

551.

Problem 41.5 (RHK)

We have to find the inductance required with a 17-pF capacitor in order to construct an oscillator capable of generating 550-nm (i.e. visible) electromagnetic waves. We have to comment on our answer.

Solution:

In an LC-oscillator frequency, ν , generated is determined by the inductance, L , and the capacitance, C , by the relation

$$2\pi\nu = \sqrt{\frac{1}{LC}}.$$

Also, frequency, ν , and the wavelength, λ , are related to each other by the speed of light, c , as

$$\nu = \frac{c}{\lambda}.$$

We therefore have the relation

$$L = \frac{1}{4\pi^2\nu^2C} = \frac{\lambda^2}{4\pi^2c^2C}.$$

The oscillator is to generate waves of wavelength $\lambda = 550 \text{ nm} = 550 \times 10^{-9} \text{ m}$ with a capacitor of capacitance, $C = 17 \text{ pF} = 17 \times 10^{-12} \text{ F}$; therefore, the inductance required will be

$$L = \frac{(550 \times 10^{-9})^2}{4\pi^2 \times (3 \times 10^8)^2 \times 17 \times 10^{-12}} \text{ H} = 5.0 \times 10^{-21} \text{ H}.$$

It is an extremely small inductance. Therefore, generation of visible radiation as an output of an LC-oscillator is impractical.

