4.43 Note that $i(t)$ is in mA where
$1\text{ mA} = 10^{-3}\text{A}$

a. $I(j\omega) = 17\times10^{-3}\angle{-\pi/12}\text{ A}$

$V(j\omega) = 3.5\angle{1.309}\text{ V}$

both angles are in radians

Basic V-I relationship in an impedance

$$V = ZI \rightarrow Z = \frac{V}{I}$$

$$Z = \frac{3.5\angle{1.309}\text{ V}}{17\times10^{-3}\angle{-\pi/12}\text{ A}} = \frac{3.5}{17\times10^{-3}}\angle{1.309+\pi/12}\ \Omega$$

$$= 205.9\angle{1.5708\text{ rad}}\ \Omega = 205.9\angle{\pi/2}\ \Omega$$

need to recognize this to finish problem, if we solved in degrees you would see this immediately.

The device could potentially be an inductor, capacitor, or resistor (the components we know). Looking at the phasor form of these components, we see

$$Z_L(j\omega) = \omega L\angle{\pi/2}\ \Omega$$

Since this matches the angle of the unknown Z we can say that the device is an inductor.

b. $\omega L = 205.9\ \Omega$

$$L = \frac{205.9}{628.3}\text{ H} = 0.327\text{ H} = 327\text{ mH}$$

given

P 4.47

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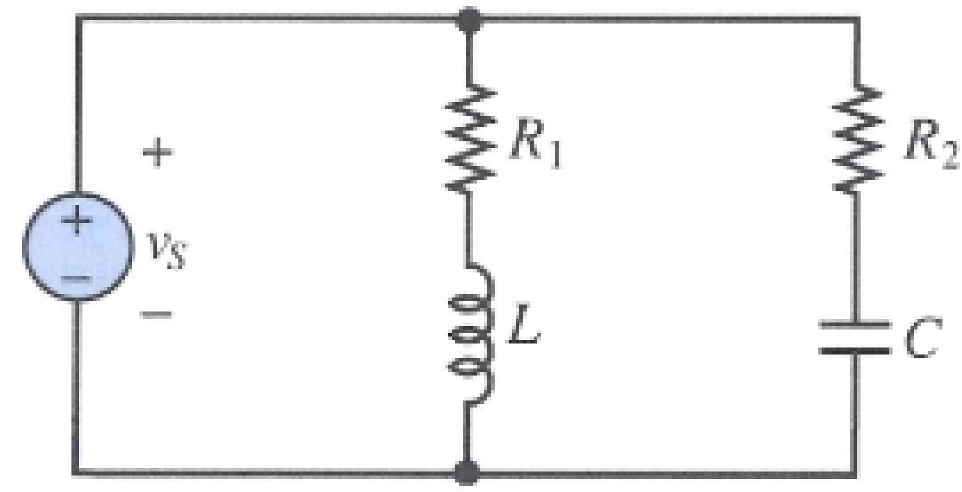
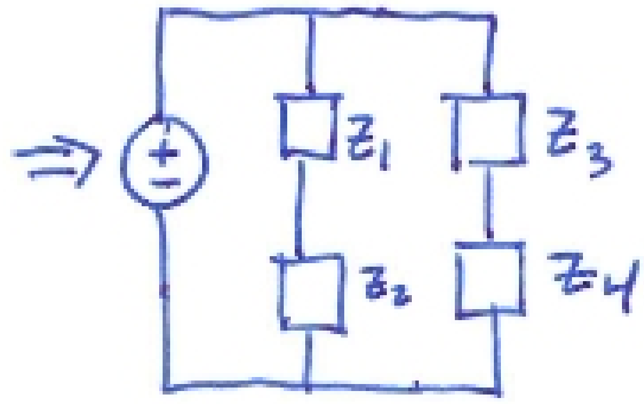


$\Rightarrow$



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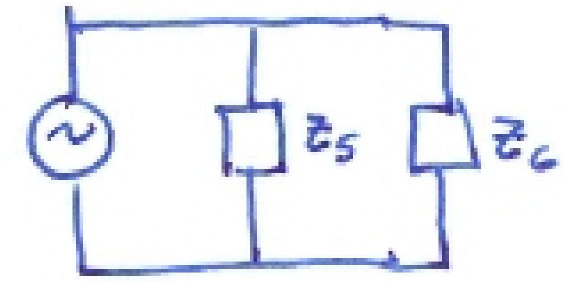

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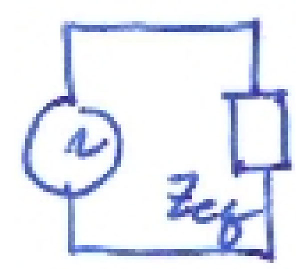

$$V_s(t) = 7\cos(\underbrace{3{,}000}_{\omega}t + \pi/6)\ V$$

$Z_1 = 2.3 \times 10^3\ \Omega$ $\qquad Z_3 = 1.1 \times 10^3\ \Omega$

$$Z_2 = j\omega L = j(3\times10^3)(190\times10^{-3})\ \Omega = j570\ \Omega$$

$$Z_4 = \frac{-j}{\omega C} = \frac{-j}{(3\times10^3)(55\times10^{-9})} = -j6.06\times10^3\ \Omega$$

$1nF = 10^{-9}F$

$$Z_5 = Z_1 + Z_2 = 2.3\times10^3 + j570\ \Omega = 2.37\times10^3 \angle 13.92^\circ\ \Omega$$

$$Z_6 = Z_3 + Z_4 = 1.1\times10^3 - j6.06\times10^3\ \Omega = 6.16\times10^3 \angle -79.71^\circ\ \Omega$$

$$Z_{eq} = \frac{Z_5 Z_6}{Z_5 + Z_6} = \frac{2.37\times10^3\angle 13.92^\circ\ \Omega\ 6.16\times10^3\angle -79.71^\circ\ \Omega}{(3.4\times10^3 - j5490)\ \Omega}$$

like parallel resistors

$$= \frac{2.37\times 6.16\times10^6 \angle -65.79}{6458\angle -58.23^\circ}\ \Omega$$

$$= 2.261\angle -7.56^\circ\ k\Omega$$

$1k\Omega = 10^3\Omega$

P 4.54

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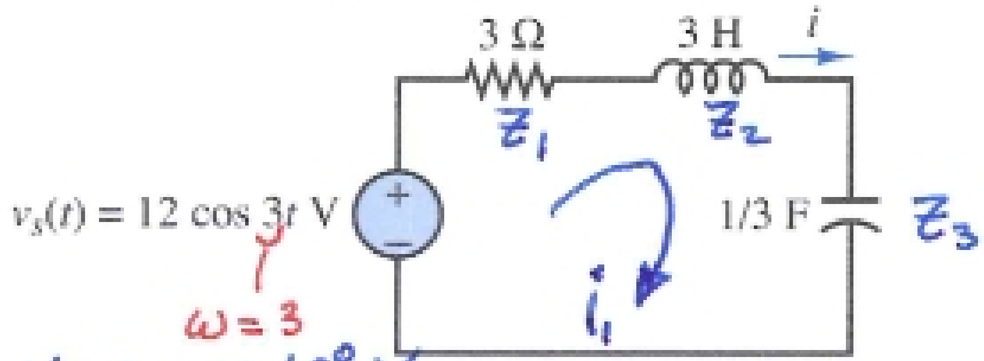

$Z_1 = 3\,\Omega$

$Z_2 = j\omega L = j\,3\cdot 3\,\Omega = j9\,\Omega$

$Z_3 = \frac{-j}{\omega C} = \frac{-j}{3\cdot \frac{1}{3}}\,\Omega = -j$

$V(j\omega) = 12\angle 0^\circ$ V

Approach 1:

$$Z_{total} = Z_1 + Z_2 + Z_3 = 3 + j9 - j\ \Omega = 3 + j8\,\Omega$$

$$I = \frac{V}{Z} = \frac{12\angle 0^\circ\ V}{3+j8\,\Omega} = \frac{12\angle 0^\circ\ V}{8.54\angle 69.4^\circ\ \Omega} = 1.4\angle -69.4^\circ A$$

$$i(t) = 1.4\cos(3t - 69.4^\circ)\ A$$

Approach 2: Mesh Current

$$\sum_{\text{mesh } 1} V_{Drops} = -12\angle 0^\circ + Z_1 I_1 + Z_2 I_1 + Z_3 I_1 = 0$$

$$I_1 = \frac{12\angle 0^\circ}{Z_1 + Z_2 + Z_3} = \frac{12\angle 0^\circ}{Z_{total}}$$

Same answer as above