

SET-1 Electric charges and field

- Two small identical sphere having charges $+10\mu\text{C}$ attract each other with a force of F newton. If they are kept in contact and then separated by the same distance, the new force between them is:
 (a) $F/6$ (b) $16F$ (c) $16F/9$ (d) $9F$
- A charge q is placed at the mid-point of the line joining two equal charges Q . The system of three charges will be in equilibrium when q has the value:
 (a) $Q/4$ (b) $Q/2$ (c) $-Q/4$ (d) $-Q/2$
- An electric dipole is placed in a non-uniform electric field. Then net:
 (a) force experienced is zero while torque is not zero
 (b) force experienced is zero and torque is also zero
 (c) both force and torque are not zero
 (d) force experienced is not zero while torque is zero
- The total electric flux leaving spherical surface of radius 1cm and surrounding an electric dipole is:
 (a) q/ϵ_0 (b) zero (c) $2q/\epsilon_0$ (d) $8\pi r^2 q/\epsilon_0$
- Two particles of masses m and $2m$ with charge $2q$ and $2q$ are placed in a uniform electric field E and allowed to move for the same time. The ratio of their kinetic energies will be:
 (a) $2 : 1$ (b) $8 : 1$ (c) $4 : 1$ (d) $1 : 4$
- Electric charges q , q , $-2q$ are placed at the corners of an equilateral triangle ABC of side l . The magnitude of electric dipole moment of the system is:
 (a) ql (b) $2ql$ (c) $\sqrt{3}ql$ (d) $4ql$
- A particle of mass m and charge q is placed at rest in a uniform electric field E and then released. The KE attained by the particle after moving a distance y is:
 (a) qEy^2 (b) qE^2y (c) qEy (d) q^2Ey
- Eight dipoles of charges of magnitude e are placed inside a cube. The total electric flux coming out of the cube will be:
 (a) $8e/\epsilon_0$ (b) $16e/\epsilon_0$ (c) e/ϵ_0 (d) zero
- A uniform vertical electric field E is established in the space between two large parallel plates. A small conduction sphere of mass m is suspended in the field from a string of length L . If the sphere is given a $+q$ charge and the lower plate is charged positively, the period of oscillation of this pendulum is:
 (a) $2\pi\sqrt{L/g}$ (b) $2\pi\sqrt{L/g + (qE/m)}$ (c) $2\pi\sqrt{L/g - (qE/m)}$ (d) $2\pi\sqrt{L/[g^2 + (qE/m)^2]}^{1/2}$
- Two point charges exert on each other a force F when they are placed r distance apart in air. When they are placed R distance apart in a medium of dielectric constant K , they exert the same force. The distance R equals:

(a) $r/\sqrt{K}$

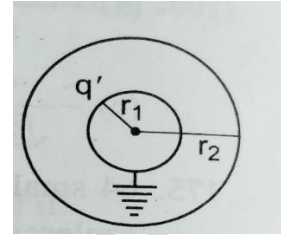
(b) r/K

(c) rK

(d) $r\sqrt{K}$

A

11. The concentric spheres are of radii r_1 and r_2 . The outer sphere is given a charge q . The



charge q' on the inner sphere will be (inner sphere is grounded):

(a) q

(b) $-q$

(c) $-q r_1/r_2$

(d) zero

12. Let $P(r) = Q/\pi R^4 r$ be the charge density distribution for a solid sphere of radius R and total charge Q . For a point P inside the sphere at distance r_1 from the centre of the sphere, the magnitude of electric field is:

(a) zero

(b) $Q/4\pi\epsilon_0 r_1^2$

(c) $Q r_1^2/4\pi\epsilon_0 R^4$

(d) $Q r_1^2/3\pi\epsilon_0 R^4$

13. An infinitely long thin straight wire has uniform linear charge density of $1/3\text{cm}^{-1}$. Then, the magnitude of the electric intensity at a point 18 cm away is:

(Given $\epsilon_0 = 8.8 \times 10^{-12}\text{C}^2\text{Nm}^{-2}$)

(a) $0.33 \times 10^{11}\text{NC}^{-1}$

(b) $3 \times 10^{11}\text{NC}^{-1}$

(c) $0.66 \times 10^{11}\text{NC}^{-1}$

(d) $1.32 \times 10^{11}\text{NC}^{-1}$

14. A dipole of electric dipole moment p is placed in a uniform electric field of strength E . If θ is the angle between positive directions of p and E , then the potential energy of the electric dipole is largest when θ is:

(a) $\pi/4$

(b) $\pi/2$

(c) π

(d) zero

(e) $2/3\pi$

15. If $q_1 + q_2 = q$, then the value of the ratio q_1/q_2 for which the force between q_1 and q_2 is maximum is:

(a) 0.25

(b) 0.75

(c) 1

(d) 0.5

(e) 1.5

Set-2 Electrostatic potential

1. n small drops of the same size are charged to V volt each. If they coalesce to form a single large drop, then its potential will be:

(a) (V/n)

(b) Vn

(c) $Vn^{1/3}$

(d) $Vn^{2/3}$

2. Two conduction spheres of radii r_1 and r_2 are at the same potential. The ratio of their charges is:

(a) (r_1^2/r_2^2)

(b) (r_2^2/r_1^2)

(c) (r_1/r_2)

(d) (r_2/r_1)

3. Two conduction spheres of radii r_1 and r_2 are equally charged. The ratio of their potential is:

(a) (r_1^2/r_2^2)

(b) (r_2^2/r_1^2)

(c) (r_1/r_2)

(d) (r_2/r_1)

4. Two concentric thin metallic sphere of radii R_1 and R_2 ($R_1 > R_2$) bear charge Q_1 and Q_2 respectively. Then the potential at radius r between R_1 and R_2 will be $1/(4\pi\epsilon_0)$ times:

- (a) $Q_1 + Q_2/r$ (b) $Q_1R_1 + Q_2/r$ (c) $Q_1/R_1 + Q_2/R_2$ (d) $Q_1/R_2 + Q_2/R_1$

5. An electron of mass m and charge e is accelerated from rest through a potential difference V in vacuum. Its final speed will be:

- (a) $\sqrt{2eV/m}$ (b) $\sqrt{eV/m}$ (c) $\sqrt{eV/2m}$ (d) eV/m

6. The kinetic energy of an electron, which is accelerated in the potential difference of 100 V, is:

- (a) $1.6 \times 10^{-17} \text{ J}$ (b) $1.6 \times 10^{-14} \text{ J}$ (c) $1.6 \times 10^{-10} \text{ J}$ (d) $1.6 \times 10^{-8} \text{ J}$

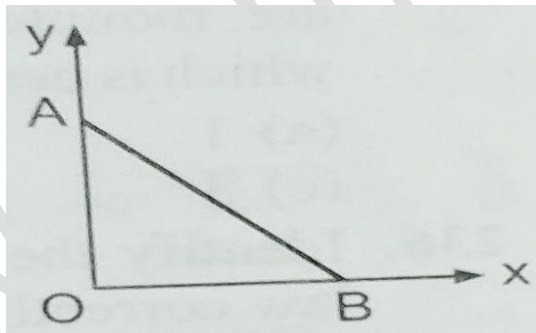
7. The radii of two sphere are a and b respectively. They are at equal electric potential. The ratio of their surface density of charge is:

- (a) a^2/b^2 (b) b/a (c) a/b (d) b^2/a^2

8. Potential at a point x -distance from the centre inside the conduction sphere of radius R and charged with charge Q is:

- (a) Q/x^2 (b) Q/x (c) Q/R (d) xQ

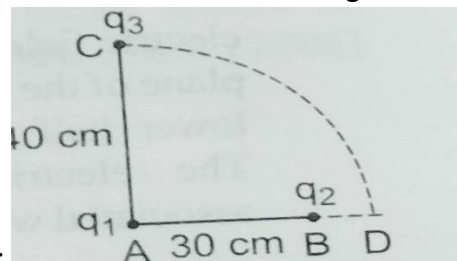
9. As per diagram, a point charge $+q$ is placed at the origin O . Work done in taking another charge $-Q$ from the point A [co-ordinate $(0, a)$] to another point B [co-ordinate $(a, 0)$] along the



straight path AB is:

- (a) $(Qq/4\pi\epsilon_0 a^2) \sqrt{2}a$ (b) zero (c) $(-Qq/4\pi\epsilon_0 a^2) \sqrt{2}a$ (d) $(Qq/4\pi\epsilon_0 a^2) a/\sqrt{2}$

10. Two charge q_1 and q_2 are placed 30 cm apart, as shown in the figure. A third charge q_3 is moved along the arc of a circle of radius 40 cm from C to D . The change in the potential



energy of the system is $q_3/4\pi\epsilon_0 k$, where k is:

- (a) $8 q_1$ (c) $8 q_2$
 (b) $6 q_1$ (d) $6 q_2$

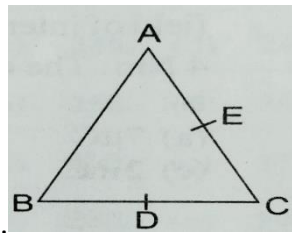
11. The potential of a large liquid drop when eight liquid drop are combined is 20 V. Then, the potential of each single drop was:

- (a) 10 V (b) 7.5 V (c) 5 V (d) 2.5 V

12. Two point charge $+5\mu\text{C}$ and $-2\mu\text{C}$ are kept at a distance of 1m in free space. The distance between the two zero potential points on the line joining the charges is:

- (a) $2/7\text{m}$ (b) $2/3\text{m}$ (c) $22/21\text{m}$ (d) $20/21\text{m}$ (e) $8/21\text{m}$

13. Three charges, each $+q$, are placed at the corners of an isosceles triangle ABC of sides BC and AC, $2a$. D and E are the mid-points of BC and CA. The work done in taking a charge Q from D to E, is: fig



- (a) $3qQ/4\pi\epsilon_0 a$ (b) $3qQ/8\pi\epsilon_0 a$ (c) $qQ/4\pi\epsilon_0 a$ (d) zero

Set-3 capacitor and its capacitance

1. The equivalent capacitance between the points A and B in given circuit is

(1) $1 \mu\text{F}$ (2) $2 \mu\text{F}$
 (3) $3 \mu\text{F}$ (4) $4 \mu\text{F}$

2. A parallel plate capacitor of plate area A and separation d filled with three dielectric materials as shown in figure. The dielectric constants are K_1 , K_2 and K_3 respectively. The capacitance across points A and B will be :

(1) $\frac{\epsilon_0 A}{d} \left(\frac{K_1 K_2 K_3}{K_1 + K_2 + K_3} \right)$
 (2) $\frac{\epsilon_0 A}{d} (K_1 + K_2 + K_3)$
 (3) $\frac{\epsilon_0 A}{3d} (K_1 + K_2 + K_3)$
 (4) $\frac{3\epsilon_0 A}{2d} (K_1 + K_2 + K_3)$

3. Six equal capacitors each of capacitance $10 \mu\text{F}$ are connected as shown in the figure. Then the equivalent capacitance between A and B is :

(1) $20 \mu\text{F}$ (2) $30 \mu\text{F}$
 (3) $15 \mu\text{F}$ (4) $10 \mu\text{F}$

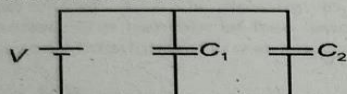
4. A parallel plate capacitor of capacitance C (without dielectric) is filled by dielectric material as shown in figure. Then the new capacitance of the capacitor across the points P and Q is

(1) 5C
 (2) $\frac{13}{3} C$
 (3) $\frac{3}{13} C$
 (4) 2.4C

5. The energy supplied by an external agent to charge a parallel plate capacitor of plate separation d and plate area A such that uniform electric field between the plates is E , is

(1) $\frac{1}{2} \epsilon_0 E^2$
 Ad (2) $\frac{1}{2} \epsilon_0 E^2 Ad$
 (3) $\epsilon_0 E^2 Ad$ (4) $\frac{\epsilon_0 E^2}{Ad}$

6. Two capacitors C_1 and C_2 of capacitances $\frac{C}{2}$ and $\frac{C}{4}$ are connected to a V volt battery, as shown in figure. The ratio of energy stored in capacitors C_1 and C_2 is

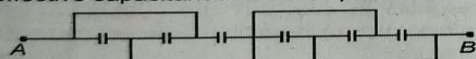


(1) 1 : 1 (2) 1 : 2
 (3) 2 : 1 (4) 2 : 3

7. A capacitor of capacitance $15 \mu\text{F}$ has a charge $30 \mu\text{C}$ and stored energy is W . If charge increased to $60 \mu\text{C}$ the energy stored will be.

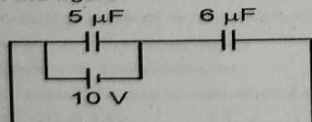
(1) W (2) $4W$
 (3) $6W$ (4) $\frac{1}{2}W$

8. Six identical capacitors are connected as shown in figure. Capacitance of each capacitor is $5 \mu\text{F}$. The effective capacitance between point A and B is



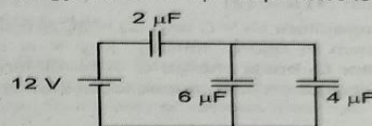
(1) $7.5 \mu\text{F}$
 (2) $10 \mu\text{F}$
 (3) $5 \mu\text{F}$
 (4) $1.5 \mu\text{F}$

9. The charge supplied by the battery in the circuit shown in the figure



(1) $\frac{300}{11} \mu\text{C}$
 (2) $60 \mu\text{C}$
 (3) $50 \mu\text{C}$
 (4) $110 \mu\text{C}$

10. The energy stored in $4 \mu\text{F}$ capacitors is

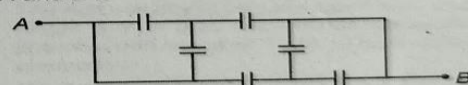


(1) $8 \mu\text{J}$
 (2) $12 \mu\text{J}$
 (3) $16 \mu\text{J}$
 (4) $20 \mu\text{J}$

11. Two identical capacitors C_1 and C_2 each of capacitance $10 \mu\text{F}$ are connected in series to a cell of emf 12 V . Capacitor C_2 is filled with dielectric of dielectric constant $k = 4$. The energy stored in capacitor C_2 is:

(1) $110 \mu\text{J}$
 (2) $112 \mu\text{J}$
 (3) $114.5 \mu\text{J}$
 (4) $115.2 \mu\text{J}$

12. Six identical capacitors each of capacitance $2 \mu\text{F}$ are connected as shown in figure. The equivalent capacitance between the points A and B is

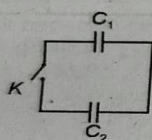


(1) $\frac{3}{8} \mu\text{F}$
 (2) $3 \mu\text{F}$
 (3) $\frac{8}{3} \mu\text{F}$
 (4) $8 \mu\text{F}$

13. Van de Graaff generator is based on

- (1) The phenomenon of corona discharge
 (2) The property of hollow conductor that if a charge given to hollow conductor is transferred to outer surface
 (3) Fact that conductor can conduct heat and electricity
 (4) Both (1) and (2)

14. Two capacitors $C_1 = C$ and $C_2 = 3C$ are connected as shown in figure. Initially, key K is open and capacitor C_1 holds charge Q . After closing the key K , the charge on each capacitor at steady state will be



(1) $\frac{Q}{4}, \frac{Q}{4}$ (2) $\frac{Q}{4}, \frac{3Q}{4}$
 (3) $\frac{3Q}{4}, \frac{3Q}{4}$ (4) $Q, \frac{Q}{3}$

15. A capacitor of capacitance C is initially charged to a potential difference of V . Now it is connected to a battery of $2V$ with opposite polarity and steady state is reached. The heat developed is

(1) $\frac{3}{2} CV^2$
 (2) $\frac{9}{2} CV^2$
 (3) CV^2
 (4) $\frac{9}{4} CV^2$