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Section: 16

Assignment: 4

Sub :

Day

Time : Date : / /

Ans to the Q : N: 1

(a)

Given that,

$$\vec{E} = 43\times10^5 \hat{k} \ N/C$$

$$\vec{B} = -2900.0 \hat{j} \ T$$

If the proton is not reflected, then electric force on the proton = magnetic force of proton.

$$|F_{el}| = |F_m|$$

$$\Rightarrow e.E = e.v.B$$

$$\Rightarrow E = v.B$$

$$\Rightarrow v = \frac{E}{B} = \frac{43\times10^5}{2900.0} = 1482.758 \ m/s$$

Sub :

(b)

We know,

$s = vt$

$\therefore \; t = \frac{s}{v}$

$= \frac{4.2}{1482.758}$

$= 2.8326 \times 10^{-6}$ s

(c)

After the speed becomes twice,

$v_2 = 2 \times v$

$= (2 \times 1482.758)$ m/s

$= 2965.516$ m/s

Electric force on proton,

$\vec{F}_P = 1.6 \times 10^{-19} \times 43 \times 10^{5} \hat{k}$

$= 6.88 \times 10^{-13} \hat{k}$ N

Sub :

Magnetic force on the proton,

$$\vec{F}_m = e \cdot \vec{v} \times \vec{B}$$

$$= 1.6 \times 10^{-19} \cdot (2965.516 \hat{i} \times -2900 \hat{j})$$

$$= -1.375 \times 10^{-12} k$$

$$\begin{pmatrix} \hat{i} & \hat{j} & \hat{k} \\ 2965.516 & 0 & 0 \\ 0 & -2900 & 0 \end{pmatrix} = -8599996.5 \hat{k}$$

$$\therefore F_{net} = \vec{F}_p + \vec{F}_m$$

$$= 6.88 \times 10^{-13} - 1.375 \times 10^{-12}$$

$$= -6.879 \times 10^{-13}$$

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Ans to the Q: N: 2

(a)

Here, R_9 and R_7 are in parallel connection.

$$\therefore \frac{1}{R_{79}} = \frac{R_7 + R_9}{R_7 R_9}$$

$$\therefore R_{79} = \frac{R_7 . R_9}{R_7 + R_9} = \frac{2.2 \times 22}{(2.2 + 22)} k\Omega$$

$$= 2 k\Omega$$

R_{79} and R_8 are in series connection.

$$\therefore R_{798} = R_{79} + R_8$$

$$= (2 + 3.3) k\Omega$$

$$= 5.3 k\Omega$$

Sub :

R_5 and R_6 are in series connection.

$$\therefore R_{56} = R_5 + R_6$$

$$= (33+33)\,k\Omega$$

$$= 66\,k\Omega$$

R_{789} and R_{56} are in parallel connection.

$$\therefore R_{bk} = \frac{R_{789} \cdot R_{56}}{R_{789} + R_{56}}$$

$$= \frac{5.3 \times 66}{5.3 + 66}$$

$$= 4.906\,k\Omega$$

$$= 4906.03\,\Omega$$

Sub :

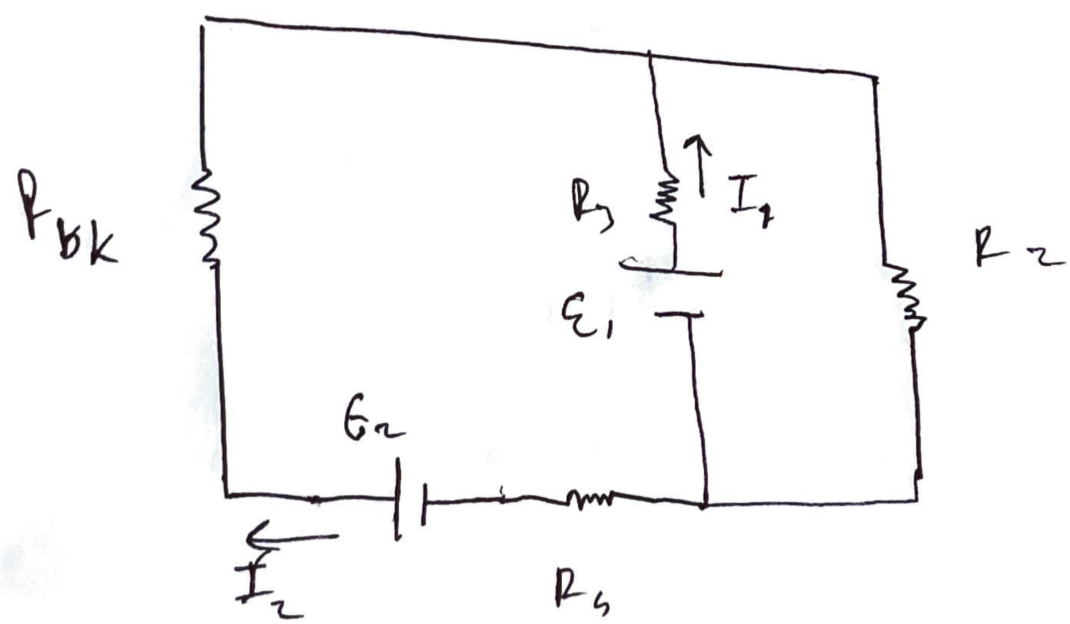
(b)

Here, the points g and p are shorted

So, no electricity will flow in R_1

$\therefore I_{R_1} = 0 A$

(c)



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Here, we have two currents for ~~ϵ~~

ϵ_2 and ϵ_1.

By using kirchoff's law,

$I_2 R_{bk} + I_2 R_3 + I_2 R_4 - I_1 R_3 = \epsilon_2 - \epsilon_1$

$\Rightarrow I_2 (R_{bk} + R_3 + R_4) - I_1 R_3 = \epsilon_2 - \epsilon_1$

$\Rightarrow I_2 (4.906 + 33 + 22) - 33 I_1 = 4 - 4$

$\Rightarrow 59.906 I_2 - 33 I_1 = 0$

$$\Rightarrow I_2 = \frac{33 I_1}{59.906}$$

$\Rightarrow I_2 = 0.55 I_1$ ......(i)

Again, for battery 1,

$$I_1 R_3 + I_1 R_2 - I_2 R_3 = \mathcal{E}_1$$

$$\Rightarrow I_1 (R_3 + R_2) - I_2 R_3 = \mathcal{E}_1$$

$$\Rightarrow I_1 (33 + 1.1) - 33 I_2 = 4$$

$$\Rightarrow 34.1 I_1 - 33 I_2 = 4$$

$$\Rightarrow 34.1 I_1 - 33 (0.55 I_1) = 4$$

$$\Rightarrow 34.1 I_1 - 18.15 I_1 = 4$$

$$\Rightarrow 15.95 I_1 = 4$$

$$\Rightarrow I_1 = 0.25 \text{ mA}$$

$$= 0.25 \times 10^{-3} \text{ A}$$

$$\therefore I_2 = (0.55 \times 0.25 \times 10^{-3}) \text{ A}$$

$$= 1.375 \times 10^{-5} \text{ A} \quad \text{(Ans)}$$

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(d)

Power distributed throug R_2,

$P_2 = I_1^2 R_2$

$= (0.25 \times 10^{-3})^2 \times 1.1 \times 10^{-3}$

$= 6.875 \times 10^{-5}$ (Ans)

(e)

Here, I_1 passes through the oc terminal and throug R_2.

$\therefore$ Potential differencey $= I_1 R_2$

$= 0.25 \times 10^{-3} \times 1.1 \times 10^{-3}$

$= 0.275$ V

(Ans)

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Ans to the Q : N : 3

(a)

We know,

$$C_{eff} = C_{fuel} + C_{air}$$

$$\Rightarrow \frac{k_{eff} \cdot \epsilon_0 A}{d} = \frac{k_{fuel} \cdot \epsilon_0 A_{fuel}}{d} + \frac{k_{air} \cdot \epsilon_0 \cdot A_{air}}{d}$$

$$\Rightarrow k_{eff} (L w) = k_{fuel} \cdot (hw) + k_{air} (L-h) w$$

$$\Rightarrow k_{eff} = \frac{k_{fuel} \cdot h + k_{air}(L-h)}{L}$$

$$= \frac{7 \times 7 \times 10^{-2} + 1 \cdot (12 - 7) \times 10^{-2}}{12 \times 10^{-2}}$$

$$= 4.5 \quad \text{(Ans)}$$

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(b)

Energy stored in the tank,

$$U = \frac{1}{2} C V^2$$

$$= \frac{1}{2} \times \frac{k_{fuel} \cdot \epsilon_0 \cdot w \cdot l}{d} \cdot V^2$$

$$= \frac{1}{2} \times \frac{7 \times 8.855 \times 10^{-12} \times 19 \times 10^{-2} \times 12 \times 10^{-2}}{18 \times 10^{-2}} \times 20^2$$

$$= 1.5701 \times 10^{-9} \text{ J}$$

(Ans)

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(c)

0.75 fraction of the tank is filled.

$$\therefore L = (0.75 \times 12 \times 10^{-2})\ m$$

$$= 0.09\ m$$

$$C_1 = \frac{k_1 \cdot w \cdot L \cdot \epsilon_0}{d}$$

$$= \frac{7 \cdot (19 \times 10^{-2}) \cdot 0.09 \times 8.854 \times 10^{-12}}{18 \times 10^{-2}}$$

$$= 5.88\ 79 \times 10^{-12}\ F$$

$$C_2 = \frac{1 \cdot (19 \times 10^{-2})(0.12 - 0.09) \times 8.855 \times 10^{-12}}{18 \times 10^{-2}}$$

$$= 2.803 \times 10^{-13}\ F$$

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$$C_F = C_1 + C_2$$

$$= 6.168 \times 10^{-12} F$$ (Ans)

(d)

$$C = \frac{K \epsilon_0 w L}{d}$$

$$= \frac{7 \times 8.854 \times 0.17 \times 0.12}{0.18} F$$

$$= 7.85 \times 10^{-12} F$$

(Ans)