

5. If f is the frequency and λ is the wavelength of an electromagnetic wave, then $f\lambda = c$. The frequency is the same as the frequency of oscillation of the current in the LC circuit of the generator. That is, $f = 1/2\pi\sqrt{LC}$, where C is the capacitance and L is the inductance. Thus

$$\frac{\lambda}{2\pi\sqrt{LC}} = c.$$

The solution for L is

$$L = \frac{\lambda^2}{4\pi^2 C c^2} = \frac{(550 \times 10^{-9} \text{ m})^2}{4\pi^2 (17 \times 10^{-12} \text{ F})(2.998 \times 10^8 \text{ m/s})^2} = 5.00 \times 10^{-21} \text{ H}.$$

This is exceedingly small.

21. Since the surface is perfectly absorbing, the radiation pressure is given by $p_r = I/c$, where I is the intensity. Since the bulb radiates uniformly in all directions, the intensity a distance r from it is given by $I = P/4\pi r^2$, where P is the power of the bulb. Thus

$$p_r = \frac{P}{4\pi r^2 c} = \frac{500 \text{ W}}{4\pi (1.5 \text{ m})^2 (2.998 \times 10^8 \text{ m/s})} = 5.9 \times 10^{-8} \text{ Pa}.$$

24. We require $F_{\text{grav}} = F_r$ or

$$G \frac{mM_s}{d_{es}^2} = \frac{2IA}{c},$$

and solve for the area A :

$$\begin{aligned} A &= \frac{cGmM_s}{2Id_{es}^2} = \frac{(6.67 \times 10^{-11} \text{ N} \cdot \text{m}^2 / \text{kg}^2)(1500 \text{ kg})(1.99 \times 10^{30} \text{ kg})(2.998 \times 10^8 \text{ m/s})}{2(1.40 \times 10^3 \text{ W/m}^2)(1.50 \times 10^{11} \text{ m})^2} \\ &= 9.5 \times 10^5 \text{ m}^2 = 0.95 \text{ km}^2. \end{aligned}$$