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15/ENG04/025.
EEE 552.

Calculate brightness

(a) (i) under illumination of 44 000 lux.

recall,

$$E = \pi L = \frac{I}{r^2}$$

$$\therefore L = \frac{E}{\pi}$$

Since reflection factor is given.

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

$$L = \frac{44\,000 \times 7}{22} \times \frac{85}{100} = 11\,900 \text{ cd/m}^2$$

(a) (ii) under 0.22 lux

$$L = \frac{0.22 \times 7}{22} \times \frac{85}{100} = 0.0595 \text{ cd/m}^2$$

(b) (i) luminance of globe.

recall,

flux emitted $\phi = I \times w$

$$\phi = 120 \times \frac{4 \times 22}{7} \text{ lumen} = \frac{10560}{7} \text{ lumen.}$$

30% of the flux is absorbed.

$$\frac{10560}{7} \times \frac{30}{100} = \frac{3168}{7}$$

$$\therefore \text{Flux emitted by globe} = \frac{10560}{7} - \frac{3168}{7} = 1056 \text{ lumen}$$

$$\text{luminance} = \frac{\text{flux emitted}}{\text{area}} = \frac{1056 \times 7}{22 \times 0.22^2} = 6942.1 \text{ lumen/m}$$

(i) candle power in any direction.

$CP = \frac{\text{lumen}}{\omega} = \frac{1056}{4\times22} \times 7 = 84$ Candela.

(c) Area of insulating slab = $75\ cm^2 = 75\times10^{-4}\ m^2$

thickness " " " = $2cm = 2\times10^{-2}\ m$.

heat required to raise it from one temp to another - $mc\Delta\theta$ -

Density = $\frac{m}{V}$ -

$m = 0.55g \times (75\times2)$

$m = 82.5g$.

$C = \frac{\varepsilon_0\varepsilon_r A}{t} = \frac{8.85\times10^{-12}\times6.5\times75\times10^{-4}}{2\times10^{-2}} = 21.57\times10^{-12}\ F$.

$w = 2\pi f = 2\times\pi\times20\times10^6 = 125.664\times10^6\ rad/s$.

Power factor = $\cos\phi = 0.04$.

$\phi = \cos^{-1}0.04$

$\phi = 87.7$

$\delta = 90 - \phi = 90 - 87.2 = 2.3$.

heat required = $mC\Delta\theta$.

$= 825\times0.255\times(80-30)$.

$= 1051.88$ cal.

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

since 1 cal = 4.186 J.

Power input = $894.098\times4.186 = 3742.7$ J.

Power = $\frac{\text{energy}}{\text{time}} = \frac{3742.7}{8\times6} = 7.797$ W.

$$P_d = V^2 \omega C \tan\delta.$$

$$V = \sqrt{\frac{P_d}{\omega C \tan\delta}}$$

$$= \sqrt{\frac{7.797}{125.664 \times 10^6 \times 21.57 \times 10^{-12} \times \tan 2.3}}$$

$$V = 267.62\ V.$$

Sini $P = IV\cos\phi.$

$$I = \frac{7.797}{267.62 \times 0.07}$$

$$I = 0.7284\ A$$