High School (H.S. Department)

Mid Semester III – 2025

Class – XII

PHYSICS

Full Marks – 35 Time: 1 Hr 15 Min

Multiple choice Questions:

1. Which of the following statements about the electric field is correct?

   A. The electric field is a scalar quantity.
   B. The electric field is defined as the force experienced per unit charge.
   C. The electric field lines can cross each other.
   D. The electric field inside a conductor is always maximum.

2. The electric field inside a solid non-conducting sphere is

   A. $\frac{\rho r}{3\varepsilon_0}$ B. $\frac{\rho}{3\varepsilon_0}$ C. $\frac{r}{3\varepsilon_0}$ D. $\frac{\rho r}{2\varepsilon_0}$

3. Electrostatic potential can be positive, zero, and negative indicating

   A. Different magnitudes of force
   B. Different directions of electric potential
   C. Attractive, null, and repulsive forces, respectively
   D. Repulsive, null, and attractive forces, respectively

4. Drift velocity in a metal conductor increases when:

   A. The number of free electrons decreases
   B. The applied electric field increases
   C. The temperature of the conductor increases
   D. The length of the conductor increases.

5. Which of the following statements about electromotive force (emf) is correct?

   A. emf is the force exerted on a charge by an electric field inside a conductor.
   B. emf is the energy supplied per unit charge by a source to maintain current in a circuit.
   C. emf and potential difference are exactly the same in all cases.
   D. emf always causes electrons to move from positive to negative terminal inside a circuit.

6. Which of the following statements correctly describes the limitations and applicability of Ohm's Law?

A. Ohm's Law is universally valid for all materials and conditions.
B. Ohm's law applies strictly when physical conditions such as temperature remain constant and the material is ohmic.
C. The resistance of an ohmic conductor changes with voltage applied but current remains proportional to voltage.
D. Non-ohmic conductors have a linear V-I characteristic but do not follow Ohm's Law.

7. To convert a galvanometer into an ammeter, which of the following is done?

A. A high resistance is connected in series with the galvanometer.
B. A low resistance (shunt) is connected in parallel with the galvanometer.
C. A high resistance is connected in parallel with the galvanometer.
D. A low resistance is connected in series with the galvanometer.

8. The direction of the magnetic field due to a current element as given by the Biot – Savart law is:

A. Along the direction of current.
B. radial from the current element.
C. Perpendicular to both the current element and the line joining the element to the point of observation.
D. Opposite to the direction of current.

9. Using the Biot-Savart law, the magnitude of the magnetic field B at a perpendicular distance r from an infinitely long straight wire carrying current I is found to be:

A. $B = \frac{\mu_0 I}{2\pi r}$
B. $B = \frac{\mu_0 I}{4\pi r^2}$
C. $B = \frac{\mu_0 I}{2r}$
D. $B = \frac{\mu_0 I}{4r^2}$

10. Consider a circular loop of radius R carrying a steady current I. According to Biot-Savart law, which of the following statements about the magnetic field B at the centre of the loop is correct?

A. The magnetic field B is directed tangentially along the loop at the centre.
B. The magnitude of B at the centre is $B = \frac{\mu_0 I}{2r}$, and its direction is perpendicular to the plane of the loop.
C. The magnetic field at the centre is zero because the contributions from opposite current elements cancel out.
D. The magnitude of B depends on the material of the wire forming the loop.

11. Faraday's first law of electromagnetic induction states that:

A. An induced emf is produced only when the magnetic flux through a circuit changes.
B. The magnitude of induced emf is independent of the rate of change of magnetic flux.
C. Induced emf occurs only if the magnetic field strength is constant.
D. The magnitude of B depends on the material of the wire forming the loop.

12. According to Faraday's second law, the magnitude of induced emf in a coil is:

A. Directly proportional to the magnetic flux.
B. Directly proportional to the number of turns and the rate of change of magnetic flux.
C. Inversely proportional to the number of turns in the coil.
D. Independent of the number of turns.

13. Which of the following is a limitation of Faraday's laws of electromagnetic induction?

A. They do not explain the direction of induced current
B. They cannot calculate the magnitude of induced emf.
C. They apply only to AC circuits.
D. They assume the magnetic field is constant.

14. Lenz's law states that the direction of induced current is such that:

A. It produces an induced magnetic field that opposes the change in magnetic flux causing it.
B. It enhances the change in magnetic flux through the coil.
C. It flows only when the coil is stationary.
D. It is always clockwise regardless of flux change.

State True or False

15. Identify whether the following statements are True or False:

I. Electric field lines originate from negative charges and terminate on positive charges.
II. The electric field at a point is zero if the net force on a test charge placed there is zero.

A. I is true and II is false
B. I is false and II is true
C. Both I and II are true
D. Both I and II are false

16. Below are some statements about electrostatic potential:

I. Electrostatic potential is a vector quantity that depends on the direction of the electric field.
II. Electrostatic potential at a point is defined as the work done inmoving a unit positive charge from infinity to that point.
III. Electrostatic potential inside a conductor is always maximum.
IV. Electrostatic potential is zero at all points where the electric field is zero.

A. I, II, II, IV – True, False, True, True
B. I, II, II, IV – True, True, True, False
C. I, II, II, IV – False, True, False, False
D. I, II, II, IV – True, True, True, False

17. Below are some statements about drift velocity:

I. Drift velocity is independent of the applied electric field
II. Drift velocity decreases when the electric field increases.
III. Drift velocity is the average velocity of charge carriers due to an electric field.
IV. Drift velocity is the random motion of electrons due to thermal energy.

A. I, II, II, IV – False, True, ~~True~~ False, False
B. I, II, II, IV – True, True, True, True
C. I, II, II, IV – False, ~~True~~ F, True, False
D. I, II, II, IV – True, True, True, False

18. Identify which of the following statements are True or False:

I. The emf of a cell is the maximum potential difference across its terminals
II. Internal resistance causes the terminal voltage of a cell to be less than the emf when current flows.
III. The terminal voltage of a cell is equal to the emf when the current is zero.
IV. Increasing the internal resistance of a cell increases the terminal voltage for a given current

A. I, II, II, IV – True, False, True, False
B. I, II, II, IV – False, True, False, True
C. I, II, II, IV – True, True, True, False
D. I, II, II, IV – False, False, True, False

19. Identify whether the following statements are True or False:

I. A voltmeter connected in series to measure current will give an accurate reading.
II. Using a voltmeter in series increases the total resistance of the circuit significantly.
III. A voltmeter used as an ammeter will reduce the current flowing through the circuit.
IV. Connecting a voltmeter in series can damage the voltmeter due to high current.

A. I, II, II, IV – True, False, True, False
B. I, II, II, IV – True, True, True, False
C. I, II, II, IV – False, False, True, False
D. I, II, II, IV – False, True, True, False

20. Identify whether the following statements about the Biot-Savart law are True or False:

I. The Biot-Savart law is applicable only for steady currents and does not apply to time-varying currents.
II. It can be used to calculate the magnetic field due to any arbitrary current distribution, regardless of complexity.
III. The Biot-Savart law is fundamental in deriving the magnetic field of a long staright current-carrying wire.
IV. The law is valid for calculating magnetic fields in regions very close to the current element but fails at large distances.

A. I, II, II, IV – True, False, True, False
B. I, II, II, IV – True, True, True, False
C. I, II, II, IV – False, False, True, False
D. I, II, II, IV – False, True, True, False

21. Identify whether the following statements about electromagnetic induction are True or False:

I. Electromagnetic induction can occur if either the magnetic field or the conductor moves relative to the other.
II. A stationary conductor in a time-varying magnetic field will have an induced emf.
III. The induced emf is always proportional to the magnitude of the magnetic field, regardless of how it changes.
IV. **The direction of induced current is given by Lenz's law.**

A. I, II, II, IV – True, False, True, False
B. I, II, II, IV – True, True, False, True
C. I, II, II, IV – False, False, True, False
D. I, II, II, IV – False, True, True, False

Assertion reasoning:

22. Assertion (A): The electric field inside a hollow charged conductor is zero.

Reason (R): Charges reside only on the surface of a conductor and not inside the conductor

A. Both A and R are true, and R is the correct explanation of A.
B. Both A and R are true, but R is not the correct explanation of A
C. A is true, but R is false.
D. A is false, but R is true.

23. Assertion (A): The work done on an equipotential surface is zero.

Reason (R): The electric field lines are parallel to the surface.

A. Both A and R are true, and R is the correct explanation of A.
B. Both A and R are true, but R is not the correct explanation of A
C. A is true, but R is false.
D. A is false, but R is true.

24. Assertion (A): The electric potential due to a positive charge decreases as the distance from the charge increases.

Reason (R): Electric potential is inversely proportional to the electric field strength at that point.

A. Both A and R are true, and R is the correct explanation of A.
B. Both A and R are true, but R is not the correct explanation of A
C. A is true, but R is false.
D. A is false, but R is true

25. Assertion (A): Household electrical circuits are connected in parallel to ensure that each appliance receives the full voltage of the supply.

Reason (R): In a parallel circuit, the voltage across each branch is the same, allowing appliances to operate independently according to Ohm's Law.

A. Both A and R are true, and R correctly explains A.
B. Both A and R are true, but R does not correctly explain A
C. A is true, but R is false.
D. A is false, but R is true.

26. Assertion (A): To convert a galvanometer into a voltmeter, a high resistance is connected in series with the galvanometer to increase the overall resistance of the instrument.

Reason (R): Increasing the resistance in series reduces the current through the galvanometer for a given voltage, allowing it to measure higher voltages safely.

A. Both A and R are true, and R correctly explains A.
B. Both A and R are true, but R does not correctly explain A
C. A is true, but R is false.
D. A is false, but R is true.

27. Assertion (A): The Biot- Savart law cannot be directly used to calculate the magnetic field due to time-varying currents.

Reason (R): The Biot-Savart law assumes steady currents and does not account for electromagnetic wave propagation or displaced currents.

A. Both A and R are true, and R correctly explains A.
B. Both A and R are true, but R does not correctly explain A
C. A is true, but R is false.
D. A is false, but R is true.

28. Assertion (A): The magnetic field at the centre of a circular current carrying loop is directed perpendicular to the plane of the loop.

Reason (R): The magnetic field inside the loop are circular and lie entirely in the plane of the loop.

A. Both A and R are true, and R correctly explains A.
B. Both A and R are true, but R does not correctly explain A
C. A is true, but R is false.
D. A is false, but R is true.

Numerical:

29. Two point charges, +4 μC and +1 μC, are fixed 5m apart in vacuum. The distance that is closest to the point on the line joining them where the net electric field is zero is:

A. 2 m from the +4 μC charge towards +1 μC charge.
B. 3 m from the +4 μC charge towards +1 μC charge.
C. 1 m from the +1 μC charge towards +4 μC charge.
D. 4 m from the +1 μC charge towards +4 μC charge.

30. The electric field in a region is given by the equation $\vec{E} = (x^2\hat{\imath} + y^2\hat{\jmath})$N/C. What is the force experienced by a charge of 5 C placed at (2, -3) ?

A. $\vec{F} = (20\hat{\imath} + 45\hat{\jmath})$N
B. $\vec{F} = (20\hat{\imath} - 45\hat{\jmath})$N
C. $\vec{F} = (-20\hat{\imath} + 45\hat{\jmath})$N
D. $\vec{F} = (20\hat{\imath} - 45\hat{\jmath})$N

31. The electric field in a region is given by $E = -2i + 4j + 5k$. What is the value of the net electric flux passing through a square of side 2 units sitting on the XZ plane in this field?

A. 25 units
B. 16 units
C. 27 units
D. 28 units

32. Three charges of 1 nC are placed on the corners of a triangle of side $\sqrt{3}$m. What is the potential at the centroid of the triangle?

A. 27 V
B. 9V
C. 81V
D. 18V

33. A cell has an emf of 12V and an internal resistance of 2Ω. If the cell is connected to an external resistor of 4Ω, what is the terminal voltage of the cell?

A. 8 V
B. 9 V
C. 6 V
D. 10 V

34. Three resistors, 2Ω, 4Ω, and 4Ω are connected as follows: the two 4Ω resistors are connected in parallel, and the combination is connected in series with the 2Ω resistor. If a current of 2A flows through the circuit, what is the power dissipated in the 2Ω resistor?

A. 4 W
B. 8 W
C. 2 W
D. 16 W

35. A galvanometer has a full-scale deflection current of 2 mA and an internal resistance of 10Ω. To convert it into an ammeter of range 2A, what should be the value of the shunt resistance connected in parallel with the galvanometer?

A. 0.01 Ω
B. 0.02 Ω
C. 0.1 Ω
D. 1 Ω