Section 1: Basics

Q1 [Rizzoni Problem 4.37]

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

a. $v(t) = 155\cos(377t - 25°)$ V

b. $v(t) = 5\sin(1000t - 40°)$ V

c. $i(t) = 10\cos(10t + 63°) + 15\cos(10t - 42°)$ A

d. $i(t) = 460\cos(500\pi t - 25°) - 220\sin(500\pi t + 15°)$ A

Q2 [Rizzoni Problem 4.38]

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

a. $4 + j4$

b. $-3 + j4$

c. $j + 2 - j4 - 3$

Q3

Determine the current that flows through an 8 Ω resistor connected if the voltage across the resistor is:
V_s = 110 cos(377t) V

Q4

Determine the voltage across a 2 μF capacitor when the current through it is:
I = 4 cos(10^6t + 25°) A

Q5

Determine the current through a 4mH inductor when the voltage across it is:
V = 60 cos(500t – 65°) V

Q6 [Rizzoni Problem 4.43]

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

$i(t) = 17\cos(\omega t - 15°)$ mA

$v(t) = 3.5\cos(\omega t + 75°)$ V

Where ω = 628.3 rad/s, determine

a. Whether the component is a resistor, capacitor, or inductor (explain why).

b. 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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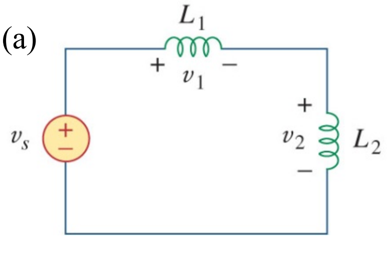
(a)



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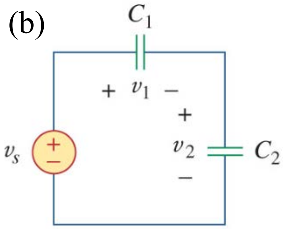
(b)



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

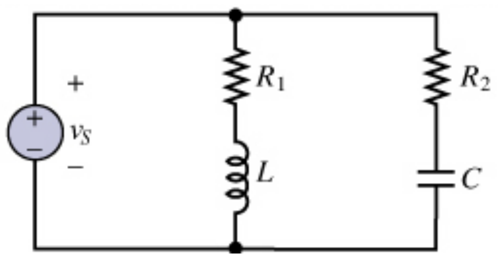


Figure P4.47

Q9 [Problem 4.65]
For the circuit shown in the Figure P4.65

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

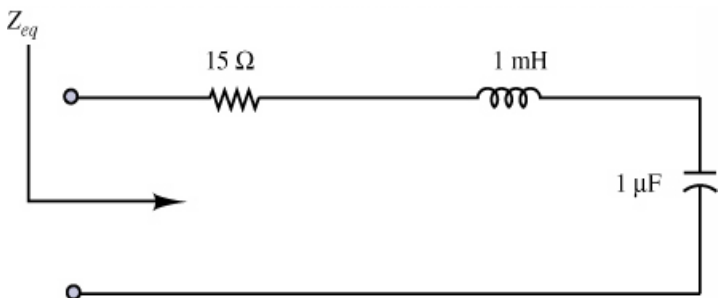


Figure P4.65

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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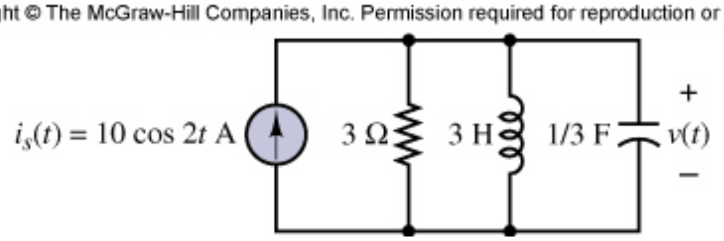

Fig P4.55

Numerical Answers

Q1

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

Q2

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

Q3

13.75 cos(377t) A

Q4

2 cos(10^6t – 65°) V

Q5

30 cos(500t – 155°) A

Q6

Inductor with value of 327.7mH

Q7

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

Q8

$7.05\angle 53.81^o$ kΩ

Q9

Z = 15 + j0.001ω – j10^6/ω
Z is purely resistive at ω = 31622.77 rad/s

Q10

v(t) = 16.64 cos(2t – 0.983) V