

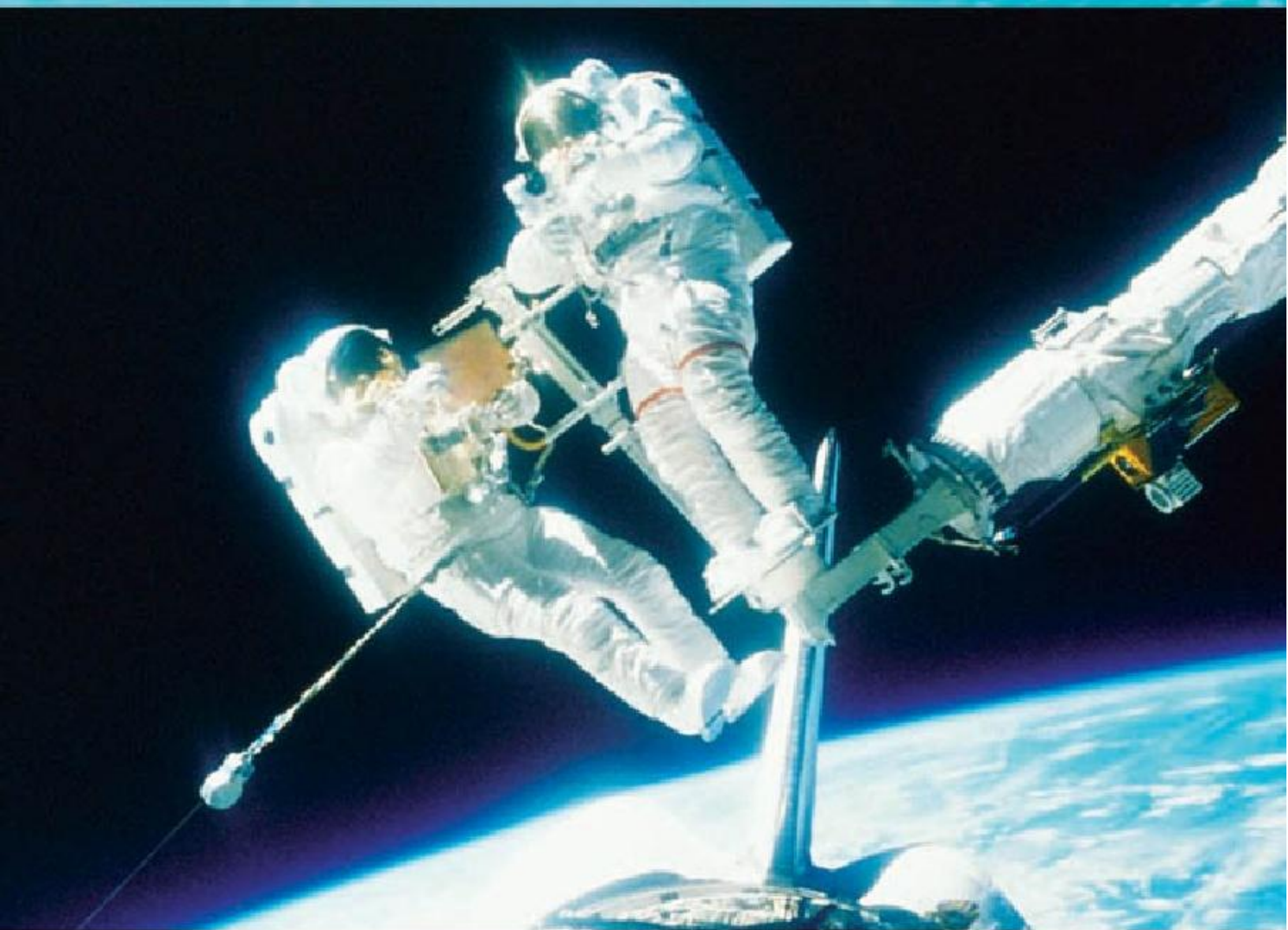
Solutions Manual

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Fundamentals of Electric Circuits

Fourth Edition



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Chapter 1, Problem 13.

The charge entering the positive terminal of an element is

$$q = 10 \sin 4\pi t \text{ mC}$$

while the voltage across the element (plus to minus) is

$$v = 2 \cos 4\pi t \text{ V}$$

- (a) Find the power delivered to the element at $t = 0.3 \text{ s}$
- (b) Calculate the energy delivered to the element between 0 and 0.6s.

Chapter 1, Solution 13

$$(a) \quad i = \frac{dq}{dt} = 40\pi \cos 4\pi t \text{ mA}$$

$$p = vi = 80\pi \cos^2 4\pi t \text{ mW}$$

At $t=0.3\text{s}$,

$$p = 80\pi \cos^2(4\pi \times 0.3) = \underline{164.5 \text{ mW}}$$

$$(b) \quad W = \int p dt = 80\pi \int_0^{0.6} \cos^2 4\pi t dt = 40\pi \int_0^{0.6} [1 + \cos 8\pi t] dt \text{ mJ}$$

$$W = 40\pi \left[0.6 + \frac{1}{8\pi} \sin 8\pi t \right]_0^{0.6} = \underline{78.34 \text{ mJ}}$$

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Chapter 3, Problem 11.

Find V_o and the power dissipated in all the resistors in the circuit of Fig. 3.60.

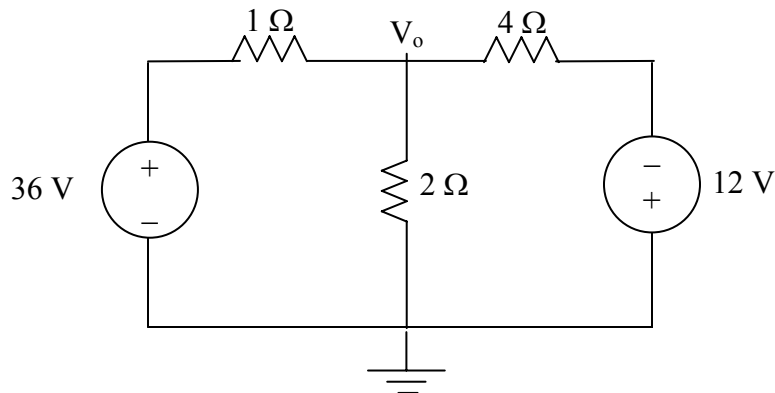


Figure 3.60 For Prob. 3.11.

Chapter 3, Solution 11

At the top node, KVL gives

$$\frac{V_o - 36}{1} + \frac{V_o - 0}{2} + \frac{V_o - (-12)}{4} = 0$$

$$1.75V_o = 33 \text{ or } V_o = 18.857\text{V}$$

$$P_{1\Omega} = (36 - 18.857)^2 / 1 = \underline{\underline{293.9 \text{ W}}}$$

$$P_{2\Omega} = (V_o)^2 / 2 = (18.857)^2 / 2 = \underline{\underline{177.79 \text{ W}}}$$

$$P_{4\Omega} = (18.857 + 12)^2 / 4 = \underline{\underline{238 \text{ W}}}.$$

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Solve Prob. 3.20 using *PSpice*.

Chapter 3, Problem 20

For the circuit in Fig. 3.69, find V_1 , V_2 , and V_3 using nodal analysis.

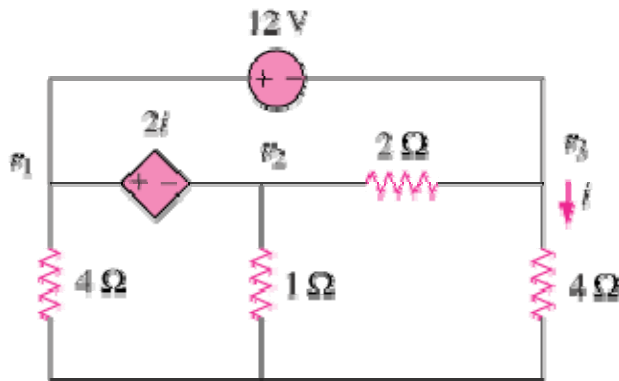


Figure 3.69

Chapter 3, Solution 78

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Chapter 6, Problem 32.

In the circuit in Fig. 6.64, let $i_s = 30e^{-2t}$ mA and $v_1(0) = 50$ V, $v_2(0) = 20$ V. Determine: (a) $v_1(t)$ and $v_2(t)$, (b) the energy in each capacitor at $t = 0.5$ s.

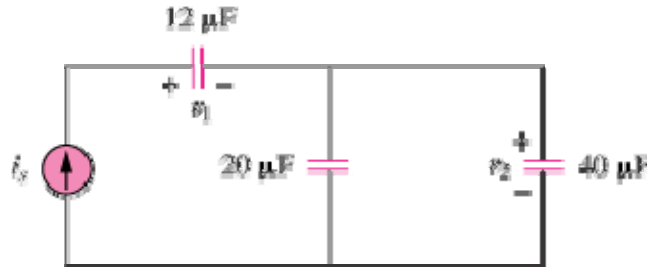


Figure 6.64

Chapter 6, Solution 32.

$$(a) \quad C_{eq} = (12 \times 60)/72 = 10 \mu F$$

$$v_1 = \frac{10^{-3}}{12 \times 10^{-6}} \int_0^t 30e^{-2t} dt + v_1(0) = \underline{-1250e^{-2t} \Big|_0^t + 50} = \underline{-1250e^{-2t} + 1300V}$$

$$v_2 = \frac{10^{-3}}{60 \times 10^{-6}} \int_0^t 30e^{-2t} dt + v_2(0) = \underline{250e^{-2t} \Big|_0^t + 20} = \underline{-250e^{-2t} + 270V}$$

(b) At $t=0.5$ s,

$$v_1 = -1250e^{-1} + 1300 = 840.2, \quad v_2 = -250e^{-1} + 270 = 178.03$$

$$w_{12\mu F} = \frac{1}{2} \times 12 \times 10^{-6} \times (840.15)^2 = \underline{4.235 \text{ J}}$$

$$w_{20\mu F} = \frac{1}{2} \times 20 \times 10^{-6} \times (178.03)^2 = \underline{0.3169 \text{ J}}$$

$$w_{40\mu F} = \frac{1}{2} \times 40 \times 10^{-6} \times (178.03)^2 = \underline{0.6339 \text{ J}}$$

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Chapter 8, Problem 76.

Find the dual of the circuit in Fig. 8.120.

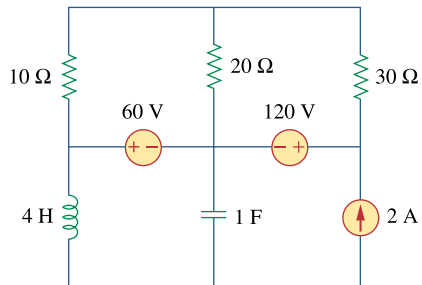
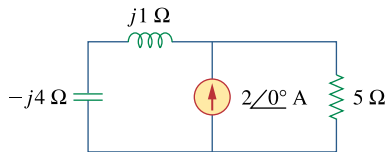


Figure 8.120
For Prob. 8.76.

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Chapter 11, Problem 2.

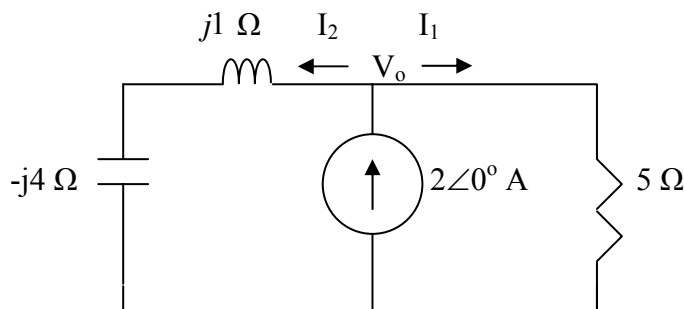
Given the circuit in Fig. 11.35, find the average power supplied or absorbed by each element.

**Figure 11.35**

For Prob. 11.2.

Chapter 11, Solution 2.

Using current division,



$$I_1 = \frac{j1 - j4}{5 + j1 - j4}(2) = \frac{-j6}{5 - j3}$$

$$I_2 = \frac{5}{5 + j1 - j4}(2) = \frac{10}{5 - j3}$$

For the inductor and capacitor, the average power is zero. For the resistor,

$$P = \frac{1}{2} |I_1|^2 R = \frac{1}{2} (1.029)^2 (5) = 2.647 \text{ W}$$

$$V_o = 5I_1 = -2.6471 - j4.4118$$

$$S = \frac{1}{2} V_o I^* = \frac{1}{2} (-2.6471 - j4.4118) \times 2 = -2.6471 - j4.4118$$

Hence the average power supplied by the current source is **2.647 W**.

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Chapter 15, Problem 50.

Use the Laplace transform to solve the differential equation

$$\frac{d^2 v(t)}{dt^2} + 2 \frac{dv(t)}{dt} + 10v(t) = 3 \cos 2t$$

subject to $v(0) = 1, dv(0)/dt = -2$.

Chapter 15, Solution 50.

Take the Laplace transform of each term.

$$[s^2 V(s) - s v(0) - v'(0)] + 2[s V(s) - v(0)] + 10 V(s) = \frac{3s}{s^2 + 4}$$

$$s^2 V(s) - s + 2 + 2s V(s) - 2 + 10 V(s) = \frac{3s}{s^2 + 4}$$

$$(s^2 + 2s + 10) V(s) = s + \frac{3s}{s^2 + 4} = \frac{s^3 + 7s}{s^2 + 4}$$

$$V(s) = \frac{s^3 + 7s}{(s^2 + 4)(s^2 + 2s + 10)} = \frac{As + B}{s^2 + 4} + \frac{Cs + D}{s^2 + 2s + 10}$$

$$s^3 + 7s = A(s^3 + 2s^2 + 10s) + B(s^2 + 2s + 10) + C(s^3 + 4s) + D(s^2 + 4)$$

Equating coefficients :

$$s^3: \quad 1 = A + C \quad \longrightarrow \quad C = 1 - A$$

$$s^2: \quad 0 = 2A + B + D$$

$$s^1: \quad 7 = 10A + 2B + 4C = 6A + 2B + 4$$

$$s^0: \quad 0 = 10B + 4D \quad \longrightarrow \quad D = -2.5B$$

Solving these equations yields

$$A = \frac{9}{26}, \quad B = \frac{12}{26}, \quad C = \frac{17}{26}, \quad D = \frac{-30}{26}$$

$$V(s) = \frac{1}{26} \left[\frac{9s + 12}{s^2 + 4} + \frac{17s - 30}{s^2 + 2s + 10} \right]$$

$$V(s) = \frac{1}{26} \left[\frac{9s}{s^2 + 4} + 6 \cdot \frac{2}{s^2 + 4} + 17 \cdot \frac{s + 1}{(s + 1)^2 + 3^2} - \frac{47}{(s + 1)^2 + 3^2} \right]$$

$$v(t) = \frac{9}{26} \cos(2t) + \frac{6}{26} \sin(2t) + \frac{17}{26} e^{-t} \cos(3t) - \frac{47}{78} e^{-t} \sin(3t)$$

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