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15/ENG04/054

Question

(a) i. $E = \pi L$

$L = E/\pi$

Assuming Snow has a reflectance factor of 85% as a perfect diffusor

for 44,000 Lux

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

$= \frac{44,000}{\pi} \times 85\%$

$= 11.905 \times 10^5 \ cd/m^2$

ii. for 0.22 Lux

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

$= \frac{0.22}{\pi} \times 85/100$

$= 59.52 \times 10^{-3} \ cd/m^2$

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(b) flux emitted = luminous intensity × solid angle

$\phi = I \times w$

$I = 120\ cp$

$w = 4\pi$

$\phi = 120 \times 4\pi$

$= 1507.96$ lumen

30% is absorbed from the flux emitted by globe

$1507.96 \times 30/100$

$= 452.39$

∴ flux emitted by the globe $= 1507.96 - 452.39$

$= 1055.57$ //

Luminance $=$ flux emitted / Area $= 1055.57 / \pi \times 0.22^2$

$= 6942.12\ lm/m^2$ //

(i) Candle power (CP) $=$ lumen / solid angle (w)

$= 1055.57 / 4\pi = 88.9959\ cd$

$= 84\ cd$ //

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(c) Area = $75\ cm^2 = 75 \times 10^{-4}\ m^2$

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

Density = $0.55\ g/cm^3$

Density = $\frac{Mass}{Volume}$

Mass = Volume × Density

$= (75 \times 2) \times 0.55 = cm^3 \times g/cm^3$

$= 82.5\ g$

$C = \frac{\varepsilon_0 \varepsilon_r A}{t}$

ε_r = relative permittivity = 6.5

ε_0 = air permittivity = 8.85×10^{-12}

C = ?

$C = \frac{8.85 \times 10^{-12} \times 6.5 \times 75 \times 10^{-4}}{2 \times 10^{-2}}$

$= 21.57 \times 10^{-2}\ F$

$\omega = 2\pi f = 2 \times \pi \times 20\ MHz$

$= 2 \times \pi \times 20 \times 10^6$

$= 125.66 \times 10^6\ rad/s$

heat required = $Mc\Delta\theta = Mc(\theta_2 - \theta_1)$

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

$= 1051.88\ Cal$

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Total heat required (100 - 18 = 85%)

$$\frac{10.51.88 \times 85}{100}$$

$$= 894.098 \text{ Cal}$$

1 cal = 4.186

Power input $= \frac{894.098 \times 4.186}{}$

$= 3742.7 \text{ (w.s)}$

$P_0 = \frac{\text{Energy}}{\text{time}} = \frac{3742.7}{8 \times 60} = 7.797 \text{w}$

$P_0 = V^2 \omega C \tan \delta$

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$R_f = \cos\theta = 0.64$

$\theta = 87.7$

$\delta = 90 - \theta = 90 - 87.5$

$= 2.3$

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

$V_2 = 267.620$

$P = IV \cos\theta$

$I = \frac{7.797}{267.62 \times 0.64} = 0.7284 \text{ A}$

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