

Section 1: Basics

Q1 [Rizzoni Problem 4.37]

Assuming cosine as the reference, find the phasor form of the following functions:

- $v(t) = 155 \cos(377t - 25^\circ) \text{ V}$
- $v(t) = 5 \sin(1000t - 40^\circ) \text{ V}$
- $i(t) = 10 \cos(10t + 63^\circ) + 15 \cos(10t - 42^\circ) \text{ A}$
- $i(t) = 460 \cos(500\pi t - 25^\circ) - 220 \sin(500\pi t + 15^\circ) \text{ A}$

Q2 [Rizzoni Problem 4.38]

Convert the following complex numbers to polar form (i.e. phasor form):

- $4 + j4$
- $-3 + j4$
- $j + 2 - j4 - 3$

Q3

Determine the current that flows through an 8Ω resistor connected if the voltage across the resistor is:

$$V_s = 110 \cos(377t) \text{ V}$$

Q4

Determine the voltage across a $2 \mu\text{F}$ capacitor when the current through it is:

$$I = 4 \cos(10^6 t + 25^\circ) \text{ A}$$

Q5

Determine the current through a 4mH inductor when the voltage across it is:

$$V = 60 \cos(500t - 65^\circ) \text{ V}$$

Q6 [Rizzoni Problem 4.43]

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

$$i(t) = 17 \cos(\omega t - 15^\circ) \text{ mA}$$

$$v(t) = 3.5 \cos(\omega t + 75^\circ) \text{ V}$$

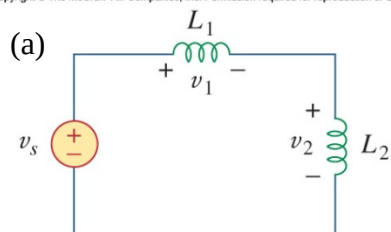
Where $\omega = 628.3 \text{ rad/s}$, determine

- Whether the component is a resistor, capacitor, or inductor (explain why).
- The value of the component in Ohms, Farads, or Henrys.

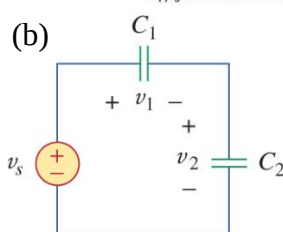
Q7

Derive the expressions for v_2 in terms of v_s and relevant component symbols (assume AC)

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Section 2: Complex impedance

Q8 [Rizzoni Problem 4.48]

Determine the equivalent impedance seen by v_s in the circuit shown in Figure P4.47:

$$v_s(t) = 636 \cos\left(3,000t + \frac{\pi}{12}\right) \text{ V}$$

Given: $R_1 = 3.3\text{k}\Omega$, $R_2 = 22\text{k}\Omega$, $L = 1.90\text{H}$, $C = 6.8\text{nF}$

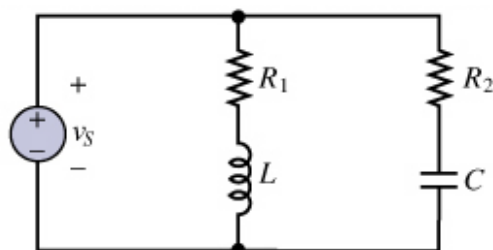


Figure P4.47

Q9 [Problem 4.65]

For the circuit shown in the Figure P4.65

- Derive the impedance of the circuit (Z_{eq}) as a function of radian frequency ω
- Find the frequency that causes Z_{eq} to appear purely resistive (i.e. phase is zero).

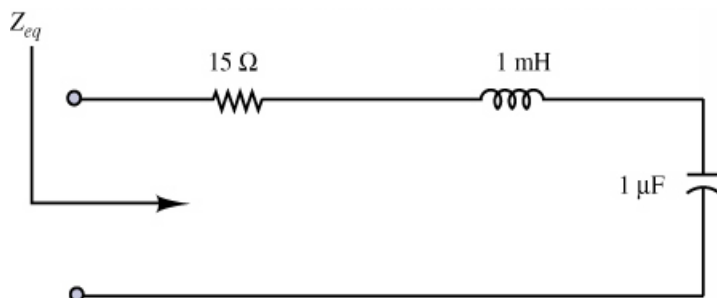


Figure P4.65

Q10 [Problem 4.55]

Find the impedance across the current source in Fig P4.55. Then use this to find the voltage across it.

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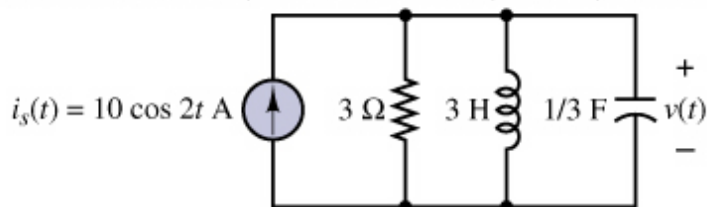


Fig P4.55

Numerical Answers

Q1

- a. $155\angle -25^\circ \text{ V}$
- b. Convert sine to cosine: $5\angle (-40^\circ - 90^\circ) = 5\angle -130^\circ \text{ V}$
- c. $10\angle 63^\circ + 15\angle -42^\circ = 15.73\angle -4.12^\circ \text{ A}$
- d. $[460\angle -25^\circ] - [220\angle (15^\circ - 90^\circ)] = 360.4\angle 2.88^\circ \text{ A}$

Q2

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

Q3

$$13.75 \cos(377t) \text{ A}$$

Q4

$$2 \cos(10^6 t - 65^\circ) \text{ V}$$

Q5

$$30 \cos(500t - 155^\circ) \text{ A}$$

Q6

Inductor with value of 327.7mH

Q7

- a. $v_2 = \frac{L_2}{L_1 + L_2} v_s$
- b. $v_2 = \frac{C_1}{C_1 + C_2} v_s$

Q8

$$7.05\angle 53.81^\circ \text{ k}\Omega$$

Q9

$$Z = 15 + j0.001\omega - j10^6/\omega$$

Z is purely resistive at $\omega = 31622.77 \text{ rad/s}$

Q10

$$v(t) = 16.64 \cos(2t - 0.983) \text{ V}$$