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IIT/PMT INSTITUTE

CHAPTER TEST

Subject : Physics **Topic : Electrostatics** **M.M. : 180**

Have patience all things are difficult before they become easy.

Marking Scheme:

(i) Each question is allotted 4 (four) marks for each correct response.

(ii) ¼ (one fourth) marks will be deducted for indicating incorrect response of each question. No deduction from the total score will be made if no response is indicated for an item in the answer sheet.

Q.1 I. If a system contains two point charges q_1 and q_2, the total charge of the system is obtained simply by adding algebraically q_1 and q_2. e.g., (– 2 units charge) + (6 units charge) = 4 units charge.

II. (– 2 units charge) + (6 units charge) = 8 units charge.

III. Charge has magnitude but no direction, similar to mass.

IV. Mass of a body is always positive whereas a charge can be either positive or negative.

Incorrect statement is

(A) only I (B) only III

(C) only IV (D) only II

Q.2 If a body gives out 10^9 electrons per second, how much time is required to get a total charge of 1 C from it?

(A) Around 200 min. (B) Around 200 hours

(C) Around 200 days (D) Around 200 years

Q.3 For 250 ml water in a cup, positive charge and negative charge in water, are respectively

(A) 1.34×10^{-7} C, -1.34×10^{-7} C

(B) 1.34×10^{7} C, -1.34×10^{7} C

(C) 1.34×10^{7} C, -1.34×10^{-7} C

(D) 1.34×10^{-7} C, -1.34×10^{7} C

Q.4 The potential energies associated with four orientations of an electric dipole in an uniform electric field are

(i) $-V_0$ (ii) $-7V_0$

(iii) $3V_0$ (iv) $4V_0$

Choose correct statement if V_0 is positive.

(A) The angle between electric field and dipole is maximum in case (ii).

(B) The maximum torque is being experienced by the dipole in case (i).

(C) $V_0 = |P|\,|E|$ with usual notations.

(D) The angle between $\vec{E}$ & $\vec{p}$ is acute in case (iii).

Q.5 Eight field lines emerge from a closed surface surrounding an isolated point charge. Would this fact change if a second identical charge were brought to a point just outside the surface?

(A) The number of lines would change but the shape of the lines remains the same.

(B) The number of lines would remain the same but the shape of the lines change.

(C) The number of lines as well as the shape of the lines remains the same.

(D) The number of lines as well as the shape of the lines would change.

Q.6 The electric field in a region is given by $\vec{E} = 200\hat{i}$ N/C for $x > 0$ and $-200\hat{i}$ N/C for $x < 0$. A closed cylinder of length 2m and cross-section area 10^2 m^2 is kept in such a way that the axis of cylinder is along X-axis and its centre coincides with origin. The total charge inside the cylinder is (Take $\varepsilon_0 = 8.85 \times 10^{-12}$ C^2m^2.N)

(A) zero (B) 1.86×10^{-5} C

(C) 1.77×10^{-11} C (D) 35.4×10^{-8} C

Q.7 Two charged spheres of radii 10 cm and 15 cm are connected by a thin wire. No current will flow, if they have

(A) The same charge on each

(B) The same potential

(C) The same energy

(D) The same field on their surfaces

Q.8 A conductor with a positive charge

(A) Is always at +ve potential

(B) Is always at zero potential

(C) Is always at negative potential

(D) May be at +ve, zero or –ve potential

Q.9 An electron and a proton are in a uniform electric field, the ratio of their accelerations will be –
(A) Zero
(B) Unity
(C) The ratio of the masses of proton and electron.
(D) The ratio of the masses of electron and proton.

Q.10 At a certain distance from a point charge the electric field is 500V/m and the potential is 3000V. What is this distance
(A) 6m (B) 12m
(C) 36m (D) 144m

Q.11 A 10μF capacitor is charged to a potential difference of 50Vand is connected to another uncharged capacitor in parallel. Now the common potential difference becomes 20volt. The capacitance of second capacitor is
(A) 10μF (B) 20μF
(C) 30μF (D) 15μF

Q.12 An electric dipole is placed in an electric field generated by a point charge
(A) The net electric force on the dipole must be zero.
(B) The net electric force on the dipole may be zero.
(C) The torque on the dipole due to the field must be zero.
(D) The torque on the dipole due to the field may be zero.

Q.13 An electric dipole has the magnitude of its charge as q and its dipole moment is p. It is placed in a uniform electric field E. If its dipole moment is along the direction of the field, the force on it and its potential energy are respectively
(A) 2q . E and minimum (B) q . E and p . E
(C) Zero and minimum (D) q . E and maximum

Q.14 Intensity of an electric field E due to a dipole, depends on distance r as
(A) $E \propto \frac{1}{r^4}$ (B) $E \propto \frac{1}{r^3}$
(C) $E \propto \frac{1}{r^2}$ (D) $E \propto \frac{1}{r}$

Q.15 Two insulated charged spheres of radii 20cm and 25cm respectively and having an equal charge Q are connected by a copper wire, then they are separated
(A) Both the spheres will have the same charge Q.
(B) Charge on the 20cm sphere will be greater than that on the 25cm sphere.
(C) Charge on the 25cm sphere will be greater than that on the 20cm sphere.
(D) Charge on each of the sphere will be 2Q.

Q.16 The electric field due to an electric dipole at a distance r from its centre in axial position is E. If the dipole is rotated through an angle of 90° about its perpendicular axis, the electric field at the same point will be
(A) E (B) E / 4
(C) E / 2 (D) 2E

Q.17 Two point charges +8q and –2q are located at x = 0 and x = L respectively. The location of a point on the x axis at which the net electric field due to these two point charges is zero is
(A) 2 L (B) L/4
(C) 8 L (D) 4 L

Q.18 An electric dipole is placed at an angle of 30° to a non-uniform electric field. the dipole will experience
(A) a torque as well as a translational force
(B) a torque only
(C) a translational force only in the direction of the field
(D) a translational force only in a directin normal to the direction of the field.

Q.19 A battery is used to charge a parallel plate capacitor till the potential difference between the plates becomes equal to the electromotive force of the battery. The ratio of the energy stored in the capacitor and the work done by the battery will be
(A) 1 (B) 2
(C) 1/4 (D) 1/2

Q.20 Two charged conducting spheres of radii a and b are connected to each other by a wire. The ratio of electric fields at the surfaces of two spheres is
(A) a/b (B) b/a
(C) a^2/b^2 (D) b^2/a^2

Q.21 Which of the following are the examples of non-polar molecules?
(A) Oxygen (B) Hydrogen
(C) Nitrogen (D) Both (A) and (B)

Q.22 Choose the correct statement.
(A) Polar molecules have permanent electric dipole moment.
(B) CO_2 molecule is a polar molecule.
(C) H_2O is a non-polar molecule.
(D) The dipole field at large distances falls of as $1/r^2$.

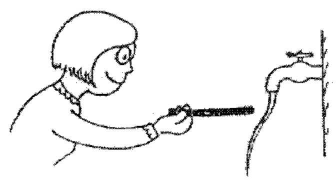
Q.23 The extent of polarisation depends on
(A) the dipole potential energy in the external field tending to align the dipoles with the field.
(B) thermal energy tending to disrupt the alignment
(C) both (A) and (B)
(D) neither (A) nor (B)

Q.24 If dielectric constant and dielectric strength be denoted by K and X respectively, then a material suitable for use as a dielectric in a capacitor must have
(A) high K and high X (B) high K and low X
(C) low K and high X (D) low K and low X

Q.25 Millikan's drop experiment attempts to measure the charge on a single electron, e, by measuring the charge of tiny oil drops suspended in an electrostatic field. It is assumed that the charge on the oil drop is due to just a small number of excess electrons. The charges 3.90×10^{-19} C, 6.50×10^{-19} C and 9.10×10^{-19} C are measured on three drops of oil. Find the charge of an electron.
(A) 0.3×10^{-19} (B) 2.1×10^{-19}
(C) 1.3×10^{-19} (D) 1.8×10^{-12}

Q.26 Which of the following statements is true –
(A) The electric field due a point charge can be same at two points.
(B) The electric field increases continuously as one goes away from centre of a solid uniformly charged sphere.
(C) The electric field of force of the electric field produced by the static charges from closed loops.
(D) The magnetic lines of force of magnetic field produced by current carrying wire from closed loops.

Q.27 In normal cases thin stream of water bends toward a negatively charged rod. When a positively charged rod is placed near the stream, it will bend in the –



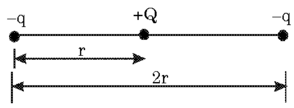
(A) Opposite direction (B) Same direction
(C) It won't bend at all (D) Can't be predicted.

Q.28 Two equal point charges are fixed at x = – a and x = + a on the x-axis. Another point charge Q is placed at the origin. The change in the electrical potential energy of Q, when it is displaced by a small distance x along the x-axis, is approximately proportional to–
(A) x (B) x^2
(C) x^3 (D) $1/x$

Q.29 The electric potential V at any point (x, y, z) in space is given by $V = 6x^2$ volt, where all the distances are measured in metre. Find the electric field at the point (1m, 0, 2m).
(A) $-12\hat{i}$ (B) $-18\hat{i}$
(C) $-6\hat{i}$ (D) $-24\hat{i}$

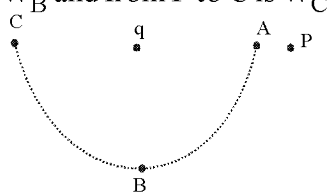
Q.30 Two charges 5×10^{-8} C and -3×10^{-8} C are located 0.16m apart. At what point on the line joining the two charges is the electric potential zero? Take the potential at infinity to be zero.
(A) 0.9m (B) 0.8m
(C) 0.5m (D) 0.1m

Q.31 Fig. shows an arrangement of three point charges. The total potential energy of this arrangement is zero. Calculate the ratio q/Q.



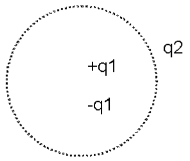
(A) 2 : 1 (B) 1 : 2
(C) 4 : 1 (D) 1 : 1

Q.32 Consider the situation of figure. The work done in taking a point charge from P to A is W_A, from P to B is W_B and from P to C is W_C.



(A) $W_A < W_B < W_C$ (B) $W_A > W_B > W_C$
(C) $W_A = W_B = W_C$ (D) None of these

Q.33 Consider the charge configuration and spherical Gaussian surface as shown in the figure. When calculating the flux of the electric field over the spherical surface the electric field will be due to –

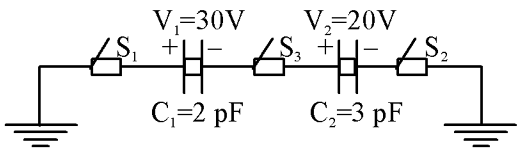


(A) q_2
(B) only the positive charges
(C) all the charges
(D) $+q_1$ and $-q_1$

Q.34 A parallel plate capacitor C is connected to a battery & is charged to a potential difference V. Another capacitor of capacitance 2C is similarly charged to a potential difference 2V volt. The charging battery is now disconnected & the capacitors are connected in parallel to each other in such a way that the positive terminal of one is connected to the negative terminal of other. The final energy of the configuration is -

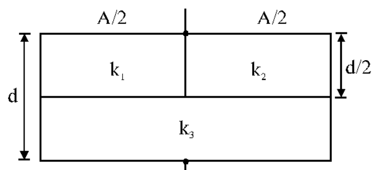
(A) zero (B) $(3/2)CV^2$
(C) $(25/6)\,CV^2$ (D) $(9/2)CV^2$

Q.35 For the circuit shown, which of the following statements is true ?



(A) with S_1 closed $V_1 = 15$ V, $V_2 = 20$ V
(B) with S_3 closed, $V_1 = V_2 = 25$ V
(C) with S_1 & S_2 closed, $V_1 = V_2 = 0$
(D) with S_1 & S_2 closed, $V_1 = 30$ V, $V_2 = 20$ V

Q.36 A parallel plate capacitor of area A, placed at a separation d and capacitance C is filled with three different dielectric materials having dielectric constants k_1, k_2 and k_3 as shown. If a single dielectric material is to be used to have the same capacitance C in this capacitor then its dielectric constant k is given by



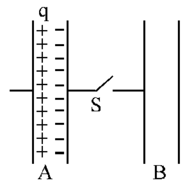
(A) $\frac{1}{k} = \frac{1}{k_1} + \frac{1}{k_2} + \frac{1}{2k_3}$

(B) $\frac{1}{k} = \frac{1}{k_1 + k_2} + \frac{1}{2k_3}$

(C) $k = \frac{k_1 k_2}{k_1 + k_2} + \frac{1}{2k_3}$

(D) $k = \frac{k_1 k_3}{k_1 + k_3} + \frac{k_2 k_3}{k_2 + k_3}$

Q.37 Consider the situation shown in the figure. The capacitor A has a charge q on it whereas B is in charged. The charge appearing on the capacitor B a long time after the switch is closed is



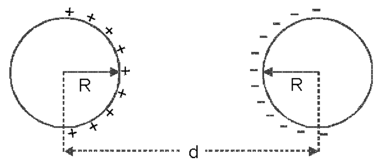
(A) zero (B) q/2
(C) q (D) 2q

Q.38 Two identical capacitors, have the same capacitance C. One of them is charged to potential V_1 and the other to V_2. The negative ends of the capacitors are connected together. When the positive ends are also connected, the decrease in energy of the combined system is -

(A) $\frac{1}{4}C\,(V_1^2 - V_2^2)$ (B) $\frac{1}{4}C\,(V_1^2 + V_2^2)$

(C) $\frac{1}{4}\,C\,(V_1 - V_2)^2$ (D) $\frac{1}{4}\,C\,(V_1 + V_2)^2$

Q.39 Two charged spheres of radius 'R' are kept at a distance 'd' (d > 2R). One has a charge +q and the other –q. The force between them will be-



(A) $\frac{1}{4\pi\varepsilon_0}\frac{q^2}{d^2}$ (B) $> \frac{1}{4\pi\varepsilon_0}\frac{q^2}{d^2}$

(C) $< \frac{1}{4\pi\varepsilon_0}\frac{q^2}{d^2}$ (D) None of these

Q.40 A charge is situated at a certain distance from an electric dipole in the end-on position experiences a force F. If the distance of the charge is doubled, the force acting on the charge will be :

(A) F/4 (B) F/8
(C) 2F (D) F/2

Q.41 If n drops of potential V merge, find new potential on the big drop –

(A) $n^{2/3}V$ (B) $n^{1/3}V$

(C) nV (D) $V^{n/3}$

Q.42 A capacitor of 1 μF withstands a maximum voltage of 6 kilovolt while another capacitor of 2 μF withstands a maximum voltage of 4 kilovolt. If the two capacitors are connected in series, the system will withstand a maximum voltage of –

(A) 2 kV (B) 4 kV

(C) 6 kV (D) 9 kV

Q.43 An electric field is given by $E_x = -2x^3$ kN/C. The potential of the point (1, –2), if potential of the point (2, 4) is taken as zero, is –

(A) 7.5×10^3 V (B) -7.5×10^3 V

(C) -15×10^3 V (D) 15×10^3 V

Q.44 A charge Q μC is placed at the centre of a cube, the flux coming out from any surface will be –

(A) $\frac{Q}{6\varepsilon_0} \times 10^{-6}$ (B) $\frac{Q}{6\varepsilon_0} \times 10^{-3}$

(C) $\frac{Q}{24\varepsilon_0}$ (D) $\frac{Q}{8\varepsilon_0}$

Q.45 Each corner of a cube of side ℓ has a negative charge, – q. The electrostatic potential energy of a charge q at the centre of the cube is –

(A) $-\frac{4q^2}{\sqrt{2}\pi\varepsilon_0\ell}$ (B) $\frac{\sqrt{3}q^2}{4\pi\varepsilon_0\ell}$

(C) $\frac{4q^2}{\sqrt{2}\pi\varepsilon_0\ell}$ (D) $-\frac{4q^2}{\sqrt{3}\pi\varepsilon_0\ell}$