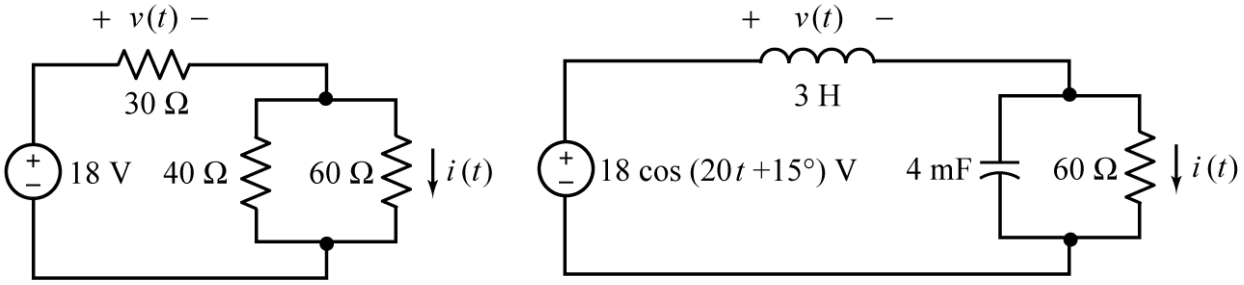
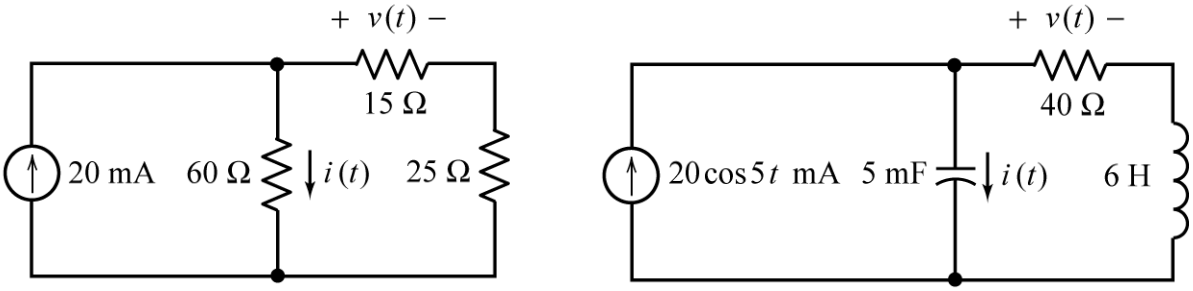
Voltage and Current Division in DC and AC Circuits

Example 1. Determine the steady state voltage, $v(t)$, and current, $i(t)$, for each of these circuits.



(*a*) (*b*)

Example 2. Determine the steady state voltage, $v(t)$, and current, $i(t)$, for each of these circuits.



(*a*) (*b*)

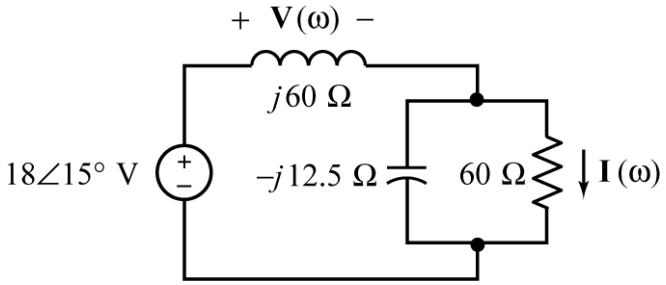
Solutions

Example 1.
(a)

$$v(t) = \frac{30}{30 + (40 \,||\, 60)} \times 18 = 10 \text{ V}$$

$$i(t) = \frac{40}{40+60} \times \frac{18}{30 + (40 \,||\, 60)} = \frac{4}{30} = 133 \text{ mA}$$

(b) Represent the circuit in the frequency domain using impedances and phasors.



$$\mathbf{V}(\omega) = -\frac{j60}{j60 + (-j12.5 \,||\, 60)} \times 18\angle 15° = \frac{(60\angle -90°)(18\angle 15°)}{j60 + \dfrac{60(-j12.5)}{60 - j12.5}} = 22.46\angle 18° \text{ V}$$

$$\mathbf{I}(\omega) = \frac{-j12.5}{60 - j12.5} \times \frac{24\angle 15°}{j60 + \dfrac{60(-j12.5)}{60 - j12.5}} = 76.35\angle -150° \text{ mA}$$

so

$$v(t) = 22.46\cos(20t + 18°) \text{ V}$$

and

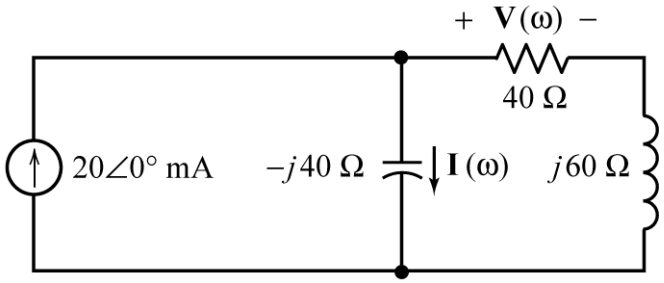
$$i(t) = 76.35\cos(20t - 150°) \text{ mA}$$

Example 2.
(a)

$$i(t) = \frac{15+25}{60 + (15+25)} 0.020 = 0.008 = 8 \text{ mA}$$

$$v(t) = \frac{15}{15+25} \times \big(60 \,||\, (15+25)\big) 0.020 = \frac{3}{8}(24)(0.020) = 0.18 \text{ V}$$

(b) Represent the circuit in the frequency domain using impedances and phasors.



$$\mathbf{I}(\omega) = \frac{40 + j60}{-j40 + (40 + j60)} \times 0.020\angle 0° = 24.25\angle 50.9° \text{ mA}$$

and

$$\mathbf{V}(\omega) = \frac{40}{40 + j60} \times \left[-j40 \,||\, (40 + j60)\right] \times 0.02\angle 0° = 0.97\angle -39° \text{ V}$$

Returning to the time domain:

$$i(t) = 24.25\cos(5t + 50.9°) \text{ mA}$$

and

$$v(t) = 0.97\cos(5t - 39°) \text{ V}$$