704.

Problem 49.7 (RHK)

We have to show (a) *that a human body of area* 1.80 m^2, *emissivity* $\varepsilon = 1.0$, *and temperature* $34^0\mathrm{C}$ *emits radiation at the rate of* 910 W. (b) *We have to answer why people do not glow in the dark.*

Solution:

(a)

We will use the Stefan-Boltzmann law for answering the first part of the problem. It states that energy emitted by a body, which is at temperature *T*, per unit area per unit time of emissivity ε is given by

$I = \varepsilon\sigma T^4$,

$\sigma = 5.67 \times 10^{-8}\ \mathrm{W\ m^{-2}\ K^{-4}}$.

As the surface area of a human body is assumed to be 1.80 m^2 and the temperature of the skin is assumed to be

$T = (273 + 34)\ \mathrm{K} = 307\ \mathrm{K}$,

and emissivity $\varepsilon = 1.0$, the rate at which emission of radiation is taking place will be

$$\mathsf{E} = 5.670 \times 10^{-8} \times 1.8 \times (307)^4 \text{ W}$$

$$= 906.6 \text{ W}.$$

(b)

The wavelength $\lambda_{\max}$ at which Planck's spectral radiation has its maximum for $T = 307$ K will be

$$\lambda_{\max} = \frac{2898}{307} \ \mu\text{m} = 9.44 \ \mu\text{m}.$$

The radiation emitted by a human body is therefore in infrared part of the electromagnetic spectrum, and so the people do not 'glow'.