Instantaneous Power

Instantaneous power (in watts) : the power at any instant of time

$$p(t) = v(t) \times i(t)$$

Where:

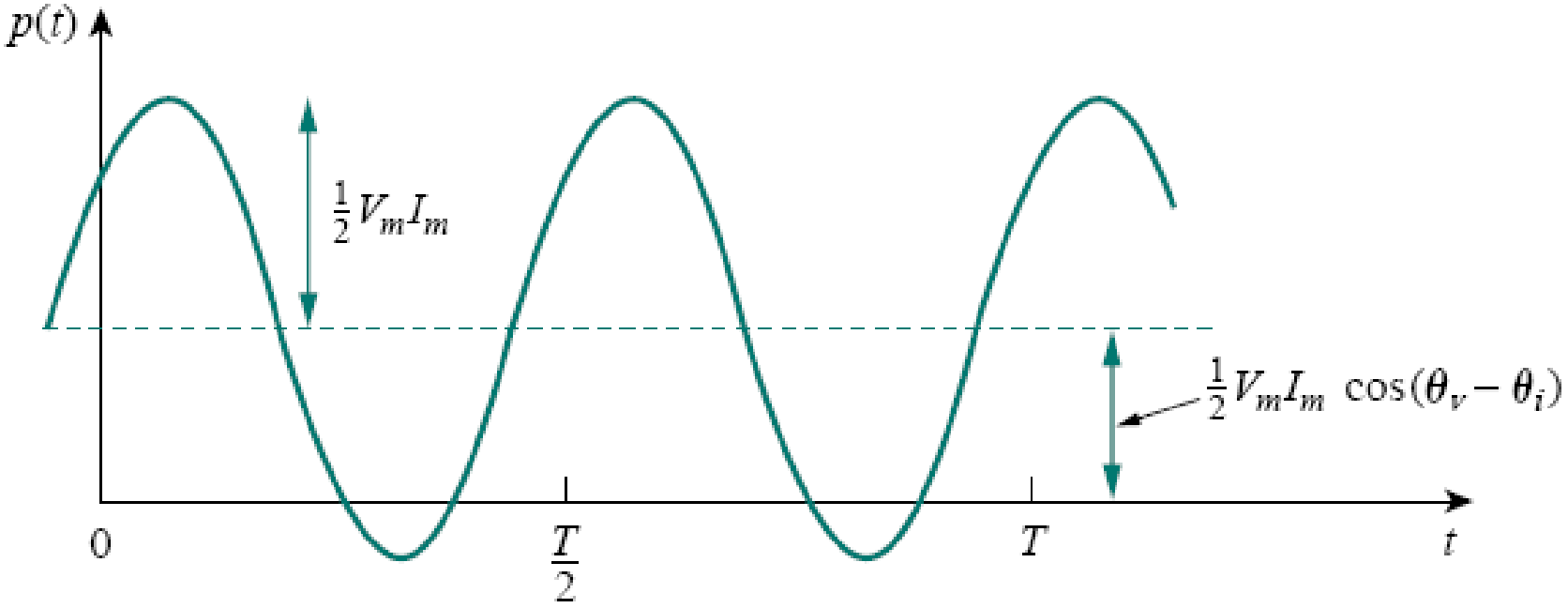
$$v(t) = V_m \cos(\omega t + \theta_v)$$

$$i(t) = I_m \cos(\omega t + \theta_i)$$

$$p(t) = \frac{V_m I_m}{2} \left\{ \cos(\theta_v - \theta_i) + \cos(2\omega t + \theta_v + \theta_i) \right\}$$

Instantaneous Power

The instantaneous power p(t) entering a circuit



Average Power

Average Power (in watts) : the average of the instantaneous power over one period

$$P = \frac{V_m I_m}{2} \cos(\theta_v - \theta_i)$$

$$P = \frac{V_m I_m}{2} \cos\theta$$

Where: $\theta = \theta_v - \theta_i$



Average Power

$$P = V_{eff} I_{eff} \cos\theta$$

$$V_{rms} \text{ or } V_{eff} = \frac{V_m}{\sqrt{2}} \qquad I_{rms} \text{ or } I_{eff} = \frac{I_m}{\sqrt{2}}$$

Circuit Elements

(a) Resistors:

In purely resistive circuit, v and i are in phase. $\theta v = \theta i$. Therefore $\theta = 0$.

$$P = \frac{V_m I_m}{2}\cos 0^0 = \frac{V_m I_m}{2} = V_{eff} I_{eff} = \frac{V_{eff}^{\ 2}}{R} = \left(I_{eff}\right)^2 R$$

The average power is only dissipated in a purely resistive circuit. For a purely inductive and capacitive, the average power is zero.

Circuit Elements

(b) Inductors:

In purely inductive circuit, v leads by 90^o, therefore $\theta = 90^o$

$$P = \frac{V_m I_m}{2} \cos(90^o) = 0$$

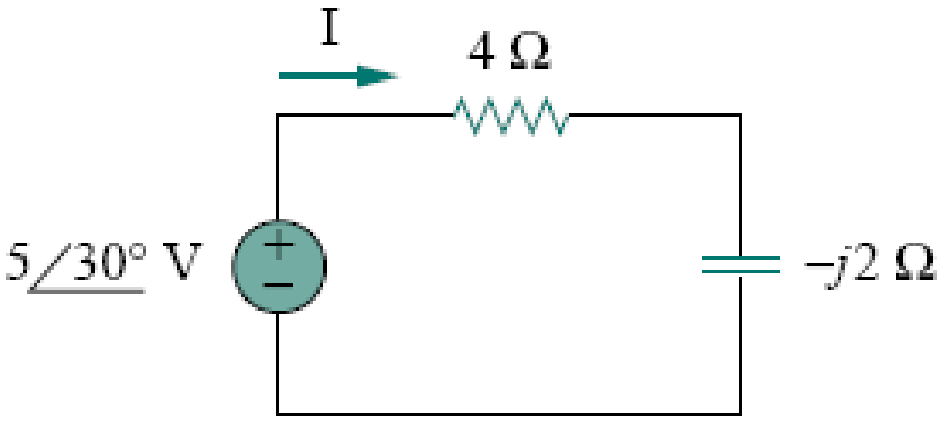
(c) Capacitors:

In purely capacitive circuit, I leads by 90^o, therefore $\theta = -90^o$

$$P = \frac{V_m I_m}{2} \cos(-90^o) = 0$$

Example 2

Find the average power supplies by the source and the average power absorbed by the resistor.

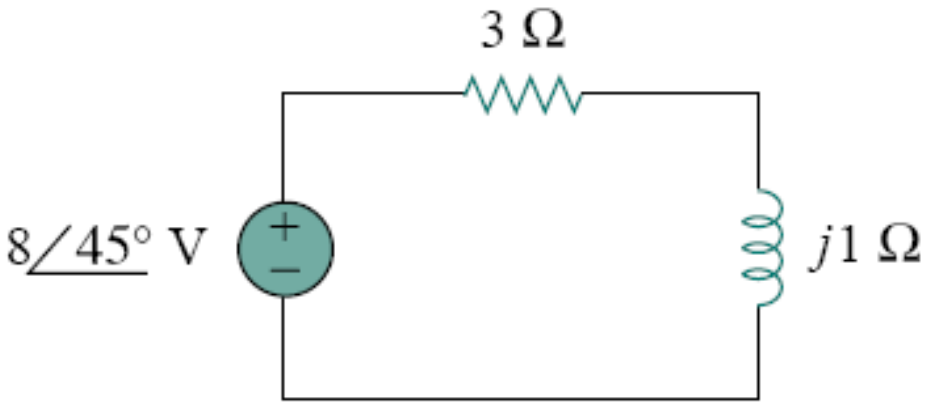


Reference : Alexander, Sadiku Chapter 11 - page 462



Exercise 2

Calculate the average power absorbed by the resistor and inductor. Find the average power supplies by the voltage source.



$P_R = 9.6W$

$P_L = 0W$

$P = 9.6W$