विद्या सर्वार्थि साधिका

ANANDALAYA

PERIODIC TEST -1

Class : XII

Subject: Physics (042) MM : 40

Date : 23-07-2024 Time: 1 Hr. 30 min.

General Instructions:

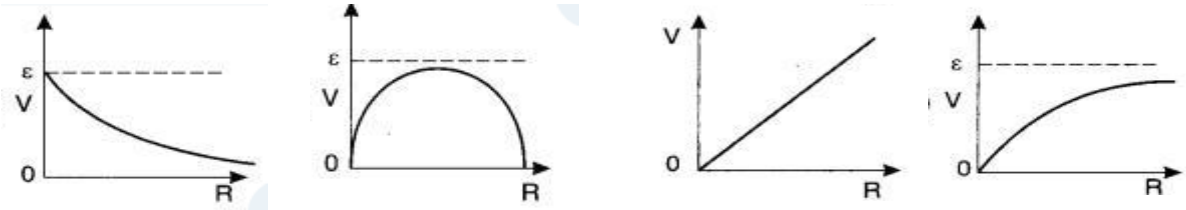
1. There are 20 questions in all. All questions are compulsory.
2. This question paper has five sections: Section A, Section B, Section C, Section D and Section E. All the sections are compulsory.
3. Section A consists of twelve MCQs of 1 mark each, Section B consists of two very short answer questions of 2 marks each, Section C consists of two short answer questions of 3 marks each, Section D consists of two long answer questions of 5 marks each and Section E consists two case study based questions of 4 marks each.
4. There is no overall choice. However, an internal choice has been provided in section E. You have to attempt only one of the choices in such questions.
5. Use of calculators is not allowed.

SECTION A

1. Total electric flux coming out of a unit positive charge put in air is ____. (1)
   (A) ε_0 (B) ε_0^{-1} (C) $4\pi\varepsilon_0$ (D) $4\pi/\varepsilon_0$

2. Two identical conducting balls B_1 and B_2 are given -7pC and +4pC charges respectively. They are brought in contact with the third identical ball B_3 and then separated. If the final charge on each ball is -2pC, then initial charge on the ball B_3 is _____. (1)
   (A) -2 pC (B) -3 pC (C) – 5 pC (D) – 15 pC

3. A cell having an emf ε and internal resistance r is connected across a variable external resistance R. As the resistance R is increased, the plot of potential difference V across R is given by ____. (1)

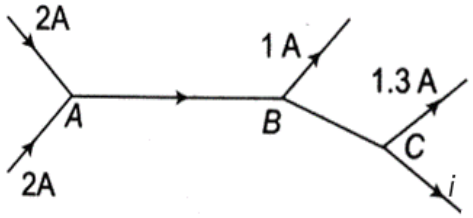


(A) (B) (C) (D)

4. When a dipole is placed in a uniform external field, then ____. (1)
   (A) net force on dipole is zero but torque is non-zero
   (B) torque is zero and net force on dipole is non-zero
   (C) both torque and net force are non-zero
   (D) both torque and net force are zero

5. An infinite line of charge produces a field of 9 x 10^4 N/C at a distance of 2 cm. The linear charge density on the wire is _____. (1)
   (A) 10^{-4} C/m (B) 10^{-5}C/m (C) 10^{-7}C/m (D) 10^{-9}C/m

6. The figure shows currents in a part of electric circuit. The current *i* is _____. (1)

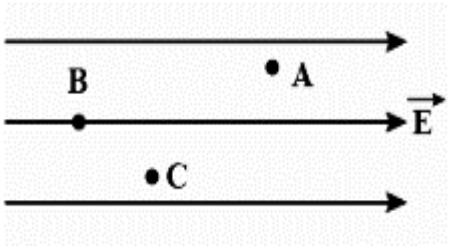


   (A) 1.3 A (B) 1.5 A
   (C) 1.7 A (D) 1.9 A

7. Two spherical conductors A and B of radii 1 mm and 2 mm are separated by a distance of 5 cm and are uniformly charged. If the spheres are connected by a conducting wire, then in equilibrium condition, the ratio of the magnitudes of the electric fields at the surfaces of sphere A and B is _____. (1)
(A) 1:2 (B) 2:1 (C) 1:4 (D) 4:1

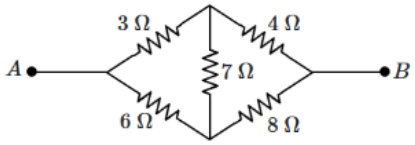
8. A capacitor of capacitance C has charged Q and stored energy is U. If the charge is increased to 2Q, the stored energy will be _____. (1)
(A) U/4 (B) 4U (C) U/2 (D) 2U

9. A, B and C are three points in a uniform field. The electric potential is ____. (1)
(A) maximum at A
(B) maximum at B
(C) maximum at C
(D) same at A, B and C



10. The net resistance of the circuit between A and B is ___. (1)

(A) $\frac{8}{3}\Omega$ (B) $\frac{14}{3}\Omega$ (C) $\frac{16}{3}\Omega$ (D) $\frac{22}{3}\Omega$



For question numbers 11 and 12, select the correct answer from the codes (A), (B), (C) and (D) as given below.
(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.

11. Assertion (A): A pure semiconductor has negative temperature coefficient of resistance. (1)
Reason(R): In semiconductor on raising the temperature, more charge carriers are released, conductance increases and resistance decreases.

12. Assertion(A): Direction of electric field on the equipotential surface is always normal to the surface. (1)
Reason(R): Between any two points on the equipotential surface, there is no potential, potential difference and work.

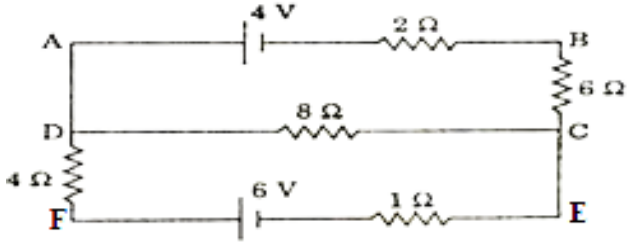
SECTION B

13. Two cells of different emfs and internal resistances are connected in parallel. Find expression for the equivalent emf and equivalent internal resistance of the combination. (2)

14. Apply Gauss's theorem to show that for a spherical shell, the electric field inside the shell vanishes, whereas outside it, the field is as if all the charge had been concentrated at the centre. (2)

SECTION C

15. (a) State Kirchhoff's laws. (3)
(b) Using Kirchhoff's laws, calculate the potential difference across the 8Ω resistor.



16. An electric dipole of length 2 cm is placed with its axis making an angle of 60^o to a uniform electric field of 10^5 N/C. If it experiences a torque of $8\sqrt{3}$ Nm, calculate the (i) magnitude of the charge on the dipole and (ii) potential energy of the dipole. (3)

SECTION D

17. A dielectric slab of thickness 't' is kept between the plates of a parallel plate capacitor separated by a distance 'd' (t < d). Derive an expression for the capacity of the capacitor. What will be its capacitance when t = d? (5)

18. (a) What is an electric dipole? (5)
(b) Define dipole moment and give its SI unit.
(c) Derive an expression for the electric field at any point on the axial line of an electric dipole.

SECTION E

Questions 19 and 20 are case study based or passage based questions and are compulsory. Each question carries 4 marks.

19. When a conductor does not have a current through it, its conduction electrons move randomly, with no net motion in any direction. When the current flows through the conductor, these electrons actually still move randomly, but now they tend to drift with drift speedv_d. The drift speed is very less as compared to speeds in random thermal motion.

(i) A steady current flows through a metallic wire whose area of cross-section (A) increases continuously from one end of the wire to the other. The magnitude of drift velocity (v_d) of the free electrons is _____. (1)

(A) independent of A (B) directly proportional to A
(C) inversely proportional to A (D) zero

(ii) The dimensional formula relation between electric field (E) and drift velocity is _____. (1)

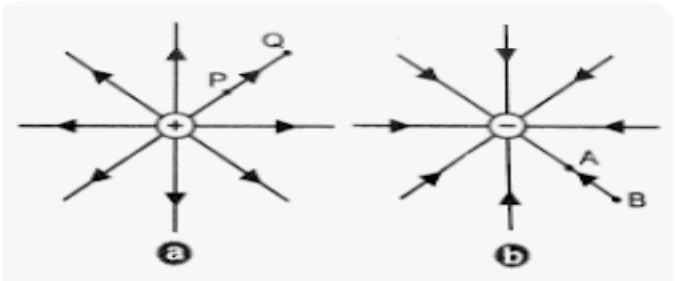
(A) $v_d \propto E^2$ (B) $v_d \propto \sqrt{E}$ (C) $v_d \propto E$ (D) $v_d \propto \frac{E}{2}$

(iii) Establish the relation between the current flowing in a wire and drift velocity of the free electrons. (2)

OR

(iii) Establish the relation between mobility and drift velocity of the free electrons.

20. Figures (a) and (b) show the field lines of a positive and negative point charge respectively.



(i) What is the sign of potential difference between the points B and A? (1)

(ii) The sign of the work done by the field and by the external agency in moving a small negative charge from B to A are _____ respectively. (1)

(A) positive and positive (B) negative and negative
(C) positive and negative (D) negative and positive

(iii) Does the kinetic energy of a small negative charge increase or decrease in going from B to A? Justify your answer. (2)

OR

(iii) Does the kinetic energy of a small negative charge increase or decrease in going from P to Q? Justify your answer.