ANANDALAYA

PERIODIC TEST - 1

Class : XII

विद्या सर्वार्थि साधिका

Subject: Physics MM : 40

Date : 15-07-2022 Time: 2 Hours

General Instructions:

1. There are 17 questions in this question paper. All questions are compulsory.
2. This question paper has four sections – Section A, Section B, Section C and Section D.
3. Q. Nos. 1 to 5 from section A are objective type questions and carry 1 mark each.
4. Q. Nos. 6 to 10 from Section B are short answer questions and carry 2 mark each.
5. Q. Nos. 11 to 15 from Section C are also short answer questions and carry 3 marks each.
6. Q. Nos. 16 and17 from Section are long answer questions and carry 5 marks each.
7. There is no overall choice. However, an internal choice has been provided in one question of three marks and one question of five marks.

SECTION A

1. Define electric field (1)

2. An electric dipole is enclosed by a Gaussian surface. What is the electric flux passing through the Gaussian surface? (1)

3. Explain why two field lines never cross each other at any point. (1)

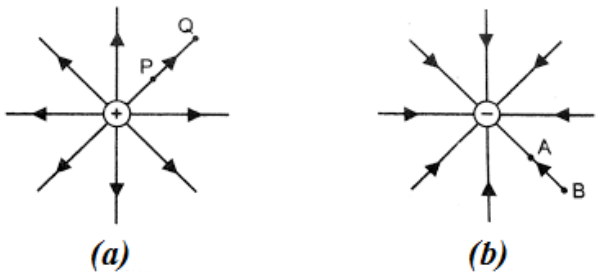
4. A charge 10 μC is moved along a spherical surface. A charge of 50 μC is at the centre of this spherical surface. What is the work done in moving the charge? (1)

5. A positively charged particle is released from rest in a uniform electric field. The electric potential energy of the charge _____. (1)
   (a) remains constant because the electric field is uniform.
   (b) increases because the charge moves along the electric field.
   (c) decreases because the charge moves along the electric field.
   (d) decreases because the charge moves opposite to the electric field.

SECTION B

6. An electric dipole with dipole moment 4×10^{-9} C m is aligned at 30° with the direction of a uniform electric field of magnitude 5×10^{4} NC^{-1}. Calculate the magnitude of the torque acting on the dipole. (2)

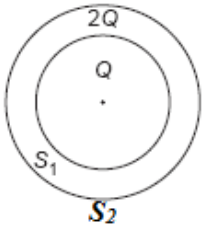
7. Figures (a) and (b) show the field lines of a positive and negative point charge respectively. (2)
   (i) Give the signs of the potential difference $V_P - V_Q$
   (ii) Give the sign of the potential energy difference of a small negative charge between the points A and B.
   (iii) Give the sign of the work done by the field in moving a small positive charge from Q to P.
   (iv) Does the kinetic energy of a small negative charge increase or decrease in going from B to A?



(a) *(b)*

8. Derive an expression for the potential energy of an electric dipole of dipole moment $\vec{p}$ in a uniform electric field $\vec{E}$. (2)

9. S_1 and S_2 are two hollow concentric spheres enclosing charge Q and $2Q$ respectively as shown in figure. (2)



(i) What is the ratio of the electric flux through S_1 and S_2?

(ii) How will the electric flux through the sphere S_1 change, if a medium of dielectric constant 5 is introduced in the space inside S_1 in place of air?

10. Two charges 3×10^{-8} C and -2×10^{-8} C are located 15 cm apart. At what point on the line joining the two charges is the electric potential zero? Take the potential at infinity to be zero. (2)

SECTION C

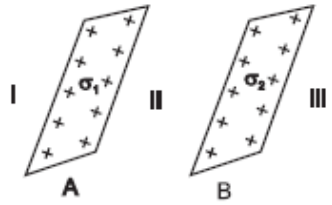
11. (a) Two insulated charged copper spheres A and B have their centres separated by a distance of 50 cm. What is the mutual force of electrostatic repulsion if the charge on each is 6.5×10^{-7} C? The radii of A and B are negligible compared to the distance of separation. (3)

(b) What is the force of repulsion if each sphere is charged double the above amount, and the distance between them is halved?

(c) Suppose the spheres A and B have identical sizes. A third sphere of the same size but uncharged is brought in contact with the first, then brought in contact with the second, and finally removed from both. What is the new force of repulsion between A and B?

12. (a) A point charge ($+Q$) is kept in the vicinity of uncharged conducting plate. Sketch electric field lines between the charge and the plate. (3)

(b) Two infinitely large plane thin parallel sheets having surface charge densities σ_1 and σ_2 ($\sigma_1 > \sigma_2$) are shown in the figure. Write the magnitudes and directions of net fields in the regions marked II and III.



13. A spherical conductor of radius 12 cm has a charge of 1.6×10^{-7}C distributed uniformly on its surface. What is the electric field (a) inside the sphere (b) just outside the sphere (c) at a point 18 cm from the centre of the sphere? (3)

14. State Gauss's theorem in electrostatics. Prove that no electric field exists inside a hollow charged sphere. (3)

OR

Using Gauss's theorem, deduce an expression for the electric field intensity at any point due to a thin, infinitely long wire of charge per length λ C/m.

15. Write three electrostatic characteristics of conductors. (3)

SECTION D

16. Deduce an expression for the electric potential due to an electric dipole at any point on its axis. Mention one contrasting feature of electric potential of a dipole at a point as compared to that due to a single charge. (5)

OR

A conducting slab of thickness t is introduced without touching between the plates of a parallel plate capacitor, separated by a distance d ($t < d$). Derive an expression for the capacitance of the capacitor.

17. Show by graph how charge given to a capacitor varies with its potential difference. Using the graph or otherwise, prove that the energy of a capacitor is $\frac{1}{2} CV^2$. Calculate the energy density of the electrostatic field in a parallel plate capacitor. (5)