directly proportional (c) proportional to the number of turns (d) none of these **OR** **v**. Direction of magnetic field due to ma solenoid can be determined by (a) Ohm's Law (b) Fleming's left-hand rule (c) Ampere's Right-hand rule (d) Biot-savart's Law	4*1=4
3	Current loop behaves like a magnetic dipole and has a magnetic field. They behave just like a magnet. Interesting part is, it depends upon the direction of current in a loop which decides whether the magnetic field line is in outward or inward direction. With the help of this outward and inward direction of magnetic field, North and South poles get decided. Anticlockwise direction of current creates north pole (outward direction magnetic field) and clockwise direction of current creates a south pole (inward direction magnetic field). Magnetic dipole moment M with the circular current loop carrying a current I and of area A. The magnitude of m is given by |m|=I x A Current in the circular coil produces a magnetic field and amperes found that the magnetic field created due to the circular coil is similar to the magnetic field due to a bar magnet. Wood screw head sign shows that the	4*1=4

direction of the screw is inward because we are not able to see the pointed part of the screw and so the direction is inward. This inward direction of the screw denotes the direction of the magnetic field.

i. A thin circular wire carrying a current I, has a magnetic moment M. The shape of a wire is changed to a square and it carries the same current. It will have a magnetic moment-

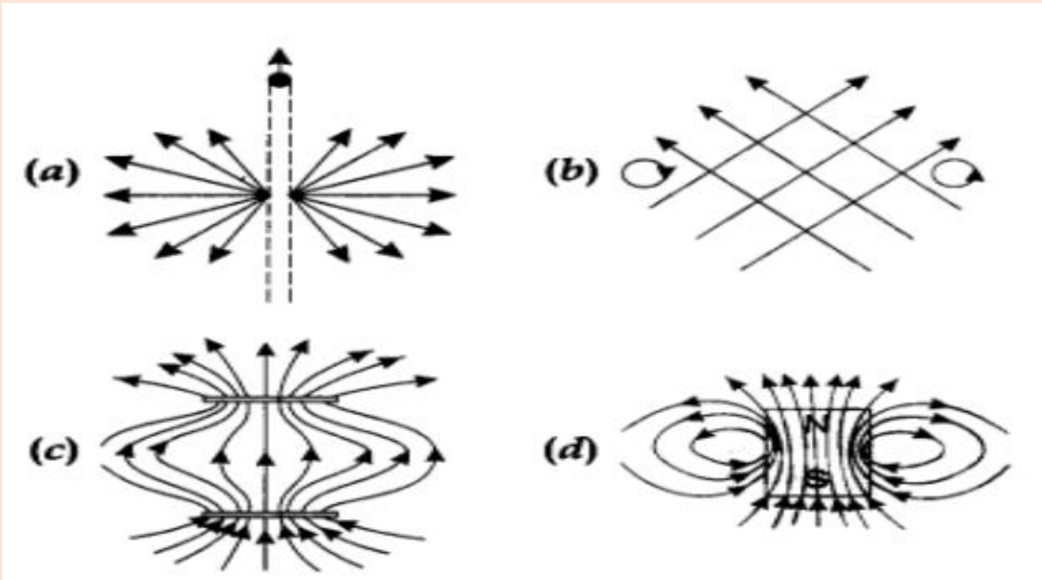
(a) $4M/\pi^2$ (b) M (c) $\pi M/4$ (d) $4M/\pi A$

ii. current carrying loop is placed in a uniform magnetic field in four different orientations as shown in figure. Arrange them in the decreasing order of potential energy.



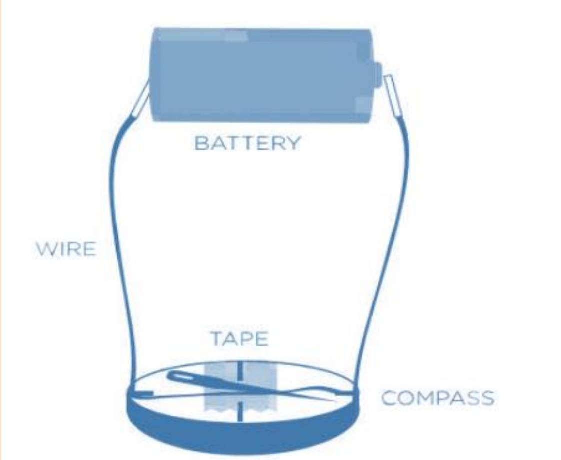
(a) 4, 2, 3,1 (b) 1, 4, 2, 3 (c) 4, 3, 2,1 (d) 1, 2, 3, 4

iii. Point out the correct direction of the magnetic field in the given figure



iv. A bar magnet of magnetic moment m is placed in uniform magnetic field B such that m is parallel to B . In this position, the torque and force acting on it are ________and _____respectively –

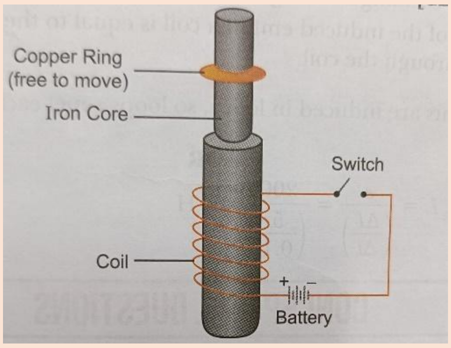
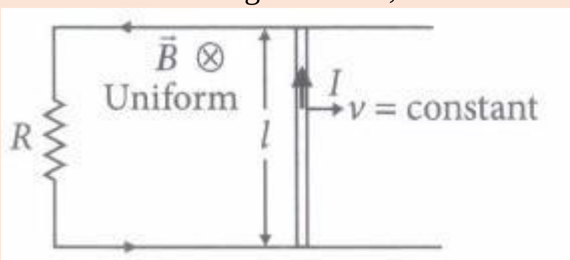
(a) 0 ,0 (b) **m x B ,** mB (c) **m . B ,** mB (d) **m x B , m . B**

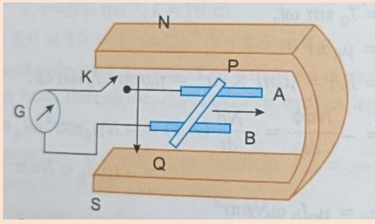
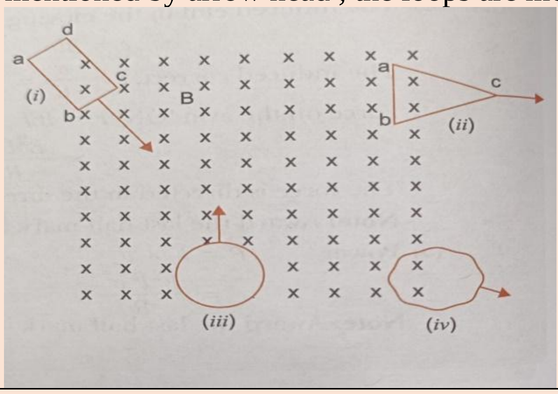
4	In 1820, a Danish physicist, Hans Christian Oersted, discovered that there was a relationship between electricity and magnetism. By setting up a compass through a wire carrying an electric current, Oersted showed that moving electrons can create a magnetic field. Oersted found that, for a straight wire carrying a steady (DC) current: The magnetic field lines encircle the current-carrying wire. The magnetic field lines lie in a plane perpendicular to the wire. If the direction of the current is reversed, the direction of the magnetic force reverses. The strength of the field is directly proportional to the magnitude of the current. The strength of the field at any point is inversely proportional to the distance of the point from the wire.  i. First who discovered the relation between electric and magnetic field is- (a) Hans Christian Oersted (b) Charles William Oersted (c) Charles Maxwell (d) Andre Marie Ampere ii. If magnitude of the current in the wire increases, strength of magnetic field- (a) Increases (b) Decreases (c) remains unchanged (d) none of these iii. Which of the following statements is true? (a) There is no relationship between electricity and magnetism. (b) An electrical current produces a magnetic field (c) A compass is not affected by electricity. (d) A compass is not affected by a magnet. iv. A compass needle is placed below a straight conducting wire. If current is passing through the conducting wire from North to South. Then the deflection of the compass is - (a) Towards West. (b) Towards East. (c) keeps oscillating in East-West direction (d) No deflection **OR** v. Charges at rest can produces- (a) Static electric field (b) Magnetic field (c) Induced current (d) Conventional current	4*1=4

ANSWERS : CASE STUDY BASED QUESTIONS

1	i) b	ii) a	iii) c	iv) a	OR	v) a
2	i) c	ii) b	iii) d	iv) a		
3	i) d	ii) b	iii) c	iv) b	OR	v) c
4	i) c	ii) a	iii) b	iv) b	OR	v) a

CHAPTER-6 ELECTROMAGNETIC INDUCTION

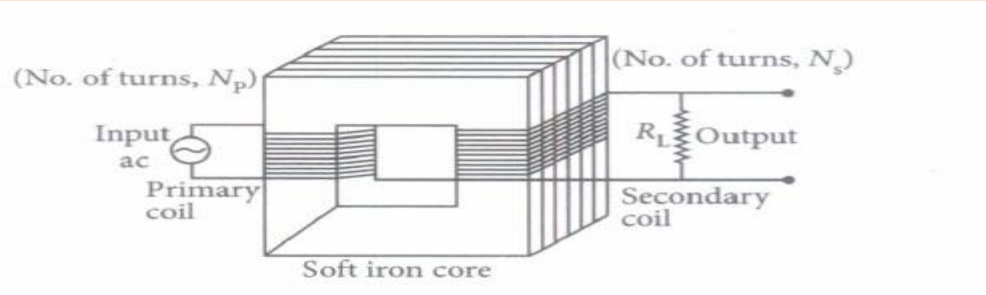
SL NO	QUESTION	MARKS
1	The experimental set up shown in the figure contain a coil wounded over a cylindrical iron core , battery and key are connected . A copper ring which is free to move is inserted in it. When current is passed through the solenoid at the time of switch on the key, the momentarily the ring is thrown off. 	
i)	What will happen if the terminals of the battery are reversed? a) Ring will not jump b) Ring will jump again c)Current will not induced in the ring d) None of these	1
ii)	Two identical circular loops X and Y of metal wire are lying on the table without touching each other. Loop X carries a current which increases with time. In response the loop Y a) remains stationary b) is attracted by loop X c) is repelled by loop X d) rotates about its centre of mass.	1
iii)	An emf of 200 V is induced in a circuit when current in the circuit falls from 5 A to 0 A in 0.1 second. The self inductance of the coil is- a) 3.5 H b) 3.9 H c) 4 H d) 4.2 H	1
2	The emf induced across the ends of a conductor due to its motion in a magnetic field is called motional emf. It is produced due to the magnetic Lorentz force acting on the free electrons of the conductor. For a circuit shown in figure, if a conductor of length I moves with velocity v in a magnetic field B perpendicular to both its length and the direction of the magnetic field, then all the induced parametres are possible in the circuit 	
i)	Direction of current induced in a wire moving in a magnetic field is found using a) Fleming left hand rule b) Fleming right hand rule c) Amperes law d) Right hand thumb rule	1
ii)	The magnitude of induce emf when the conductor of length l is moved with velocity **v** does not depends on- on	1

	a) magnetic field b) velocity c) resistance d) length of conductor l	
iii)	The current in the primary coil of pair of coils changes from 7 A to 3 A in 0.04s. The mutual inductance between the two coils is 0.5 H. the induced emf in the secondary coil is a) 50 V b) 75 V c) 100 V c) 220 V	1
3	Figure shows a metal rod PQ of length l, resting on a smooth horizontal rail AB positioned between the poles of a permanent magnet. The rails, rod and the magnetic field B are in three mutually perpendicular direction s. A galvanometer G connects the rails through a key K. Assume the magnetic field be uniform. Given the resistance of the closed loop containing the rod is R.  	
i)	Suppose the K is open and the rod is moved with a speed v in the direction shown , then the polarity of induced emf is a) P is positive and Q is negative b) P is negative and Q is positive c) Both are at same potential d) None of these	1
ii)	With K Open and the rod is moving uniformly, there is no net force on the electrons in the end PQ even though they do experience magnetic force due to the motion of the rod . Give reason	1
iii)	What is the induced emf in the moving rod if the magnetic field is parallel to the rails instead of being perpendicular ?	1
4	Figure shows planar loops of different shapes moving out of or in to a region of magnetic field which is directed normal to the plane of the loops downwards. As mentioned by arrow head , the loops are moving in magnetic field.  	
i)	The direction of induced current in loop i.	1
ii)	The direction of induced current in loop ii	1
iii)	Specify the induced current in loop iii is clockwise or anti clockwise	1

ANSWERS : CASE STUDY BASED QUESTIONS

1. i) b   ii) c   iii) 4H
2. i) b   ii) c   iii) a
3. i) a   ii) The magnetic Lorentz force is cancelled by the electric force   iii) Zero
4. i) abcd anticlock wise   ii) acb clockwise   iii) anticlockwise

CHAPTER -7 ALTERNATING CURRENT

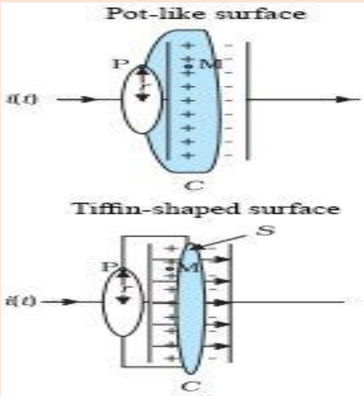
SL NO	QUESTION	MARKS
1	A group of students is preparing for their physics exam, focusing on transformers and their applications in electrical systems. They explore how transformers operate based on electromagnetic induction principles, emphasizing their role in efficiently transferring electrical energy between circuits. They learn that transformers can step up or step down voltages, which is crucial for long-distance power transmission, reducing energy losses. During their study session, they discuss various types of transformers, such as step-up and step-down transformers, and how the turns ratio influences their functionality. They also consider real-world applications, like how high-voltage transmission lines minimize current and thus reduce resistive losses in the wires. As they prepare for practical questions, they recognize the importance of understanding the limitations of transformers, such as energy losses due to heat and the necessity for alternating current (AC) for operation. 	
I	A power company uses transformers to step up the voltage to 500 kV for transmission over long distances. If a fault occurs, resulting in the voltage dropping to 100 kV at the substation, what could be the immediate consequences for the electrical grid? a) Increased power loss due to higher current flow. b) Improved efficiency in power transmission. c) Immediate shutdown of all connected devices. d) Decrease in voltage regulation across the grid.	1
Ii	An electric vehicle charging station utilizes a transformer to convert 480 V AC from the grid to 240 V AC for charging. If the transformer has an efficiency of 95% and the charging station requires 6 kW of power, what is the minimum input power required from the grid? a) 5.7 K W b) 6.3 kW c) 6.7 kW d) 5.9 K W	1
iii	In a renewable energy application, a solar power system uses a transformer to convert the generated voltage from the solar panels (typically low voltage) to a higher voltage suitable for feeding into the grid. If the transformer steps up the voltage from 48 V to 240 V, what is a key benefit of this voltage transformation in terms of energy transmission? a) It allows for lower current, reducing resistive losses over long distances. b) It increases the overall energy produced by the solar panels. c) It eliminates the need for batteries in the system. d) It increases the efficiency of solar panel operation	1

iv	A transformer operates at an efficiency of 90%. If the input power is 1000 W, what is the maximum output power it can deliver? a) 900 W b) 1000 c) 1100 W d) 100 W OR Which of the following factors primarily affects the voltage transformation ratio in a transformer? a) The frequency of the alternating current. b) The material of the wire used for the coils. c) The number of turns in the primary and secondary coils. d) The temperature of the transformer	1

ANSWERS : CASE STUDY BASED QUESTIONS

1 i) a ii) b iii) a iv) a OR c

CHAPTER 8. ELECTROMAGNETIC WAVES

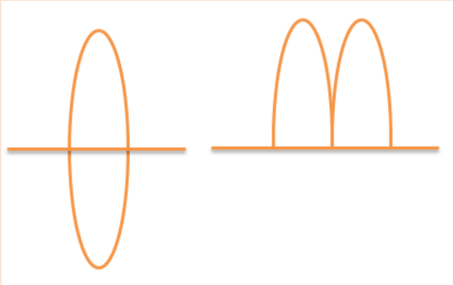
1	Displacement current, introduced by James Clerk Maxwell, is a crucial concept in electromagnetism that accounts for the changing electric fields in scenarios like charging capacitors, where no physical current flows through the dielectric. This concept modifies Ampere's law to include a displacement current term, allowing it to apply even in situations with time-varying electric fields, thereby linking electric and magnetic fields. Displacement current plays a vital role in the propagation of electromagnetic waves and enhances our understanding of how electric and magnetic fields interact in various applications, emphasizing the interconnectivity of these fundamental forces in physics.  To demonstrate displacement current experimentally, you can set up a capacitor circuit with an AC voltage source. As the capacitor charges and discharges, measure the electric field between its plates. Use an ammeter in the circuit to show that, even though there is no direct current through the dielectric, a measurable displacement current exists, reflecting the changing electric field. This illustrates how displacement current allows for the continuity of current in the circuit despite the absence of conventional conduction current.	
i	Which statement about displacement current is true? a) Displacement current is equal to the conduction current in all situations. b) Displacement current exists only in conductive materials. c) Displacement current contributes to the total current in circuits with changing electric fields. d) Displacement current is always greater than conduction current.	1
ii	What happens to the displacement current in a capacitor as the frequency of the AC source increases? a) It decreases due to lower electric field changes. b) It remains constant regardless of frequency changes. c) It increases due to faster changes in the electric field. d) It becomes negligible compared to conduction current.	1

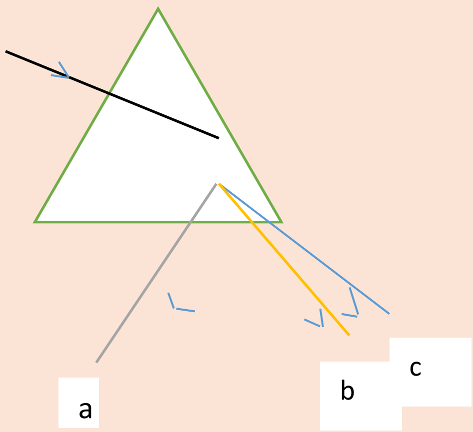
iii	In the context of Maxwell's equations, why was the concept of displacement current introduced? a) To account for electric fields in superconductors. b) To ensure continuity in Ampere's law for time-varying electric fields. c) To replace the need for magnetic fields in electric circuits. d) To describe the flow of charge in insulators.	1
iv	A capacitor is connected to an AC source. What role does displacement current play in this setup? a) It allows for the direct flow of charge through the dielectric. b) It maintains current flow even when the capacitor is fully charged. c) It generates heat within the capacitor. d) It reduces the effective capacitance of the capacitor. OR In a parallel plate capacitor being charged, an electric field builds up between the plates, while no physical current flows through the dielectric. Maxwell introduced the concept of displacement current to address this situation. Which of the following statements best describes the displacement current? a) It represents the actual flow of electric charges through the dielectric material. b) It accounts for the changing electric field between the plates, allowing us to apply Ampère's law in regions where there is no conduction current. c) It is the same as the conduction current that flows in a conductive material. d) It only exists in vacuum and has no relevance in dielectric materials.	1

Answer key
i) Displacement current contributes to the total current in circuits with changing electric fields. ii) It increases due to faster changes in the electric field. iii) To ensure continuity in Ampere's law for time-varying electric fields. iv) It maintains current flow even when the capacitor is fully charged. OR It accounts for the changing electric field between the plates, allowing us to apply Ampère's law in regions where there is no conduction current.

CHAPTER–9 RAY OPTICS AND OPTICAL INSTRUMENTS

S. NO	QUESTION	MARKS
1	Power (P) of a lens is given by-reciprocal of focal length (f) of the lens i.e., $P = \frac{1}{f}$, where f is in metre and P is in dioptre. For a convex lens, power is positive and for a concave lens, power is negative. When a number of thin lenses of powers P_1, P_2, P_3,..... are held in contact with one another, the power of the combination is given by algebraic sum of the powers of all the lenses i.e., $P_{equi} = P_1 + P_2 + P_3 + ...$	
i)	The power of the lens depends on- (a) refractive index of the lens (b) radii of curvature of the lens surfaces (c) both a & b (d) none of the above	
ii)	A lens has a power of -2D. The lens has a focal length of- (a) -0.5 cm (b) -50 m (c) -50 cm (d) -20 cm	
iii)	A convex lens of power P, is cut vertically from the middle into 2 equal parts. The power of each part will be- (a) 2P (b) P (c) P/2 (d) P^2	

iv)	If the lens is cut horizontally & the pieces are kept side to side as shown in figure, the effective power of the combination will be-  (a) 2P (b) P/2 (c) 4P (d) P **OR** The power of a thick lens is …………….. than a thin lens. (a) More (b) Less (c) Equal (d) Data inadequate	
2	Total internal reflection is the phenomenon of reflection of light into denser medium at the interface of denser medium with a rarer medium. For this phenomenon to occur necessary condition is that light must travel from denser to rarer and angle of incidence in denser medium must be greater than critical angle (C) for the pair of media in contact. Critical angle depends on nature of medium and wavelength of light. We can show that $\mu = \frac{1}{Sin\ C}$.	
i)	The angle of refraction when light is incident on a refracting boundary at Critical Angle is- (i) 0° (ii) 90° (iii) 45° (iv) r = C	
ii)	Which of the following is **NOT** an application / consequences of Total Internal Reflection- (i) Mirage (ii) Brilliance of diamond (iii) Optical fiber (iv) Colours visible on bubbles	
iii)	The refractive index of a prism with respect to air is 2. The Critical Angle for Prism is…………….. (i) 30° (ii) 60° (iii) 45° (iv) 75°	

iv)	The critical angle for a medium is highest for ……….. light (i) Yellow (ii) Green (iii) Violet (iv) Red **OR** A light having three colours / wavelengths ie, Red, Violet and Green is incident normally on a prism as shown in the figure. The emergent rays for the three colours are numbered i, ii & iii. Identify the red light from the given emergent rays.  (i) a (ii) b (iii) c (iv) Can't say	

Answer Key **1- (i) c** **(ii) c** **(iii) c** **(iv) a** **OR** **(iv) a**	**2- (i) (ii)** **(ii) (iv)** **(iii) (i)** **(iv) (iv)** **OR** **(iv) (iii)**

CHAPTER–10 WAVE OPTICS

1.	When light from a monochromatic source is incident on single narrow slit. It gets diffracted and a pattern of alternate bright and dark fringes is obtained on screen, called “Diffraction Pattern” of single slit. In diffraction pattern of single slit, it is found that (i) Central bright fringe is of maximum intensity and the intensity of any secondary bright fringe decreases with increase in its order. (ii) Central bright fringe is twice as wide as any other secondary bright or dark fringe	
i	A single slit of width 0.1 mm is illuminated by a parallel beam of light of wavelength 6000 **Å and diffraction bands are observed on a screen 0.5 m from the slit. The distance of the third dark band from the central bright band is** (a) 3mm (b) 1.5 mm (c) 9mm (d) 4.5 mm	1
ii	In Fraunhofer diffraction pattern, slit width is 0.2 mm and screen is at 2 m away from the lens. If wavelength of light used is 5000 **Å then the distance between the first minimum on either side central maximum is** **(a) 10^{-1}m** **(b) 10^{-2} m** **(c) 2 x 10^{-2} m** **(d) 2 x 10^{-1}m**	1
iii	Light of wavelength 600 nm is incident normally on a slit of when 0.2 mm. The angular width of central maxima in the diffraction pattern is (measured from minimum to minimum) (a) 6 x 10^{-3}rad (b) 4 x 10^{-3}rad (c) 2.4 x 10^{-3} rad (d) 4.5 x 10^{-3}rad	1
Iv	A Diffraction pattern is obtained by using a beam of red light. What will happen, if the red light is replaced by the blue light? (a) Bands disappear (b) Bands become broader and farther apart (c) No change will take place (d) Diffraction bands become narrower and crowded together. (Or) To observe diffraction, the size of the obstacle (a) Should be $\lambda/2$, when λ is the wavelength (b) Should be of the order of Wavelength. (c) Has no relation to wavelength. (d) Should be much larger than the wavelength.	1

Case Based Question: 2

2.	Huygens's principle explains the wave nature of light and helps in understanding phenomena like reflection and refraction. According to sHuygen's, every point on a wavefront acts as a source of secondary wavelets that spread out in all directions with the speed of light in the medium. The new wavefront is the envelops of these secondary wavelets. When light strikes a boundary between two media (e.g., air and glass), sit undergoes reflection or refraction. Consider a light wave traveling from air (refractive index $n_1 = 1$) into glass (refractive index $n_2 = 1.5$) at an angle of incidence 30^0, Use Huygen's principle to analyze the behavior of the wavefronts.	
i	What is the angle of refraction when light passes from air to glass at an angle of incidence 30^0? (a) 19.47^0 (b) 45^0 (c) 30^0 (d) 60^0	1
ii	According to Huygen's principle, what happens to the speed of light as it passes from air into glass? (a) Increases (b) Decreases (c) Remains the same (d) Oscilltes	1
iii	What will be the wavelength of light inside the glass if the wavelength of light in air is 600nm? (a) 400 nm (b) 600 nm (c) 900 nm (d) 300 nm	1
iv	How does Huygen's principle explain the law of reflection (a) Secondary wavelets converge towards the normal (b) The angle of incidence is equal to the angle of reflection (c) The speed of light changes during reflection (d) The refracted wave front forms at an angle less then the angle of incidence (or) If the refractive index of glass was increased to 2, what would happen to the angle of refraction for the same angle of incidence (30^0) (a) The angle of refraction increases (b) The angle of refraction decreases (c) The angle of refraction remains the same (d) Total internal reflection occurs	1

CHAPTER 11 : DUAL NATURE OF MATTER AND RADIATION

QUESTION NO. 1

The discovery of the phenomenon of photoelectric effect has been one of the most important discoveries in modern science. The experimental observations associated with this phenomenon made us realize that our, ‘till then’, widely accepted picture of the nature of light – The electromagnetic (wave) theory of light – was quite inadequate to understand this phenomenon. A ‘new picture’ of light was needed and it was provided by Einstein through his ‘photon theory’ of light. This theory, regarded light as a stream of particles. Attempts to understand photoelectric effect thus led us to realize that light, which was being regarded as ‘waves’, could also behave like ‘particles’. This led to the idea of ‘wave-particle duality’ vis-à-vis the nature of light. Attempts to understand this ‘duality’, and related phenomenon, led to far reaching, and very important developments, in the basic theories of Physics.

1) Which of the following phenomenas explain the wave nature of light?

i) Interference ii) Diffraction iii) polarization iv) all of them

2) Wave –particle duality is shown by

i) Light only ii) matter only iii) both light and matter iv) None of them

3) The experiment to explain the wave nature of light i.e electromagnetic wave theory is given by

i) Hertz ii) Einstein iii) Lenard iv) Huygen

4) The concept of photoelectric effect given by Einstein explains that the light is a

i) Photon ii)Wave iii) Particle iv) Both

5) The practical application of the phenomenon of photoelectric effect and the concept of ‘matter waves’ is

i) Photocells ii) Automatic doors at shops and malls iii) automatic light switches iv) All of them

Answers: 1) option iv 2) option iii 3) option i 4) iii 5) iv

QUESTION NO 2

The concept of ‘wave nature of matter’ was postulated by de Broglie in 1924. It was confirmed experimentally by Davisson and Germer a few years after its postulation. Therefore, the realization was that ‘wave nature’ and ‘particle nature’ can be viewed as the ‘two sides of a coin’. Both matter and radiation can exhibit either of these ‘natures’, depending on the experimental situation. The phenomena of photoelectric effect and the concept of ‘matter waves’, have been put to very useful and interesting practical applications. We are aware of photocells, automatic doors at shops and malls, automatic light switches that turn on the lights as soon as the intensity drops.

1) Who confirmed experimentally the wave nature of electron?

i) De-broglie ii)Davisson& Germer iii) Einstein iv) None of these

2) A proton and an electron have same kinetic energy. Which one has greater de-Broglie wavelength ?

i) Electron ii) Proton iii) Same iv) Can't be calculated

3) An electron is accelerated through a potential difference of 100 volts. What is the de-Broglie wavelength associated with it?

i) 1.227 A˚ ii) 12.27 A˚ iii) 122.7 A˚ iv) 1227 A˚

4) The de-broglie wavelength ,associated with a proton and neutron are found to be equal.Which of the two has a higher value of K.E?

i) Proton ii) Neutron iii)Same for both iv)Can't be calculated

5)An electron is accelerated through a potential difference of 300 volt.What is its energy in eV?

i) 30 eV ii) 300 eV iii)10 eV iv) 0.3eV

Answers: 1) option ii 2) option i 3) option i 4) i 5) ii

Chapter–12: Atoms
Chapter–13: Nuclei

CASE BASED QUESTIONS

SL NO	QUESTION	MARKS
1	In an experiment, a student studies the spectral lines of an unknown gas. By observing the emission spectrum, she notes that the lines correspond to transitions between energy levels, similar to those in hydrogen. The student identifies the following transitions: n=3 to n=2, and n=4 to n=3	
i)	If the transition from n=3 to n=2 emits light with a wavelength of 656nm, what is the energy of that photon? A) 1.89 eV B) 2.54 eV C) 3.02 eV D)4.54eV	**1**
ii)	For a transition from n=4 to n=3, which of the following is true about the emitted light? A) It is in the ultraviolet range. B) It is in the infrared range. C) It is in the visible range. D) It cannot be emitted.	**1**
iii)	Which quantum number represents the lowest energy level in an atom? n=0 n=1 n=2 n=3	**1**
iv)	If the Rydberg formula is applied to the transition n=5 to n=2, what would the wavelength of the emitted photon approximately be? A) 410 nm B) 434 nm C) 656 nm D) 486 nm **OR** In a hydrogen atom, an electron transitions from n=6 to n=5. Which of the following statements about the emitted photon is correct? A) The photon has a longer wavelength than that emitted from n=3 to n=2. B) The energy of the photon is in the ultraviolet range. C) This transition emits a photon with a higher energy than the transition from n=4 to n=3. D) The emitted photon will not be observable	**1**
2	A student is examining the emission spectrum of a hydrogen atom. She observes that when the electron transitions from higher energy levels to lower energy levels, distinct spectral lines appear. She focuses on the Balmer series, which corresponds to transitions that end at n=2. **Given:** The wavelengths of the emitted light can be calculated using the Rydberg formula:	

	$$\frac{1}{\lambda} = R\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$$ where R (Rydberg constant) is approximately $1.097 \times 10^7\ \mathrm{m}^{-1}$, $n_1 = 2$ for the Balmer series, and n_2 can be 3, 4, 5, etc.	
i)	What is the wavelength of the first line in the Balmer series (n=3 to n=2)? A) 656 nm B) 486 nm C) 434 nm D) 410 nm	**1**
ii)	If an electron in the hydrogen atom transitions from n=5 to n=2, which of the following wavelengths would be emitted? A) 656 nm B) 434 nm C) 410 nm D) 375 nm	**1**
iii)	Which transition in the hydrogen atom corresponds to the emission of light in the visible range of the spectrum? A) n=3 to n=2 B) n=4 to n=3 C) n=6 to n=5 D) n=5 to n=1	**1**
iv)	The energy of a photon emitted when an electron transitions from n=4 to n=2 can be calculated as: A) 1.89 eV B) 3.4 eV C) 2.55 eV D) 6.56 eV **OR** When an electron in a hydrogen atom transitions from n=5 to n=1, what is the energy of the emitted photon? A) 10.2 eV B) 12.1 eV C) 13.6 eV D) 15.5 eV	**1**

3	A student is analysing the binding energy curve of nuclei. She observes that the binding energy per nucleon varies with the mass number A. She notes that lighter nuclei tend to have lower binding energies per nucleon compared to medium-sized nuclei, while very heavy nuclei again show a decrease in binding energy per nucleon due to the effects of instability.	
i)	Which of the following statements is true about the binding energy per nucleon for stable nuclei? A) It increases monotonically with mass number A.	**1**
	B) It peaks around A≈56 (Iron-56) and then decreases for heavier nuclei. C) It remains constant for all nuclei regardless of mass number. D) It is highest for very light nuclei such as helium.	
ii)	What is the significance of the binding energy of a nucleus? A) It determines the mass of the nucleus. B) It indicates the stability of the nucleus; higher binding energy means greater stability. C) It represents the total energy of the nucleus. D) It is the energy required to create the nucleus from free nucleons.	**1**
iii)	According to the binding energy curve, which of the following elements would be expected to be the most stable? A) Hydrogen (H) B) Iron (Fe) C) Uranium (U) D) Lithium (Li)	**1**

iv)	When a heavy nucleus undergoes fission, what happens to the total binding energy? A) It decreases. B) It remains constant. C) It increases. D) It becomes negative. **OR** When a light nucleus undergoes fusion, what happens to the total binding energy of the resulting nucleus compared to the original nuclei? A) It decreases. B) It remains constant. C) It increases. D) It becomes negative.	**1**
4	A nuclear physicist is studying different types of nuclides to understand their properties. She focuses on three key concepts: isotopes, isotones, and isobars. She considers examples like Carbon-12 and Carbon-14 , as well as Oxygen-16 and Nitrogen-14.	
i)	Which of the following pairs are isotopes? A) C^{12} and C^{14} B) O^{16} and N^{14} C) Na^{23} and Mg^{24} D) Fe^{56} and Ni^{58}	**1**
ii)	Which of the following pairs are isobars? A) C^{12} and C^{14} B) O^{16} and O^{18} C) N^{14} and C^{14} D) Ar^{40} and Ca^{40}	**1**
	Which of the following pairs are isotones? A) He^{4} and Li^{6} B) C^{12} and N^{14} C) O^{16} and F^{18} D) N^{15} and C^{14}	**1**

iv)	What characteristic distinguishes isobars from isotopes? A)Isobars have the same number of protons. B) Isobars have the same mass number. C) Isobars have different numbers of neutrons but the same mass number. D) Isobars have the same number of neutrons. OR If an isotope has a mass number of 20 and contains 8 neutrons, what is it's atomic number? A) 12 B) 8 C) 20 D) 16	**1**

ANSWER KEY:

1.	i) A	ii)B	iii)B	iv)A
2.	i) B	ii)C	iii)A	iv)B
3.	i)B	ii)B	iii)B	iv)C
4.	i)A	ii)D	iii) B	iv)C or B

Chapter–14: Semiconductor Devices

CASE-BASED QUESTIONS:

Case1	Q.NO1	Marks
	A PN junction diode is an essential component in many electronic circuits. When a p-type and an n-type semiconductor are joined, a depletion region forms at the junction. The behavior of the diode depends on whether it is forward biased or reverse biased. In forward bias, the diode allows current to flow, while in reverse bias, the current flow is minimal, except for a small leakage current. Consider a diode connected in a circuit with a power supply of 5V, a resistor of 100Ω, and a current of 40mA in forward bias. Q1: What is the depletion region in a PN junction? A. The area where excess electrons accumulate in the p-type region B. The area around the junction where mobile charge carriers are absent C. The region where mobile charge carriers are highly concentrated D. The region outside the PN junction where recombination happens Q2: How does the width of the depletion region change under different bias conditions? A. In forward bias, it increases; in reverse bias, it decreases B. In forward bias, it remains constant; in reverse bias, it increases C. In forward bias, it decreases; in reverse bias, it increases D. In forward bias, it increases; in reverse bias, it remains constant Q3: What is the current through a diode with a 5V supply, a 100Ω resistor, and a 0.7V forward voltage drop across the diode? A. 30Ma B. 40mA C. 43mA D. 50Ma Q4: If the reverse bias voltage across the diode is increased to 50V, what happens to the leakage current? A. It decreases and the diode eventually breaks down due to overheating B. It stays constant, and the diode operates normally C. It increases gradually, and the diode will eventually break down D. It decreases, and the diode remains in reverse bias without breaking	

	Q5: Which of the following circuits would protect sensitive electronics from voltage spikes? A. A PN junction diode connected in reverse bias with no limiting resistor B. A clamping circuit using a Zener diode in reverse bias C. A PN junction diode connected in forward bias to ground D. A series combination of two diodes in forward bias	
	ANSWER KEY 1)B 2)C 3)C 4)C 5)B	5
Case2	A rectifier is an essential component used in converting AC (Alternating Current) to DC (Direct Current). A half-wave rectifier allows current to pass through during only one half of the input AC cycle, whereas a full-wave rectifier allows current to pass during both halves of the cycle, making it more efficient. Consider a full-wave bridge rectifier circuit connected to a 240V AC input, a load resistor of 100Ω, and a diode forward voltage drop of 0.7V for each diode in the rectifier.	
	Q1: What is the primary function of a rectifier? A. To amplify AC signals B. To convert AC to DC C. To convert DC to AC D. To stabilize voltage levels Q2: How does a full-wave bridge rectifier differ from a half-wave rectifier? A. A half-wave rectifier allows current during both halves of the AC cycle, while a full-wave rectifier blocks both halves B. A full-wave rectifier allows current during both halves of the AC cycle, while a half-wave rectifier allows current only during one half C. A half-wave rectifier produces smoother DC output than a full-wave rectifier D. A full-wave rectifier blocks both positive and negative cycles of the input AC signal Q3: If the AC input voltage is 240V RMS, what is the peak DC output voltage of the full-wave bridge rectifier, assuming a forward voltage drop of 0.7V for each diode? A. 240V B. 339.4V C. 337.2V D. 236.6V Q4: If one of the diodes in the full-wave bridge rectifier fails and becomes an open circuit, what will be the effect on the output voltage? A. The output voltage will become zero B. The rectifier will continue to work as a full-wave rectifier C. The rectifier will behave like a half-wave rectifier, and the output voltage will decrease. D. The rectifier will produce double the original output voltage	

	Q5: How would you modify the full-wave bridge rectifier circuit to improve the smoothness of the DC output voltage? A. Add a capacitor in series with the load resistor B. Add an inductor in parallel with the AC input C. Add a capacitor in parallel with the load resistor to filter the output D. Remove one of the diodes to simplify the circuit	
	ANSWER KEY 1)B 2)B 3)C 4)C 5)C	5
Case3	In semiconductor technology, p-type and n-type semiconductors are two fundamental types of doped semiconductors. A p-type semiconductor is created by doping a pure semiconductor (like silicon) with an element that has one less valence electron than silicon, such as boron. This results in the creation of "holes" (absence of electrons) as the majority charge carriers. On the other hand, an n-type semiconductor is formed by doping the semiconductor with an element that has one more valence electron than silicon, such as phosphorus, which introduces extra electrons as the majority carriers.	
	Q1: What type of charge carriers are the majority in a p-type semiconductor? A. Electrons B. Holes C. Neutrons D. Ions Q2: How does doping with boron make a semiconductor p-type? A. Boron adds extra electrons, making the material negatively charged B. Boron adds extra holes by capturing electrons from neighboring atoms C. Boron atoms remove holes from the material, making it p-type D. Boron increases the free electron concentration, making it p-type Q3: A silicon semiconductor is doped with phosphorus. What effect will this have on the material’s electrical properties? A. It will increase the number of holes and decrease conductivity B. It will decrease the number of free electrons and increase resistance C. It will increase the number of free electrons and improve conductivity D. It will increase both electrons and holes equally, maintaining neutral conductivity	

	Q4: In an n-type semiconductor, how would the minority carrier concentration change if the temperature is increased significantly? A. The minority carrier concentration (holes) will increase B. The minority carrier concentration (holes) will decrease C. The majority carrier concentration (electrons) will decrease D. The majority carrier concentration (electrons) will increase Q5: You are tasked with designing a p-n junction for a diode. How would you ensure that the p-type region has a lower resistance to current flow than the n- type region? A. Increase the doping level of the p-type region B. Decrease the doping level of the p-type region C. Use an intrinsic semiconductor in the p-type region D. Apply reverse bias to the p-type region ANSWER KEY 1)B 2)B 3)C 4)A 5)A	

Case4	Semiconductors can be categorized as intrinsic or extrinsic based on their purity and doping levels. Intrinsic semiconductors are pure materials, like silicon or germanium, without any doping. In these materials, the number of electrons equals the number of holes. Extrinsic semiconductors are formed by adding impurities (doping), creating either an n-type (electron majority) or p- type (hole majority) semiconductor. The difference in energy between the valence band and the conduction band is known as the energy gap (band gap). For intrinsic semiconductors, thermal excitation can move electrons across this gap, while doping reduces the energy required to move charge carriers, enhancing conductivity. Q1: What is the primary characteristic of an intrinsic semiconductor? A. It has an equal number of electrons and holes B. It is doped with impurities to increase conductivity C. It has more electrons than holes D. It has more holes than electrons	

Q2: How does doping an intrinsic semiconductor create an extrinsic semiconductor?

A. Doping decreases the energy gap, making the material conduct better

B. Doping adds impurities, increasing the number of free charge carriers electrons or holes)

C. Doping reduces the number of charge carriers, making the material less conductive

D. Doping changes the atomic structure, creating a new type of material

Q3: If a silicon semiconductor has an energy gap of 1.1 eV, what is the effect of increasing temperature on its conductivity?

A. Conductivity decreases because electrons cannot cross the energy gap

B. Conductivity increases because more electrons gain enough energy to cross the energy gap

C. Conductivity remains constant, as the energy gap is unaffected by temperature

D. Conductivity decreases because the energy gap widens with increasing temperature

Q4: In an extrinsic semiconductor, how does the band gap compare to an intrinsic semiconductor, and what is the impact on conductivity?

A. The band gap is larger in extrinsic semiconductors, which reduces conductivity

B. The band gap remains the same, but the doping increases the number of free charge carriers, increasing conductivity

C. The band gap is reduced by doping, which increases the number of electrons in the conduction band and boosts conductivity

D. The band gap is completely eliminated in extrinsic semiconductors

Q5: Design a scenario where you would use an intrinsic semiconductor instead of an extrinsic semiconductor. Justify your choice.

A. In high-temperature environments where precise control of conductivity is required, as intrinsic semiconductors maintain stable properties

B. In low-power devices where you need to increase the number of charge carriers to enhance conductivity

C. In photo voltaic cells where you want to maximize the free electrons without requiring thermal excitation

D. In electronic devices where conductivity must be significantly higher than in a pure material

ANSWER KEY 1)A 2)B 3)B 4)B 5)A