

Block B: AC circuits**Q1. Problem 4.37**

Find the phasor form of the following functions:

- a) $v(t) = 155 \cos(377t - 25^\circ) \text{ V}$
- b) $v(t) = 5 \sin(1,000t - 40^\circ) \text{ V}$
- c) $i(t) = 10 \cos(10t + 63^\circ) + 15 \cos(10t - 42^\circ) \text{ A}$
- d) $i(t) = 460 \cos(500\pi t - 25^\circ) - 220 \sin(500\pi t + 15^\circ) \text{ A}$

Q2. Problem 4.38

Covert the following complex numbers to polar form:

- a) $4 + j4$
- b) $-3 + j4$
- c) $j + 2 - j4 - 3$

Q3. Problem 4.43

If the current through and the voltage across a component in an electric circuit are

$$i(t) = 17 \cos(\omega t - \pi/12) \text{ mA}$$

$$v(t) = 3.5 \cos(\omega t + 1.309) \text{ V}$$

Where $\omega = 628.3 \text{ rad/s}$, determine

- a) Whether the component is a resistor, capacitor, or inductor.
- b) The value of the component in ohms, farads, or henrys.

Q4. Problem 4.46

The current through and the voltage across an electrical component are

$$i(t) = I_o \cos(\omega t + \pi/4) \quad v(t) = V_o \cos(\omega t)$$

where

$$I_o = 3 \text{ mA} \quad V_o = 700 \text{ mV} \quad \omega = 6.283 \text{ rad/s}$$

- a) Is the component inductive or capacitive?
- b) Plot the instantaneous power $p(t)$ as a function of ωt over the range $0 < \omega t < 2\pi$.
- c) Determine the average power dissipated as heat in the component.
- d) Repeat part (b) and (c) if the phase angle of the current is changed to 0° .

Q5. Problem 4.47

Determine the equivalent impedance in the circuit shown in Figure 4.47

$$v_s(t) = 7 \cos(3000t + 30^\circ) \text{ V}$$

$$R_1 = 2.3 \text{ k}\Omega, R_2 = 1.1 \text{ k}\Omega, L = 190 \text{ mH}, C = 55 \text{ nF}$$

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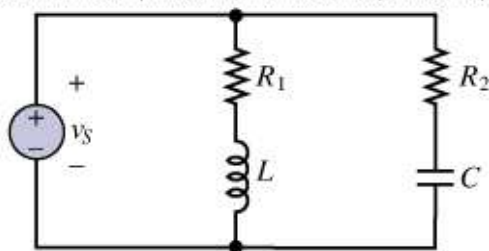


Figure 4.47

Q6. Problem 4.61

Find the impedance Z in figure 4.61, given $\omega = 4 \text{ rad/s}$.

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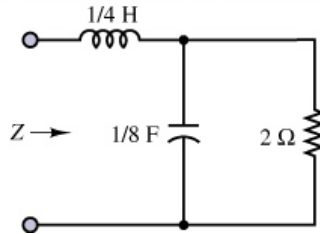


Figure 4.61

Q7. Problem 7.2

A coffee-maker has a rated power of $1,000 \text{ W}$ at $240 \text{ V}_{\text{rms}}$. Find the resistance of the heating element.

$[57.6 \Omega]$

Q8. Problem 7.9

A current source $i(t)$ is connected to a 100Ω resistor. Find the average power delivered to the resistor, given that $i(t)$ is:

- a) $4 \cos(100t) \text{ A}$
- b) $4 \cos(100t - 50^\circ) \text{ A}$
- c) $4 \cos(100t) - 3 \cos(100t - 50^\circ) \text{ A}$
- d) $4 \cos(100t) - 3 \text{ A}$

Q9. Problem 7.10

Find the rms value of each of the following periodic currents

- a) $i(t) = \cos(377t) + \cos(377t) \text{ A}$
- b) $i(t) = \sin(2t) + \cos(2t) \text{ A}$
- c) $i(t) = \cos(377t) + 1 \text{ A}$
- d) $i(t) = \cos(2t) + \cos(2t + 135^\circ) \text{ A}$
- e) $i(t) = \cos(2t) + \cos(3t) \text{ A}$

Numerical solutions

Q1. Problem 4.37

- a. $155\angle -25^\circ$ V b. $5\angle -130^\circ$ V
 b. $15.73\angle -4.11^\circ$ A d. $360.4\angle 2.88^\circ$ A

Q2. Problem 4.38

- a. $5.66\angle 45^\circ$ b. $5\angle 126.9^\circ$
 c. $3.16\angle -108.4^\circ$

Q3. Problem 4.43

- a. Inductor b. 327.7mH

Q4. Problem 4.46

- a. $165.0 - j165.0\Omega$, Capacitor b. $(1050\cos(2\omega t + 45^\circ) + 742.4)\mu\text{W}$
 c. $\frac{1}{2\pi}(1050\mu\text{W})\frac{1}{2}[0 - 0] + 742.4 = 742.4\mu\text{W}$
 d. $1050(\cos(2\omega t) + 1)\mu\text{W}$, $1050\mu\text{W}$

Q5. Problem 4.47

$$Z_{eq} = 2.260\angle -7.56^\circ \text{ k}\Omega$$

Q6. Problem 4.61

$$Z = 1\Omega$$

Q7. Problem 7.2

$$R = 57.6\Omega$$

Q8. Problem 7.9

- a. 800W b. 800W c. 478.64W d. 1700W

Q9. Problem 7.10

- a. 1.414 b. 1 c. $\sqrt{\frac{3}{2}}$ d. $I_{rms} = 0.5412$
 e. $I_{rms} = \sqrt{\frac{1}{2\pi} \int_0^{2\pi} (\cos 2t + \cos 3t)^2 dt} = 1$