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15/ENG04/051

EEE 552
Assignment

(a) (i) From $E = \pi \times L = \frac{I}{r^2}$

$E = \pi L$ which means $L = E/\pi$

Considering reflection factor:

$L = \frac{E}{\pi} \times$ reflection factor

$\therefore L = \frac{44,000}{\pi} \times \frac{85}{100} = 11.905 \times 10^3$ cd/m^2

(ii) $L = \frac{0.22}{\pi} \times \frac{85}{100} = 59.52 \times 10^{-3}$ cd/m^2

(b) (i) flux emitted by the source

$\phi = IW = 120 \times 4\pi$ lumen

flux emitted by globe (30% is absorbed)

$120 \times 4\pi \times \frac{30}{100} = 144\pi$

$\therefore$ flux emitted by globe $= 120 \times 4\pi - 144\pi = 336\pi$ lumen

Luminance $= \frac{\text{flux emitted}}{A} = \frac{336\pi}{\pi \times 0.22^2} = 6942.1$ nt/m^2

(ii) Candle power (P) $= \frac{\text{lumen}}{\omega} = \frac{336\pi}{4\pi} = 84$ cd

C. $A = 75 \times 10^{-4}$ m^2 $= 75$ cm^2

$t = 2 \times 10^{-2}$ m $= 2$ cm

Heat required $= mCA\theta$

Density $= \frac{\text{mass}}{\text{volume}}$, $m = 0.55$ g/cm^3 $\times (75 \times 2)$ cm^3

$= 82.5$ g

$C = \frac{\varepsilon_0 \varepsilon_r A}{t} = \frac{8.85 \times 10^{-12} \times 6.5 \times 75 \times 10^{-4}}{2 \times 10^{-2}} = 21.57 \times 10^{-12}$ F

$W = 2\pi F = 2\pi \times 20 \times 10^6 = 125.664 \times 10^6$ rad/s

P.F $= \cos\phi = 0.04$ ($\theta = \cos^{-1}(0.04)$)

$\phi = 87.7$

$\delta = 90 - \phi = 90 - 87.7 = 2.3^\circ$

Heat required = $mc\Delta\theta$

$= 82.5 \times 0.255 \times (80 - 30)$

$= 1051.88\ cal$

Total heat required $= 1051.88 \times \frac{85}{100} = 894.098\ cal$

Recall, $1\ cal = 4.186\ (w \cdot s)$

$894.098 = x$

Power input $= 894.098 \times 4.186 = 3742.7\ (w \cdot s)$

$P = \frac{Energy}{time} = \frac{3742.7}{8 \times 60} = 7.797W$

$P_2 = V^2 w C \tan\delta$

$7.797 = V^2 \times 125.664 \times 10^6 \times 21.57 \times 10^{-12} \times \tan(2.3^\circ)$

$\frac{7.797}{1.08868 \times 10^{-4}} = V^2$

$\therefore V = \sqrt{\frac{7.797}{1.08868 \times 10^{-4}}}$

$V = 267.62V$

Recall, $P = IV\cos\phi$

$\therefore I = \frac{7.797}{267.62 \times 0.04} = 0.7284A$

$I = 0.7284A$