SANI JOHNPAUL
15/ENG04/055
EEE552

a: From $E = \pi L = I/r^2$

$E = \pi L \therefore L = E/\pi$

Considering reflection factor

$L = E/\pi \times$ reflection factor

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

or

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

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

(b:) Flux emmited by source

$\phi = 7 \times 10 = 120 \times 4\pi$ lumen

Flux emmited by globe (30% is absorbed)

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

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

$$\text{luminance} = \frac{\text{flux emmited}}{\text{area}} = \frac{336\pi}{\pi \times 0.22^2} = 6944.21 \text{ m/m}^2$$

(ii) Candle power $cp = \frac{\text{lumen}}{10} = \frac{336\pi}{4\pi} = 8.4 \text{ cd}$

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

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

heat required $= mc\Delta\theta$

Density $= \frac{m}{V}$ $\quad m = \frac{0.55\ g}{cm^3} \times (75 \times 2)\ cm^3$

$= 82.5\ g$

$C = \frac{\theta_0 \varepsilon_r A}{\theta} = \frac{8.85 \times 10^{-12} \times 6.5 \times 75 \times 10^{-4}}{2 \times 10^{-12}} = 21.57 \times 10^{-12}\ f$

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

P.f $= \cos\phi = 0.04$

$\phi = 87.7$

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

heat required $= mc\Delta\theta$

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

$= 1051.88\ Cal.$

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

$1\ cal = 4.186\ (w.s)]$

$894.098 = x$

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

$P = \frac{Energy}{Time} = \frac{3742.7}{8 \times 60} = 7.7970$

$P_0 = V^2\ \omega c \tan\delta, \quad 7.797 = V^2 \times 125.664 \times 10^6 \times 21.57 \times 10^{-12} \times \tan 2.3$

$\frac{7.797}{1.08868 \times 10^{-4}} = V^2, \quad V = 267.62V$

$P = IV\cos\theta, \quad I = \frac{7.797}{267.62 \times 0.04} = 0.7284A$