DPP-5

Solution

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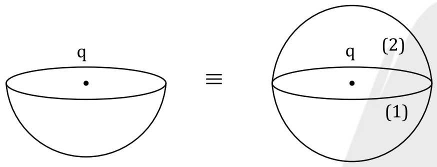
1. ϕ due to inside charge

$$\phi = \frac{q_{in}}{\varepsilon_0} = \frac{8.85 \times 10^{-8}C}{8.85 \times 10^{-12}} = 10^4$$

ϕ due to out side charge

$$\phi = \frac{q_{in}}{\varepsilon_0} = \frac{0}{\varepsilon_0} = 0$$

2.



$$\phi = \frac{q}{2\varepsilon_0}$$

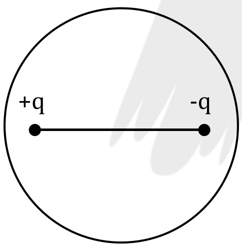
$$\phi_1 + \phi_2 = \frac{q}{\varepsilon_0}$$

$$\phi_1 = \phi_2 = \phi$$

$$2\phi = \frac{q}{\varepsilon_0}$$

$$\phi = \frac{q}{2\varepsilon_0} = \phi_1 = \phi_2$$

3.



$$\phi_{net} = \frac{q_{in}}{\varepsilon_0}$$

$$\phi_{net} = \frac{0}{\varepsilon_0}$$

$$\phi_{net} = 0$$

Option – D

4.

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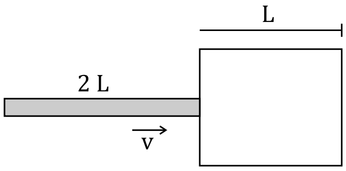
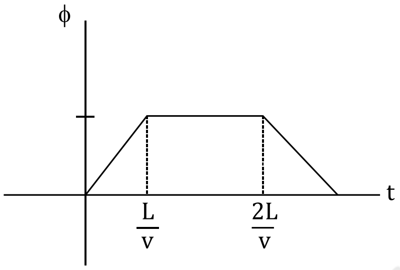


$t = 0 \qquad \phi = 0$



$t = \frac{L}{v} \qquad \phi = \frac{\lambda L}{\varepsilon_0}$

5. q inside $= q$

$\phi_{\text{cube}} = \frac{q}{\varepsilon_0}$

$\phi_{\text{one side}} = \frac{q}{6\varepsilon_0}$

6. Solid angle for both surface is same so: $\phi_1 = \phi_2$

7. $\phi = \frac{q_{in}}{\varepsilon_0}$

$q_{in} = 0$

$\phi = 0$

but Electric field not zero on the surface of sphere

8. $q_{in} = \lambda_0 x$

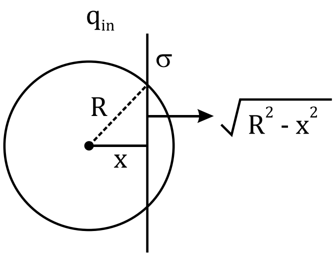
$\phi = \frac{\lambda_0 x}{\varepsilon_0}$

$\phi \propto x$

9. $\phi_{\text{total}} = \frac{Q}{2\varepsilon_0}$

ϕ_{one} face $= \frac{\phi}{8\varepsilon_0}$ [due to identical]

10. $\phi = \frac{q_{in}}{\varepsilon_0}$



$q_{in} = \sigma A$

$q_{in} = \sigma\pi(R^2 - x^2)$

$\phi = \frac{\sigma\pi(R^2 - x^2)}{\varepsilon_0}$

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11. $h = \sqrt{3}R$

$\phi_{total} = \dfrac{q}{\varepsilon_0}$

$\phi_{curve} + \text{ curcular part } = \dfrac{q}{\varepsilon_0}$

$\phi_{curve} + \dfrac{q}{2\varepsilon_0}(1 - \cos\ \theta) = \dfrac{q}{\varepsilon_0}$

$\phi_{curve} = \dfrac{q}{\varepsilon_0} - \dfrac{q}{2\varepsilon_0}\left(1 - \dfrac{\sqrt{3}R}{2R}\right)$

$\phi_{curve} = \dfrac{2}{2\varepsilon_0}\left(2 - 1 + \dfrac{\sqrt{3}}{2}\right)$

$= \dfrac{2}{2\varepsilon_0}\left(1 + \dfrac{\sqrt{3}}{2}\right)$

12. $Q \rightarrow$ outside the hemisphere

$\phi_{total} = 0$

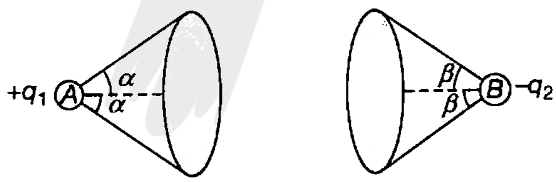
$\phi_{flat} + \phi_{curve} = 0$

$\phi_{curve} = \dfrac{Q}{2\varepsilon_0}$

13. A line can leave $+q_1$ in a cone of apex angle α and then enter $-q_2$ in a cone of apex angle β.

So, flux due to the charge $+q_1$ is $\phi_1 = \frac{q_1}{2\varepsilon_0}(1 - \cos\ \alpha)$ and that due to the charge $-q_2$ is

$\phi_2 = \dfrac{q_2}{2\varepsilon_0}(1 - \cos\beta)$.



Since, we know that only one line is leaving q_1 to enter $-q_2$. So, we can say

$\dfrac{\phi_1}{\phi_2} = \dfrac{N_1}{N_2} = 1$

$\Rightarrow \dfrac{q_1}{2\varepsilon_0}(1 - \cos\ \alpha) = \dfrac{q_2}{2\varepsilon_0}(1 - \cos\ \beta)$

$\Rightarrow q_1\left[2\sin^2\left(\dfrac{\alpha}{2}\right)\right] = q_2\left[2\sin^2\left(\dfrac{\beta}{2}\right)\right]$

$\Rightarrow \sin\left(\dfrac{\beta}{2}\right) = \sqrt{\dfrac{q_1}{q_2}}\sin\left(\dfrac{\alpha}{2}\right) \Rightarrow \beta = 2\sin^{-1}\left[\sqrt{\dfrac{q_1}{q_2}}\sin\left(\dfrac{\alpha}{2}\right)\right]$