

A coil has a resistance of 10Ω and an inductance of 0.4 henry. It is connected to an AC source of 6.5 V , $\frac{30}{\pi} \text{ Hz}$. Find the average power consumed in the circuit.

Given, $R = 10 \Omega$, $L = 0.4 \text{ H}$

For given AC source $V_{\text{rms}} = 6.5 \text{ V}$, $\omega = \frac{30}{\pi} \text{ Hz}$

$$\therefore \text{Inductive reactance } X_L = \omega L$$

$$= (2\pi\nu)L$$

$$= (2\pi) \left(\frac{30}{\pi} \right) (0.4)$$

$$\Rightarrow X_L = 24 \Omega$$

$$\therefore Z = \sqrt{R^2 + X_L^2}$$

$$= \sqrt{100 + 576}$$

$$= \sqrt{676}$$

$$\boxed{Z = 26 \Omega}$$

$$\begin{aligned} \therefore P_{\text{average}} &= (E_{\text{rms}})(I_{\text{rms}}) \cos \phi \\ &= (E_{\text{rms}}) \left(\frac{E_{\text{rms}}}{Z} \right) \left(\frac{R}{Z} \right) \quad \left(\because \cos \phi = \frac{R}{Z} \right) \end{aligned}$$

$$= \frac{(E_{\text{rms}})^2 R}{Z^2}$$

$$= \frac{(6.5)^2 (10)}{676}$$

676

$P_{\text{average}} = 5 \text{ W}$
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