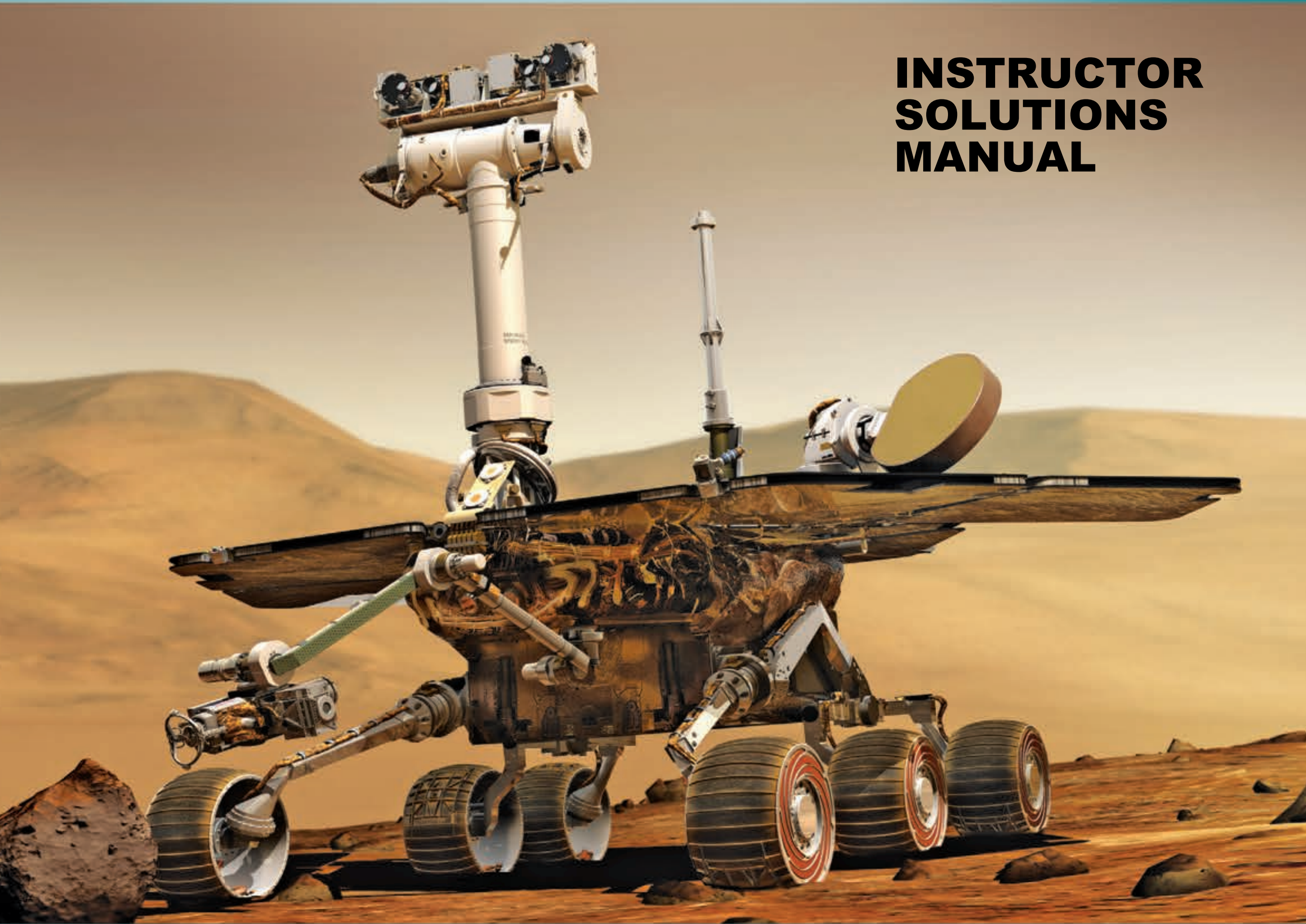
FIFTH EDITION

Fundamentals of Electric Circuits



INSTRUCTOR SOLUTIONS MANUAL

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Chapter 1, Solution 1

(a) $q = 6.482\text{x}10^{17}$ x $[-1.602\text{x}10^{-19}\ \text{C}]$ = **–103.84 mC**

(b) $q = 1.24\text{x}10^{18}$ x $[-1.602\text{x}10^{-19}\ \text{C}]$ = **–198.65 mC**

(c) $q = 2.46\text{x}10^{19}$ x $[-1.602\text{x}10^{-19}\ \text{C}]$ = **–3.941 C**

(d) $q = 1.628\text{x}10^{20}$ x $[-1.602\text{x}10^{-19}\ \text{C}]$ = **–26.08 C**

Chapter 1, Solution 2

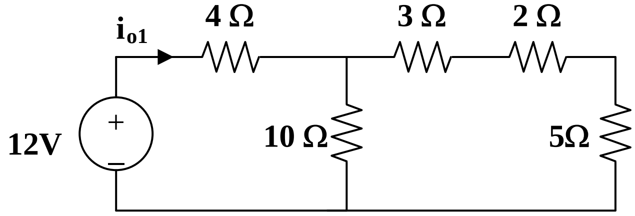
(a) i = dq/dt = 3 mA
(b) i = dq/dt = (16t + 4) A
(c) i = dq/dt = ($-3e^{-t}$ + $10e^{-2t}$) nA
(d) i=dq/dt = $1200\pi \cos 120\pi t$ pA
(e) i =dq/dt = $-e^{-4t}(80\cos 50t + 1000\sin 50t)$ μ**A**

$$R_{eq} = 4 + 1.829 + (3.977 + 7.368) \| (0.5964 + 14)$$
$$= 5.829 + 11.346 \| 14.5964 = \mathbf{12.21\ \Omega}$$

$i = 20/(R_{eq}) =$ **1.64 A**

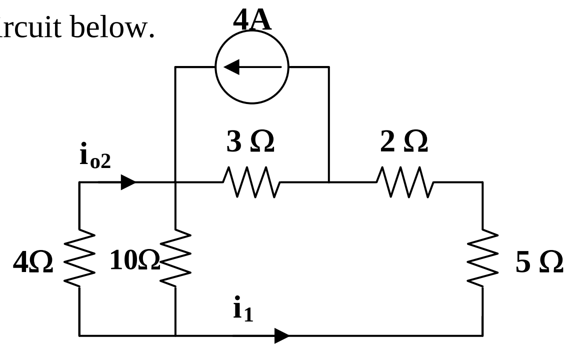
Chapter 4, Solution 16.

Let $i_o = i_{o1} + i_{o2} + i_{o3}$, where i_{o1}, i_{o2}, and i_{o3} are due to the 12-V, 4-A, and 2-A sources. For i_{o1}, consider the circuit below.



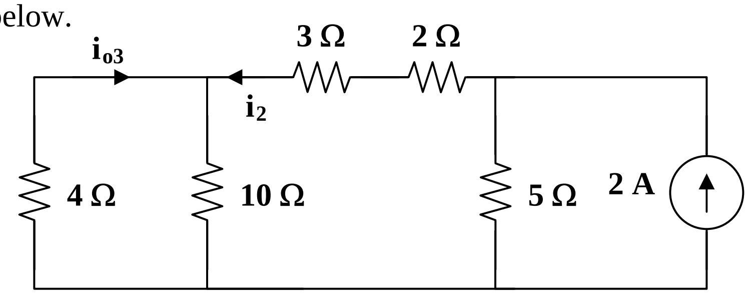
$$10||(3 + 2 + 5) = 5 \text{ ohms}, \; i_{o1} = 12/(5 + 4) = (12/9) \text{ A}$$

For i_{o2}, consider the circuit below.



$$2 + 5 + 4||10 = 7 + 40/14 = 69/7$$
$$i_1 = [3/(3 + 69/7)]4 = 84/90, \; i_{o2} = [-10/(4 + 10)]i_1 = -6/9$$

For i_{o3}, consider the circuit below.



$$3 + 2 + 4||10 = 5 + 20/7 = 55/7$$

$$i_2 = [5/(5 + 55/7)]2 = 7/9, \; i_{o3} = [-10/(10 + 4)]i_2 = -5/9$$

$$i_o = (12/9) – (6/9) – (5/9) = 1/9 = \mathbf{111.11 \text{ mA}}$$

$$(v_1 – 10m)/(10k) + v_1/30k + (v_1 – 3.87m)/20k = 0$$

or $$6v_1 – 60m + 2v_1 + 3v_1 – 11.61m = 0$$

or $$v_1 = 71.61/11 = 6.51 \text{ mV.}$$

The current through the 20k-ohm resistor, left to right, is,

$$i_{20} = (6.51m – 3.87m)/20k = 132 \times 10^{–9} \text{ A}$$

thus, $$v_o = 3.87m – 132 \times 10^{–9} \times 80k = \mathbf{–6.69\ mV}.$$

Chapter 7, Solution 30.

(a) $\int_{-\infty}^{\infty} 4t^2\, \delta(t-1)\, dt = 4t^2\Big|_{t=1} = \mathbf{4}$

(b) $\int_{-\infty}^{\infty} 4t^2 \cos(2\pi t)\, \delta(t-0.5)\, dt = 4t^2 \cos(2\pi t)\Big|_{t=0.5} = \cos\pi = \mathbf{-1}$

Chapter 9, Solution 68.

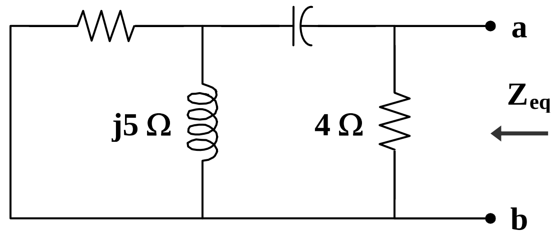
$$\mathbf{Y}_{eq} = \frac{1}{5 - j2} + \frac{1}{3 + j} + \frac{1}{-j4}$$

$$\mathbf{Y}_{eq} = (0.1724 + j0.069) + (0.3 - j0.1) + (j0.25)$$

$$\mathbf{Y}_{eq} = \mathbf{(472.4 + j219)\ mS}$$

Chapter 10, Solution 60.

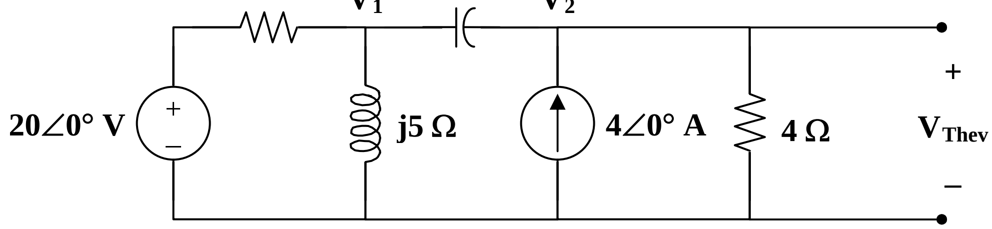
(a) To find $\mathbf{Z}_{eq}$, consider the circuit in Fig. (a).



(a)

$$\mathbf{Z}_{eq} = 4 \,||\, (\text{-}j4 + 10 \,||\, j5) = 4 \,||\, (\text{-}j4 + 2 + j4)$$
$$\mathbf{Z}_{eq} = 4 \,||\, 2$$
$$= \mathbf{1.333\ \Omega}$$

To find $\mathbf{V}_{Thev}$, consider the circuit in Fig. (b).



(b)

At node 1,

$$\frac{20 - \mathbf{V}_1}{10} = \frac{\mathbf{V}_1}{\text{j5}} + \frac{\mathbf{V}_1 - \mathbf{V}_2}{\text{- j4}}$$

$$(1 + \text{j}0.5)\,\mathbf{V}_1 - \text{j}2.5\,\mathbf{V}_2 = 20 \qquad (1)$$

At node 2,

$$4 + \frac{\mathbf{V}_1 - \mathbf{V}_2}{\text{- j4}} = \frac{\mathbf{V}_2}{4}$$

$$\mathbf{V}_1 = (1 - \text{j})\,\mathbf{V}_2 + \text{j}16 \qquad (2)$$

Substituting (2) into (1) leads to

$$28 - \text{j}16 = (1.5 - \text{j}3)\,\mathbf{V}_2$$

$$\mathbf{V}_2 = \frac{28 - \text{j}16}{1.5 - \text{j}3} = 8 + \text{j}5.333$$

Chapter 11, Solution 34.

$$f_{rms}^2 = \frac{1}{T}\int_0^T f^2(t)dt = \frac{1}{3}\left[\int_0^2 (3t)^2\, dt + \int_2^3 6^2\, dt\right]$$

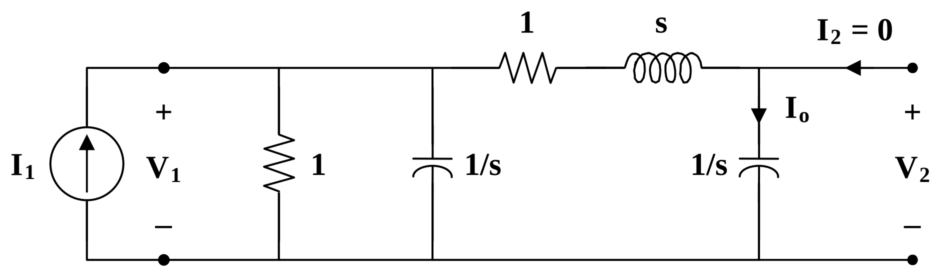
$$= \frac{1}{3}\left[\left.\frac{9t^3}{3}\right|_0^2 + 36\right] = 20$$

$$f_{rms} = \sqrt{20} = 4.472$$

f_{rms} = **4.472**

Chapter 19, Solution 5.

Consider the circuit in Fig. (a).



(a)

$$\mathbf{z}_{11} = 1 \| \frac{1}{s} \| \left(1+s+\frac{1}{s}\right) = \frac{\frac{1}{s}}{1+\frac{1}{s}} \| \left(1+s+\frac{1}{s}\right) = \frac{\left(\frac{1}{s+1}\right)\left(1+s+\frac{1}{s}\right)}{\left(\frac{1}{s+1}\right)+1+s+\frac{1}{s}}$$

$$\mathbf{z}_{11} = \frac{s^2+s+1}{s^3+2s^2+3s+1}$$

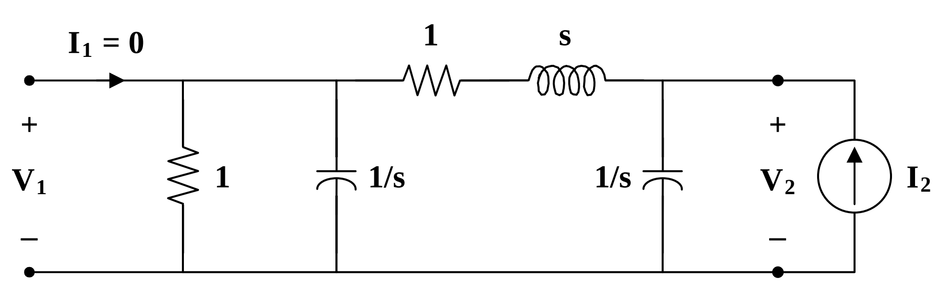
$$\mathbf{I}_o = \frac{1 \| \frac{1}{s}}{1 \| \frac{1}{s}+1+s+\frac{1}{s}} \mathbf{I}_1 = \frac{\frac{1}{s+1}}{\frac{1}{s+1}+1+s+\frac{1}{s}} \mathbf{I}_1 = \frac{\frac{s}{s+1}}{\frac{s}{s+1}+s^2+s+1} \mathbf{I}_1$$

$$\mathbf{I}_o = \frac{s}{s^3+2s^2+3s+1} \mathbf{I}_1$$

$$\mathbf{V}_2 = \frac{1}{s} \mathbf{I}_o = \frac{\mathbf{I}_1}{s^3+2s^2+3s+1}$$

$$\mathbf{z}_{21} = \frac{\mathbf{V}_2}{\mathbf{I}_1} = \frac{1}{s^3+2s^2+3s+1}$$

Consider the circuit in Fig. (b).



(b)