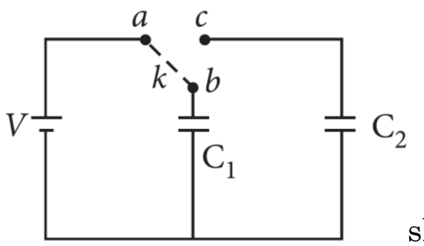
1. A hollow metal sphere of radius R is uniformly charged. The electric field due to the sphere at a distance r from the centre
   (a) decreases as r increases for $r < R$ and for $r > R$
   (b) increases as r increases for $r < R$ and for $r > R$
   (c) zero as r increases for $r < R$, decreases as r increases for $r > R$
   (d) zero a sr increases for $r < R$, increases as r increases for $r > R$ (*NEET2019*)
2. Two-point charges A and B, having charges $+Q$ and $-Q$ respectively, are placed at certain distance apart and force acting between them is F. If 25% charge of A is transferred to B, then force between the charges becomes
   (a) $\frac{4F}{3}$
   (b) F
   (c) $\frac{9F}{16}$
   (d) $\frac{16F}{9}$ (*NEET 2019*)
3. Two parallel infinite line charges with linear charge densities $+\lambda \ C/m$ and $-\lambda C/m$ are placed at a distance of $2R$ in free space. What is the electric field mid - way between the two-line charges?
   (a) $\frac{\lambda}{2\pi\varepsilon_0 R} N/C$
   (b) zero
   (c) $\frac{2\lambda}{\pi\varepsilon_0 R} N/C$
   (d) $\frac{\lambda}{\pi\varepsilon_0 R} N/C$ (*NEET 2019*)
4. Two metal spheres, one of radius R and the other of radius $2R$ respectively have the same surface charge density σ. They are brought in contact and separated. What will be the new surface charge densities on them?
   (a) $\sigma_1 = \frac{5}{6}\sigma, \sigma_2 = \frac{5}{2}\sigma$
   (b) $\sigma_1 = \frac{5}{2}\sigma, \sigma_2 = \frac{5}{6}\sigma$
   (c) $\sigma_1 = \frac{5}{2}\sigma, \sigma_2 = \frac{5}{3}\sigma$
   (d) $\sigma_1 = \frac{5}{3}\sigma, \sigma_2 = \frac{5}{6}\sigma$ (*Odisha NEET 2019*)
5. Two identical capacitors C_1 and C_2 of equal capacitance are connected as



shown in the circuit. Terminals a and b of the key k are connected to charge capacitor C_1 using battery of emf V volt. Now disconnecting a and b the terminals b and c are connected. Due to this, what will be the percentage loss of energy?.

(a) 75%

(b) 0%

(c) 50%

(d) 25% (*Odisha NEET 2019*)

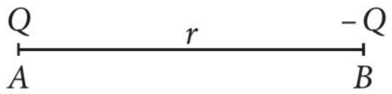
EXPLANATIONS

1. (c) : In a uniformly charged hollow conducting sphere,

   (i) For $r < R, \vec{E} = 0$

   (ii) For $r > R, \vec{E} = \frac{1}{4\pi\varepsilon_0}\frac{Q}{|\vec{r}|}\hat{r}$; $\vec{E}$ decreases

2. (c) : In case I:



$F = -\frac{1}{4\pi\varepsilon_0}\frac{Q^2}{r^2}$ $\cdots$(i) In Case II: $Q_A = Q - \frac{Q}{4}$, $Q_B = -Q + \frac{Q}{4}$

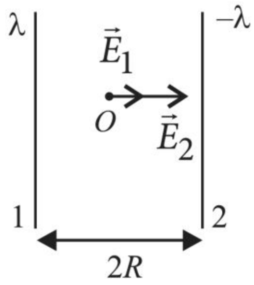
$$\therefore F' = \frac{1}{4\pi\varepsilon_0}\frac{\left(Q - \frac{Q}{4}\right)\left(-Q + \frac{Q}{4}\right)}{r^2}$$

$$= \frac{1}{4\pi\varepsilon_0}\frac{\left(\frac{3}{4}Q\right)\left(\frac{-3}{4}Q\right)}{r^2} = -\frac{1}{4\pi\varepsilon_0}\frac{9}{16}\frac{Q^2}{r^2} \quad \cdots\text{(ii)}$$

From equations (i) and (ii), $F' = \frac{9}{16}F$

3. (d): Electric field due to an infinite line charge, $E = \frac{\lambda}{2\pi\varepsilon_0 r}$ Net electric field at mid - point O,

$\vec{E} = \vec{E} + \vec{E}$



As, $E_1 = E_2 = \frac{\lambda}{2\pi\varepsilon_0 R}$ $\therefore E_0 = 2E_1 = \frac{\lambda}{\pi\varepsilon_0 R} NC^{-1}$

4. (d): Before contact, $Q_1 = \sigma \cdot 4\pi R^2$

and $Q_2 = \sigma \cdot 4\pi(2R)^2$

As, surface charge density,

$$\sigma = \frac{Net\,charge(Q)}{Surface\,area(A)}$$

Now, after contact, $Q_1^{'} + Q_2^{'} = Q_1 + Q_2 = 5Q_1 \;\; = 5\left(\sigma \cdot 4\pi R^2\right) \; \cdots$(i) They will be at equal potentials, so,

$$\frac{Q_1^{'}}{R} = \frac{Q_2^{'}}{2R} \;\Rightarrow\; Q_2^{'} = 2Q_1^{'}$$

$\therefore 3Q_1^{'} = 5\left(\sigma \cdot 4\pi R^2\right)$ (From equation (i))

and $Q_2^{'} = \frac{10}{3}\left(\sigma \cdot 4\pi R^2\right)$

$\therefore \sigma_1 = \frac{5}{3}\sigma$ and $\sigma_2 = \frac{5}{6}\sigma$.

5. (c) : As we know that, loss of electrostatic energy,

$$E_{1oss} = \frac{1}{2}\frac{C_1 C_2}{(C_1 + C_2)}V^2 = \frac{1}{2} \times \frac{C^2}{2C}V^2$$

$$= \frac{1}{2}\left(\frac{1}{2}CV^2\right) = \frac{1}{2}E \quad [\because C_1 = C_2 = C]$$

$\therefore$ Percentage of loss of energy $= \frac{\frac{1}{2}E}{E} \times 100\%$

$$= \frac{1}{2} \times 100\% = 50\%.$$