DPP – 01

SOLUTION

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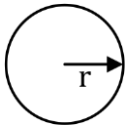
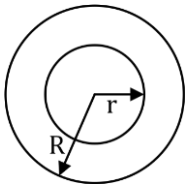
1. Let Initial radii is r



$C_1 = 4\pi\varepsilon_0 r$

When earthed by radii R



$\Rightarrow c_2 = \frac{4\pi\varepsilon_0 rR}{R-r}$

$n = 20$

$c_2 = nc_1$

$\Rightarrow \frac{4\pi\varepsilon_0 rR}{R-r} = n4\pi\varepsilon_0 r$

$\Rightarrow \frac{R}{r} = \frac{n}{n-1}$

$\frac{R}{r} = \frac{20}{20-1} = \frac{20}{19}$

2. $C = 4\pi\varepsilon_0 \left[\frac{bc}{b-c}\right]$

$\beta = 1, \alpha = 0, \gamma = 0$

$d + \beta + \gamma = 1$

3. $C = 4\pi\varepsilon_0 R = \frac{1}{18} \times 10^{-12}$ F

Rate of escape of charge from

surface $= 8 \times 10^{-9}$C/sec

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$q = (8 \times 10^{-9})t$

$q = C\,V$

$8 \times 10^{-9} \times t = \frac{1}{18} \times 10^{-12}$

$t = 6.95\ \mu S$

4. Extension in spring $= d - 0.8d = 0.2d$

Farce due to spring $= kx = k \times 0.2d$

Farce on plate $= \frac{q^2}{2\varepsilon_0 A}$

Force on plate $\frac{q^2}{2\varepsilon_0 A} = k \times 0.2d$

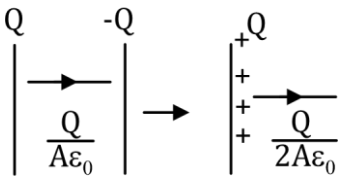
$q = C\varepsilon \Rightarrow c = \frac{A\varepsilon_0}{d}$

$\Rightarrow \frac{C^2\varepsilon^2}{2\varepsilon_0 A} = k \times 0.2d$

$k = \frac{A\varepsilon_0 E^2}{0.4d^3} = \frac{2.5\varepsilon_0 A\varepsilon^2}{d^3}$

5. $C = \frac{2\pi\varepsilon_0 l}{2.303\log_{10}\left(\frac{b}{a}\right)}$

6.



7. $\frac{1}{2}\varepsilon_0 E^2 = u$

$\frac{\text{Energy}}{\text{Volume}} = \frac{1}{2}\varepsilon_0 E^2$

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$$\Rightarrow E^2 = \frac{2u}{\varepsilon_0} = \frac{2 \times 1.8 \times 10^{-9}}{9 \times 10^{-12}}$$

$$E^2 = \frac{2 \times 1.8 \times 10^3}{9}$$

$$= 4 \times 10^2$$

$$E^2 = 400\ N^2/C^2$$

$$= 20\ N/C$$

8. Initially C_{eq} of ckt $= \frac{8\times4}{12} = \frac{8}{3}\mu F$

q_{flow} through battery $CV = \frac{8}{3} \times 15$

$q_{flow} = 40\mu C$

charge store in $4\mu F = 20\mu C$

when s is closed.

$C_{eq} = 4\mu F$

$q_{flow} = 60\mu C \rightarrow q_{flow}$ swith $= 60\mu C$

9 & 10

finally both capacitor have charge. CE.

→Net charge crossing the cell $= 2CE$

$\rightarrow w_{battery} = (2CE)E = 2CE^2$

Store energy in capacitor $= \frac{1}{2}CE^2 + \frac{1}{2}CE^2$

$= CE^2$

Heat produced $= W - V = CE^2$