

Bhavan's Tripura Vidyamandir1st Quarterly Test (2025-2026)**Class:- 12**

Time:- 2 hours

Subject:- Physics

Total :- 50 Marks

Name of the student :

Roll:

Section:

General instructions:

(1) There are 25 questions in all. All questions are compulsory.

(2) This question paper has five sections: Section A, Section B, Section C, Section D, Section-E. All the sections are compulsory.

(3) Section A contains eight MCQ and two Assertion-Reason of 1 mark each, Section B contains eight questions of 2 marks each, Section C contains five questions of 3 marks each, section D contains one long questions of 5 mark, And Sec-E contains one Case Study of Four marks.

(4) There is no overall choice. However, an internal choice has been provided in section

B, C, D. You have to attempt only one of the choices in such questions.

(5) Use of calculators is not allowed.

SECTION-A**Each of the following carries 1 mark:****[1X10=10]**

1. A thin plastic rod is bent into a circular ring of radius R. It is uniformly charged with charge density λ . The magnitude of the electric field at its centre is:
a) $\lambda/(2\epsilon_0 R)$ b) Zero c) $\lambda/(4\pi\epsilon_0 R)$ d) $\lambda/(4\epsilon_0 R)$
2. Kirchhoff's first law, i.e., $\sum i = 0$ at a junction, deals with the conservation of-
a) charge b) energy c) momentum d) angular momentum
3. How to increase the capacity of the parallel plate capacitor?
a) Decrease the area of the plate b) Increase the area of the plate
c) Increase the distance between the plate d) None of the above
4. An electric dipole is placed in non-uniform electric field, then it experiences-
a) only torque b) force and torque
c) only force d) neither force nor torque
5. In a Wheatstone bridge if the battery and galvanometer are interchanged then the deflection in galvanometer will
a) change in previous direction b) not change
c) change in opposite direction d) none of these.
6. By performing a set of experiments, a scientist found that the electric field between two points A and B is zero. What can he conclude regarding the potential of the two points?
a) $V_A=0, V_B=0$ b) $V_A>V_B$ c) V_A+V_B d) $V_A=V_B$
7. What is angle between electric field and equipotential surface?
a) 90° b) 0° c) 0° to 90° d) 0° to 180°
8. Calculate potential at a point at 9 cm distance due to charge $4 \times 10^{-7} \text{C}$.
a) $8 \times 10^{-5} \text{ V}$ b) $8 \times 10^4 \text{ V}$ c) $4 \times 10^{-4} \text{ V}$ d) $4 \times 10^4 \text{ V}$

Question no. 9-10 are assertion-reason based question. These consist of two statements-Assertion(A) and Reason(R). Answer the question selecting the appropriate option given below:

- (a) Both A and R are true and R is the correct explanation of A.
- (b) Both A and R are true and R is not the correct explanation of A.
- (c) A is true but R is false
- (d) A is false but R is true

9. **Assertion(A):** On disturbing an electric dipole in stable equilibrium in an electric field, it returns back to its stable equilibrium orientation.

Reason(R): A restoring torque acts on the dipole on being disturbed from its stable equilibrium.

10. **Assertion(A):** In a simple battery circuit, the point of the lowest potential is positive terminal of the battery.

Reason(R): The current flows towards the point of the higher potential, as it does in such a circuit from the negative to the positive terminal.

SECTION-B

[2x8=16]

11. Two conducting wires X and Y of same diameter across a battery. If the number density of electro in X is twice that in Y, find the ratio of drift velocity of electrons in the two wires.

12. Find the potential difference across the whole terminals for given cell which has an emf of 5.0 volt and also an internal resistance of $1.0\ \Omega$. Cell terminals are joined through a $9\ \Omega$ resistor.

OR

State the two Kirchhoff's law for electrical circuits.

13. How much positive and negative charge is here in a cup of water (250g)?

14. A system has two charges $q_a = 2.5 \times 10^{-7}\text{ C}$ and $q_b = -2.5 \times 10^{-7}\text{ C}$ located at points a (0, 0, -15cm) and b (0, 0, 15cm), respectively. What is the total charge and electric dipole moment of the system?

15. Three charges - q, Q and - q are placed at equal distances on a straight line. If the total potential energy of the system of three charges is zero, what is the ratio Q: q ?

16. A wire of resistance 8R is bent in the form of a circle. What is the effective resistance between the ends of a diameter?

17. In a region of space the electric field is given by $\vec{E} = 8\vec{i} + 4\vec{j} + 3\vec{k}\text{ N/C}$, Calculate the electric flux through a surface of area of 100 m^2 lying in x-y plane.

18. Estimate the average drift speed of conduction electrons in a copper wire of cross sectional area $1.0 \times 10^{-7}\text{ m}^2$ carrying a current of 1.5 A. Assume the density of conduction electron to be $9 \times 10^{28}\text{ m}^{-3}$.

SECTION-C

[3x5=15]

19. Two point charges $q_A = 3\ \mu\text{C}$ and $q_B = -3\ \mu\text{C}$ are located 20 cm apart in a vacuum.

(i) What is the electric field at the midpoint O of the line AB joining the two charges?

(ii) If a negative test charge of magnitude $1.5 \times 10^{-9}\text{ C}$ is placed at this point, what is the force experienced by the test charge?

20. Three charges of $+5\ \mu\text{C}$ are located at the corners of an equilateral triangle whose sides are 6 cm long. Find the potential at the mid-point of the base of the triangle.

21. Derive an expression for the potential energy of an electric dipole placed in a uniform electric field.

22. When a Wheatstone bridge is said to be balanced? Apply Kirchhoff's law to derive the balance condition of the Wheatstone bridge.

OR

Derive a relation between the internal resistance, emf and terminal potential difference of a cell.

23. Deduce the expression for the capacitance of a parallel plate capacitor when a dielectric slab is inserted between its plates. Assume the slab thickness less than the plate separation.

SECTION-D

[5x1=5]

24. a) Derive an expression for drift velocity of electron.
b) When 5 V potential difference is applied across a wire of length 0.1 m the drift speed of electron is 2.5×10^{-4} m/s. If the electron density in the wire is 8×10^{28} m³, calculate the resistivity of the wire. [3+2]

OR

- a) Establish the relation between $\vec{j}$, σ and $\vec{E}$.
b) A heating element using nichrome connected to a 230 V supply draws an initial current of 3.2 A which settles after a few seconds to a steady value of 2.8 A. What is the steady temperature of the heating element if the room temperature is 27°C ? Temperature coefficient of resistance of nichrome averaged over the temperature range involved is $1.70 \times 10^{-4} \text{ } ^\circ\text{C}^{-1}$. [2+3]

SECTION-E

[4x1=4]

25. Coulomb's law states that the electrostatic force of attraction or repulsion acting between two stationary points charges. Here F denotes the force between two charges q_1 and q_2 separated by a distance in free space, ϵ is a constant known as permittivity of space. And, free space is vacuum and may be taken to be air practically. If free space is replaced by a medium, where k is known as dielectric constant or relative permittivity. From the concept of force we can find the expression for electric field intensity for a point charge at any point. If E be electric field then $F=qE$, is the expression force.

Read the given passage carefully and give the answer of the following questions:

Qi. In Coulomb's law, $F = k * (q_1q_2)/(r^2)$, then on which of the following factors does the proportionality constant k depends?

- a. Electrostatic force acting between the two charges
- b. Nature of the medium between the two charges
- c. Magnitude of the two charges
- d. Distance between the two charges

Qii. Dimensional formula for the permittivity constant of free space is:

- a. $(\text{ML}^{-1}\text{T}^4\text{A}^2)$
- b. $(\text{M}^{-1}\text{L}^{-3}\text{T}^4\text{A}^2)$
- c. $(\text{M}^{-1}\text{L}^3\text{T}^2\text{A}^2)$
- d. $(\text{M}^{-1}\text{L}^{-3}\text{T}^4\text{A}^{-2})$

Qiii. The force of repulsion between two charges of 1 C each, kept 1 m apart in vacuum is:

- a. $1/(9 \times 10^9)$ N
- b. 9×10^9 N
- c. 9 N
- d. $1/(9 \times 10^{12})$ N

Qiv. The electric field strength of a charge

- a. Increase with distance
- b. Decrease with cube of distance
- c. Decrease with distance
- d. decrease with square of distance