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16/ENG04/066
EEE 552

a $E = \pi L = I/r$

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

reflection factor = 85%

i for 44,000 lux

$L = \frac{44,000}{\pi} \times 0.85 = 11,904.79 \text{ cd/m}^2$

$L = 1.19 \times 10^4 \text{ cd/m}^2$

ii for 0.22 lux

$L = \frac{0.22}{\pi} \times 0.85 = 0.059524 \text{ cd/m}^2$

$L = 59.524 \times 10^{-3} \text{ cd/m}^2$

b luminous intensity = 120 cp

Total flux emitted = $I \times w$

$= 120 \times 4\pi = 1507.9644$ lumen

flux absorbed by globe after 30% absorption.

$1507.9644 \times 0.3 = 452.3893$ Lumen

flux emitted by globe = Total flux − absorbed flux.

$= 1507.9644 - 452.3893$

$= 1,055.5751$ Lumen

bi Luminance = $\frac{\text{flux emitted}}{\text{Area}} = \frac{1,055.5751}{\pi \times 0.22^2}$

$= 6942.15 \text{ lm/m}^2$

ii candle power, cp = $\frac{\text{flux emitted}}{w} = \frac{1,055.5751}{4\pi}$

$= 84 \text{ cd}$

c $A = 75 \text{cm}^2$, $t = 2\text{cm}$, $c = 0.255 \text{ cal/g°c}$, $\rho = 0.55 \text{ g/cm}^3$, $t = 8 \text{ mins}$

heat required = $mc\Delta\theta$

$\rho = \frac{m}{V}$, $m = 0.55 \times 75 \times 2$

$m = 82.5 \text{g}$

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

$f = 20 MHz$

$\omega = 2\pi f = 2 \times \pi \times 20,000,000 = 125.664 \times 10^6$ rad/s

power factor $= \cos\phi = 0.04$

$\phi = \cos^{-1} 0.04 = 87.7^\circ$

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

heat required $= mc\Delta\theta = 82.5 \times 0.255 \times (80 - 30)$

$= 1051.88$ cal

15% of heat is wasted on the slab so

TOTAL heat $= 1051.88 \times 0.85 = 894.098$ cal

1 cal $= 4.186$ (w-s) J

894.098 cal $= 894.098 \times 4.186$

power input $= 3742.7$ (W-S)

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

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

$V^2 = \frac{P_d}{\omega C \tan\delta}$

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

$\sqrt{V^2} = 267.62 V$

$P = IV\cos\phi$

$I = \frac{P}{V\cos\phi} = \frac{7.797}{267.62 \times 0.04}$

$I = 0.7284 A$