Ch. 15 Prob 33

$V_0 = 100\ V$ $\quad V_{rms} = \frac{100V}{\sqrt{2}} = 70.7\ V$

$f = 500\ Hz$ $\quad \omega = 2\pi f = 2\pi(500) = 1000\pi\ \frac{r}{s}$

$R = 500\ \Omega$ $\quad L = 0.20\ H$

Find the power dissipated in the resistor.

a) For $C = 2.0\ \mu F$

$$X_L = \omega L = (1000\pi)(0.20) = 628\ \Omega$$

$$X_C = \frac{1}{\omega C} = \frac{1}{(2\times10^{-6})(1000\pi)} = 159\ \Omega$$

$$Z = \sqrt{R^2 + (X_L - X_C)^2} = \sqrt{(500)^2 + (628-159)^2} = 686\ \Omega$$

$$I_{rms} = \frac{V_{rms}}{Z} = \frac{70.7\ V}{686\ \Omega} = 0.103\ A$$

$$V_R = I_{rms} \cdot R = (0.103A)(500\ \Omega) = 51.5\ V$$

No phase shift in resistor $\longrightarrow$ $P_R = I_{rms} \cdot V_{rms} = (0.103A)(51.5V)$

$$\boxed{P_R = 5.31\ W}$$ $\longleftarrow$ Textbook solution incorrect.

Look at the source

phase shift between V + I $\quad \phi = \tan^{-1}\left(\frac{X_L - X_C}{R}\right) = \tan^{-1}\left(\frac{628-159}{500}\right) = 0.75\ rad$

$$P_{source} = I_{rms} V_{rms} \cos\phi = (0.103A)(70.7V)\cos(0.75\ rad)$$

$$\boxed{P_{source} = 5.32\ W}$$

Notice the power by the source equals power used by the resistor.

Ch 15. Prob. 33

b) For $C = 0.20\,\mu F$

$$X_L = \omega L = (1000\pi)(0.20) = 628\,\Omega$$

$$X_C = \frac{1}{\omega C} = \frac{1}{(1000\pi)(2\times10^{-7})} = 1592\,\Omega$$

$$Z = \sqrt{R^2 + (X_L - X_C)^2} = \sqrt{(500)^2 + (628-1592)^2} = 1086\,\Omega$$

$$I_{rms} = \frac{V_{rms}}{Z} = \frac{70.7\,V}{1086\,\Omega} = 0.0651\,A$$

$$V_R = I_{rms} \cdot R = (0.0651\,A)(500\,\Omega) = 32.6\,V$$

$$P_R = I_{rms} \cdot V_{rms} = (0.0651\,A)(32.6\,V)$$

$$\boxed{P_R = 2.12\,W}$$ ← Textbook answer incorrect