INDIAN SCHOOL AL WADI AL KABIR

UNIT TEST-2024-25

CLASS: XII **Sub: PHYSICS (042)** **MAX.MARKS: 30**

DATE: 02-06-2024 **Set -II** **TIME: 1 HOUR**

General Instructions: -

(1) There are 15 questions in all. All questions are compulsory.

(2) This question paper has 5 sections. Section A, Section B, Section C, Section D and Section E.

(3) All sections are compulsory.

(4) Section A contains 8 questions, 6 MCQ and 2 Assertion -reasoning based of 1 mark each. Section B contains 2 questions of 2 marks each. Section C contains 3 questions of 3 marks each. Section D contains 1 case study-based question of 4 marks. Section E contains 1 long answer question of 5 marks.

(5) There is no overall choice. However, an internal choice has been provided in 1 question in section B ,1 question in section C,1 question in section D and 1 question in section E. You have to attempt only one of the choices in such questions.

(6) You may use log tables if necessary but use of calculator is not allowed. You may use the following values of physical constants wherever necessary:

$C = 3 \times 10^8\ ms^{-1}$, $h = 6.626 \times 10^{-34} Js$, $e = 1.602 \times 10^{-19}\ C$, $\epsilon o = 8.854 \times 10^{-12}\ C^2N^{-1}m^{-2}$,
$m_e = 9.1 \times 10^{-31} kg$, $1/4\pi\epsilon o = 9 \times 10^9\ Nm^2/C^2$

SECTION- A (8 x 1=8)

1. A point charge situated at a distance ‘r’ from a short electric dipole on its axis, experiences a force $\vec{F}$. If the distance of the charge is ‘2r’, the force on charge will be:

(a) $\vec{F}$ /16 (b) $\vec{F}$ /8 (c) $\vec{F}$ /4 (d) $\vec{F}$ /2

2. An electron experiences a force $(1.6 \times 10^{-16}\ N)\ \hat{\imath}$ in an electric field $\vec{E}$. The electric field $\vec{E}$ is:

(a) $(1.0 \times 10^3\ N/C)\ \hat{\imath}$ (b) $-(1.0 \times 10^3\ N/C)\ \hat{\imath}$

(c) $(1.0 \times 10^{-3}\ N/C)\ \hat{\imath}$ (d) $-(1.0 \times 10^{-3}\ N/C)\ \hat{\imath}$

3. The unit of permittivity of free space (ε_0) is

(a) $CN^{-1}m^{-1}$ (b) Nm^2C^{-2} (c) $C^2N^{-1}m^{-2}$ (d) $C^2N^{-2}m^{-2}$

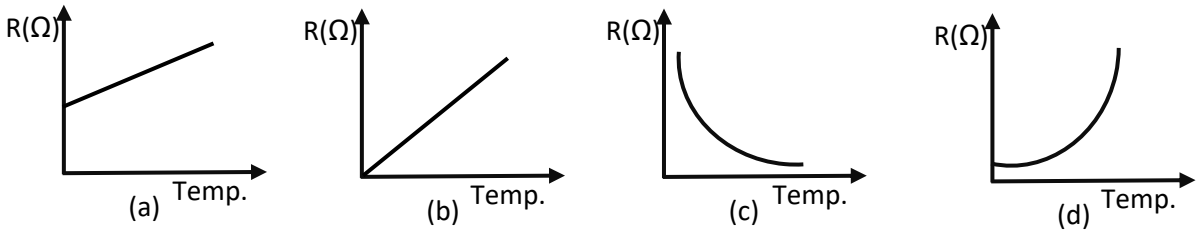
4. The capacitance of parallel plate capacitor having a medium of dielectric constant K = 4 in between the plates is C. If this medium is removed, then the capacitance of the capacitor becomes

(a) 4C (b) C (c) C/4 (d) 2C

5. If potential difference across a capacitor is changed from 15 V to 30 V, work done is W. The work done when potential difference is changed from 30 V to 60 V, will be:

(a) W (b) 4W (c) 3 W (d) 2 W

6. For a metallic conductor, the correct representation of variation of resistance R with temperature T is:



Question 7 and 8 are Assertion-Reason based questions. Find the correct answer using the codes given below.

(a) Both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.
(b) Both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.
(c) Assertion is correct but Reason is incorrect.
(d) Both the Assertion and Reason are incorrect.

7. **Assertion:** Two equipotential surfaces cannot cut each other.
   Reason: Two equipotential surfaces are parallel to each other.

8. **Assertion:** Electric energy resides out of the spherical isolated conductor.
   Reason: The electric field at any point inside the conductor is zero.

SECTION- B (2 x 2=4)

9. Define equipotential surface and write its orientation with electric field. Draw equipotential surface for (i) an isolated positive charge, and (ii) an electric dipole.

OR

Apply Gauss's law to show that for a charged spherical shell, the electric field outside the shell is, as if the entire charge were concentrated at the centre.

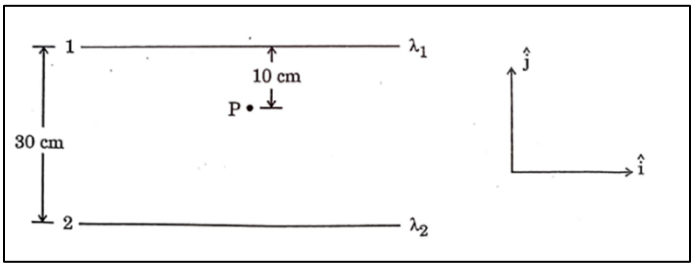
10. (i) Define the term 'drift velocity' of electrons in a current carrying conductor.
    (ii) Potential difference across a cell in the open circuit is 6 V. It becomes 4 V when a current of 2 A is drawn from it. Find the load resistance connected to the cell.

SECTION- C (3 x 3=9)

11. Define current density and relaxation time. Derive an expression for resistivity of a conductor in terms of number density of charge carriers in the conductor and relaxation time.

12. (i) Define electric potential energy.
    (ii) Three-point charges + 1 μC, – 1 μC and + 2 μC are initially infinite distance apart. Calculate the work done in assembling these charges at the vertices of an equilateral triangle of side 10 cm.

13. Two long straight wires 1 and 2 are kept as shown in the figure. The linear charge density of the two wires are λ_1 = 10 μ C/m and λ_2 = - 20 μC/m. Find the net force F experienced by an electron held at point P.



OR

Use Gauss' law to obtain an expression for the electric field due to an infinitely long thin straight wire with uniform linear charge density λ.

SECTION- D (4 x 1=4)

14.

The electric field inside the cavity is zero, whatever be the size and shape of the cavity and whatever be the charge on the conductor and the external fields in which it might be placed. The electric field inside a charged spherical shell is zero. But the vanishing of electric field in the (charge-free) cavity of a conductor is, as mentioned above, a very general result. A related result is that even if the conductor is charged or charges are induced on a neutral conductor by an external field, all charges reside only on the outer surface of a conductor with cavity.
If we join the points in an electric field, which are at same potential, the surface (or curve) obtained is known as equipotential surface (curve).

As we have, $\vec{E} = -\frac{dV}{dr}$ and $dV = -\vec{E}.d\vec{r} = -E\,dr\cos\theta$

(i) A metallic shell having inner radius R_1 and outer radii R_2 has a point charge Q kept inside cavity. Electric field in the region $R_1 < r < R_2$ where r is the distance from the centre is given by

(a) depends on the value of r
(b) Zero
(c) Constant and non-zero everywhere
(d) None of the above

(ii) The electric field is oriented with equipotential surfaces at

(a) right angle
(b) zero
(c) 180^o
(d) None of the above

(iii) Electrostatic shielding is based on the following.

(a) electric field inside the cavity of a conductor is less than zero.
(b) electric field inside the cavity of a conductor is zero.
(c) electric field inside the cavity of a conductor is greater than zero.
(d) electric field inside the cavity of a plastic is zero.

(iv) When a charge is carried on an equipotential surface

(a) work done is positive (b) work done is negative

(c) work done is zero (d) work done depends upon field

OR

(iv) Which of the following material can be used to make a Faraday cage (based on electrostatic shielding)?

(a) Plastic (b) Glass (c) Wood (d) Copper

SECTION- E (1 x 5=5)

15. (i) What are dielectrics? Define dielectric polarisation.

(ii) A 200 μF parallel plate capacitor having plate separation of 5 mm is charged by a 100 V dc source. It remains connected to the source. Using an insulated handle, a dielectric slab of thickness 5 mm and dielectric constant 10 is introduced between the plates.
Explain with reason, how the (a) capacitance, (b) electric field between the plates, (c) energy density of the capacitor will change?

OR

(i) Derive an expression for the electric field at a point on the equatorial plane of an electric dipole consisting of charges + q and - q separated by a distance 2a.

(ii) The distance of a far-off point on the equatorial plane of an electric dipole is halved. How will the electric field be affected for the dipole?

(iii) Two identical electric dipoles are placed along the diagonals of a square ABCD of side $\sqrt{2}$ m as shown in the figure. Obtain the magnitude and direction of the net electric field at the centre (O) of the square.