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PH 222-2A

Note :- Answering easy questions first!

Question 2

Ans. $emf = -\frac{d\phi}{dt}$

$= -NB.(0.12) \times \frac{dl}{dt}$

$= -2.85 \times 0.12 \times 0.772 \times 7$

$= -0.26334\ V \times 7$

$= -1.84338\ V$

$|emf| = 1.84338\ V$

Current induced $= \frac{|emf|}{\text{Resistance}}$

$= \frac{1.84338}{46.67}$

$= 0.03949\ A$

$= 39.49\ mA$

Question 3

Ans:- Current coming from a to e will equally distribute to both resistance branches of and gh.

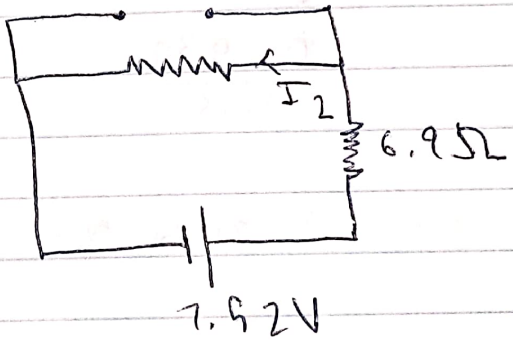
Hence, current in $ef = \frac{I}{2}$

$= \frac{1.799}{2}$

$I_{ef} = 0.8995$ amp

Question 4

Ans:- At the moment when the switch is closed, the inductor acts as an open circuit.



$I_2 = \frac{7.52}{2.23+6.9}$ A

$= 0.824$ A

Question 5

Ans:- (a) From law of Reflection,

Incident angle = Reflected angle

$$\theta_i = \theta_R$$

$$70^\circ = \theta_R$$

$$\therefore \theta_R = 70^\circ$$

(b) From Snell's law:-

$$n_1 \sin\theta_i = n_2 \sin\theta_R$$

$$1 \cdot \sin 70^\circ = 1.33 \sin\theta_R$$

$$\frac{0.939}{1.33} = \sin\theta_R$$

$$0.706\,5 = \sin\theta_R$$

$$\theta_R = \sin^{-1}(0.7065)$$

$$\theta_R = 44.953$$

$$\theta_R \simeq 45^\circ$$

$\therefore$ Angles of reflection and refraction are 70° & 45°.

Question 6

Ans:- $R = 20$ cm

$v = -30$ cm (∵ negative since image forms in front of the mirror),

$u = ?$,

We know that focal length $f = \frac{\text{radius } R}{2}$

$= \frac{20}{2}$

$= -10$ cm

[∵ negative, since the focal length of a concave mirror is negative].

$\therefore f = -10$ cm

By lens equation, we have:-

$$\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$$

$$\Rightarrow \frac{1}{u} = \frac{1}{f} - \frac{1}{v}$$

$$= \frac{-1}{10} + \frac{1}{30}$$

$$= \frac{-30+10}{300} = \frac{-20}{300}$$

$\therefore \frac{1}{u} = -\frac{1}{15}$

$u = -15\ cm$ ∴ Again, negative since object will be 15 cm in front of the mirror

Answer :- (a)

Question 1

Ans:- Given :- $R_1 = 1.82\ \mu m$

$R_2 = 21.75\ \mu m$

$R_3 = 47.55\ \mu m$

$\alpha = 7.91$

Net charge $= -9.25\ \mu C$

Charge at $4.25\ \mu m$ sphere $= Q = \alpha r$

$= 7.91 \times 4.25$

$= 33.6175\ \mu C$

And, $\int \vec{E} \cdot \vec{ds} = \frac{Q}{\epsilon_0}$

$$E \times 4\pi r^2 = \frac{Q}{\varepsilon_0}$$

$$E = \frac{Q}{\varepsilon_0} \times \frac{1}{4\pi r^2}$$

$$= \frac{33.6175 \times 10^{-6}}{8.85 \times 10^{-12} \times 4\pi \times (4.25 \times 10^{-6})^2}$$

$$= \frac{33.6175 \times 10^{-6}}{8.85 \times 10^{-12} \times 4 \times 3.142 \times 18.0625 \times 10^{-12}}$$

$$= \frac{33.6175 \times 10^{-6}}{2009.034 \times 10^{-24}}$$

$$= 0.0167 \times 10^{18}$$

$$= 1.67 \times 10^{16} \text{ N/C}$$

$$\therefore E = 1.67 \times 10^{16} \text{ N/C}$$