P1.6-1

a.) $q = \int i\,dt = i\Delta t = (10\text{ A})(2\text{ hrs})(3600\text{ s/hr}) = \underline{7.2\times10^4\text{ C}}$

b.) $P = v\,i = (110\text{ V})(10\text{ A}) = \underline{1100\text{ W}}$

c.) $\text{Cost} = \dfrac{0.06\,\$}{\text{kWhr}} \times 1.1\text{kW} \times 2\text{ hrs} = \underline{0.132\,\$}$

P1.6-2

$$P = (6\text{ V})(10\text{ mA}) = 0.06\text{ W}$$

$$\Delta t = \frac{\Delta w}{P} = \frac{200\text{ W}\cdot\text{s}}{0.06\text{ W}} = \underline{3.33\times10^3\text{ s}}$$

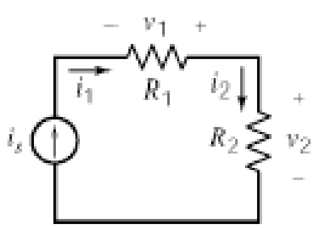
VP 1-1

Notice that the element voltage and current of each branch adhere to the passive convention. The sum of the powers absorbed by each branch are:

(-2 V)(2 A)+(5 V)(2 A)+(3 V)(3 A)+(4 V)(-5 A)+(1 V)(5 A) = -4 W + 10 W + 9 W -20 W + 5 W = 0 W

The element voltages and currents satisfy conservation of energy and may be correct.

P2.5-6



$i_1 = i_2 = i_s = 2$ A ;

$R_1 = 4\ \Omega$ and $R_2 = 8\ \Omega$

v_1 and i_1 do <u>not</u> adhere to the passive convention so

$v_1 = -R_1\, i_1 = -4\cdot2 = \underline{-8\text{ V}}.$

The power absorbed by R_1 is

$P_1 = -v_1 i_1 = -(-8)(2) = \underline{16\text{ W}}.$

v_2 and i_2 do adhere to the passive convention so $v_2 = R_2\, i_2 = 8\cdot2 = \underline{16\text{ V}}$.

The power absorbed by R_2 is $P_2 = v_2 i_2 = 16\cdot2 = \underline{32\text{ W}}.$

P2.5-7

Model the heater as a resistor, then

with a 250 V source: $P = \dfrac{v^2}{R} \Rightarrow R = \dfrac{v^2}{P} = \dfrac{(250)^2}{1000} = \underline{62.5\,\Omega}$

with a 210 V source: $P = \dfrac{v^2}{R} = \dfrac{(210)^2}{62.5} = \underline{705.6\text{ W}}$

P2.6-2

(a) $v = R\, i_s = 5 \cdot 2 = \underline{10\ \text{V}}$ and $P = \frac{v^2}{R} = \frac{10^2}{5} = \underline{20\ \text{W}}$

(b) v and P do not depend on v_s.

The values of v and P are 10V and 20 W both when $v_s = 10$ V and when $v_s = 5$ V

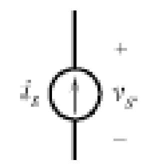
P2.6-3

Consider the current source:

i_s and v_s do not adhere to the passive convention,

so $P_{cs} = i_s v_s = 3 \cdot 12 = \underline{36\ \text{W}}$

is the power supplied by the current source.



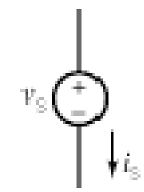
Consider the voltage source:

i_s and v_s do adhere to the passive convention,

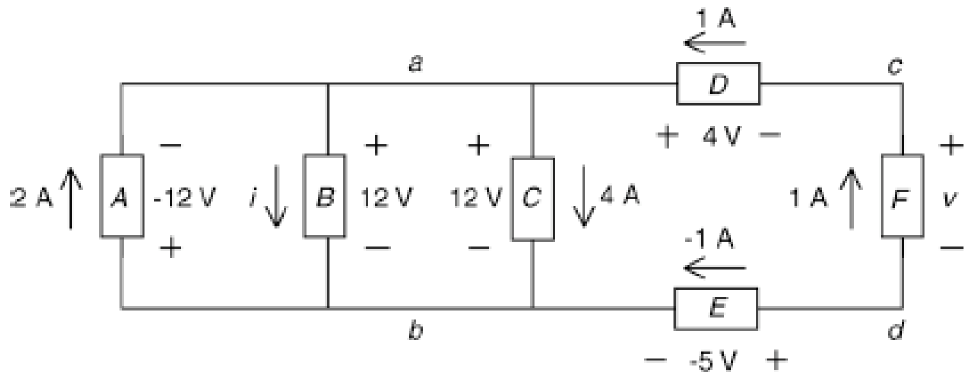
so $P_{vs} = i_s\ v_s = 3 \cdot 12 = \underline{36\ \text{W}}$

is the power absorbed by the voltage source.

$\therefore$ <u>The voltage source supplies –36 W.</u>



P3.3-1



Apply KCL at node *a* to get $2 + 1 = i + 4 \Rightarrow i = -1$ A

The current and voltage of element *B* adhere to the passive convention so (12)(-1) = -12 W is power received by element *B*. The power supplied by element *B* is <u>12 W</u>.

Apply KVL to the loop consisting of elements *D*, *F*, *E*, and *C* to get

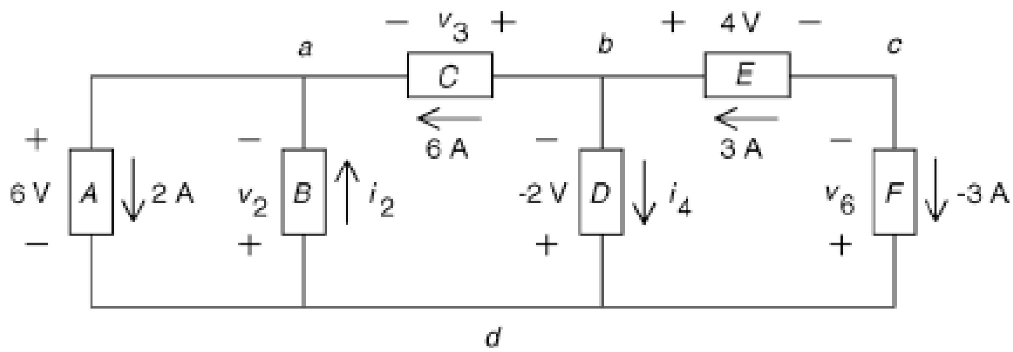
$$4 + v + (-5) - 12 = 0 \Rightarrow v = 13 \text{ V}$$

The current and voltage of element *F* do not adhere to the passive convention so (13)(1) = <u>13 W</u> is the power supplied by element *F*.

Check: The sum of the power supplied by all branches is

$$-(2)(-12) + \underline{12} - (4)(12) + (1)(4) + \underline{13} - (-1)(-5) = 24 + 12 - 48 + 4 + 13 - 5 = 0$$

P3.3-2



Apply KCL at node *a* to get $\quad 2 = i_2 + 6 = 0 \Rightarrow \; i_2 = -4 \text{ A}$

Apply KCL at node *b* to get $\quad 3 = i_4 + 6 \Rightarrow \; i_4 = -3 \text{ A}$

Apply KVL to the loop consisting of elements *A* and *B* to get

$$-v_2 - 6 = 0 \Rightarrow \; v_2 = -6 \text{ V}$$

Apply KVL to the loop consisting of elements *C*, *D*, and A to get

$$-v_3 - (-2) - 6 = 0 \Rightarrow \; v_4 = -4 \text{ V}$$

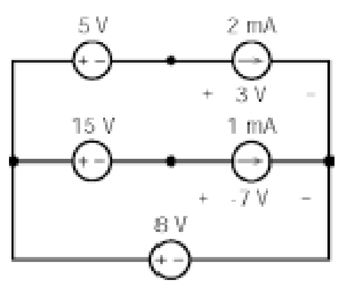
Apply KVL to the loop consisting of elements *E*, *F* and *D* to get

$$4 - v_6 + (-2) = 0 \Rightarrow \; v_6 = 2 \text{ V}$$

Check: The sum of the power supplied by all branches is

$$-(6)(2) - (-6)(-4) - (-4)(6) + (-2)(-3) + (4)(3) + (2)(-3) = -12 - 24 + 24 + 6 + 12 - 6 = 0$$

P3.3-6

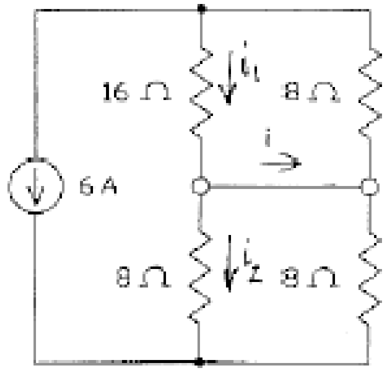


$$P_{2\text{mA}} = -\left[3\times\left(2\times10^{-3}\right)\right] = -6\times10^{-3} = -6 \text{ mW}$$

$$P_{1\text{mA}} = -\left[-7\times\left(1\times10^{-3}\right)\right] = 7\times10^{-3} = 7 \text{ mW}$$

(checked using LNAP 8/16/02)

P3.5-4



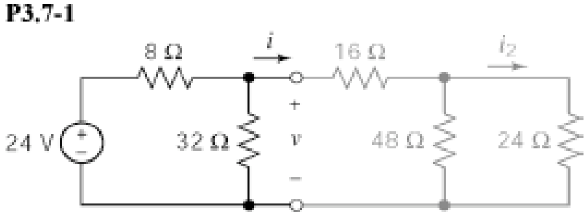
Current division:

$$i_1 = \frac{8}{16+8}(-6) = -2 \text{ A}$$

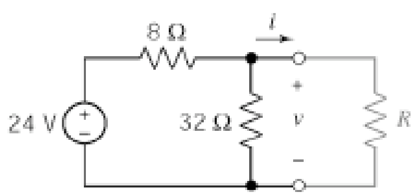
$$i_2 = \frac{8}{8+8}(-6) = -3 \text{ A}$$

$$i = i_1 - i_2 = \underline{+1 \text{ A}}$$

P3.7-1



(a)



(b)

$$(a)\;\; R = 16 + \frac{48 \cdot 24}{48+24} = \underline{32\ \Omega}$$

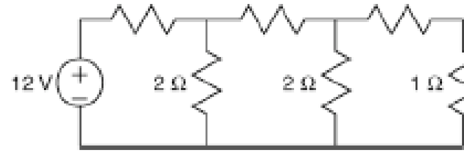
$$(b)\;\; v = \frac{\dfrac{32 \cdot 32}{32+32}}{8 + \dfrac{32 \cdot 32}{32+32}} 24 = \underline{16 \text{ V}};$$

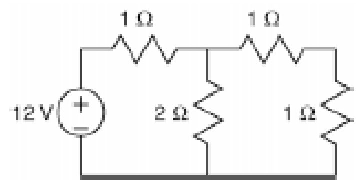
$$i = \frac{16}{32} = \underline{\frac{1}{2} \text{ A}}$$

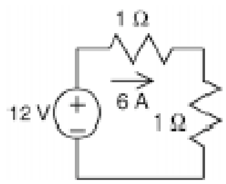
$$(c)\;\; i_2 = \frac{48}{48+24} \cdot \frac{1}{2} = \underline{\frac{1}{3} \text{ A}}$$

P3.7-3

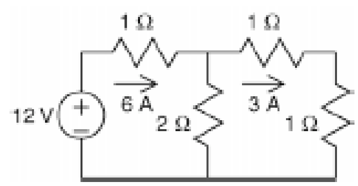
Reduce the circuit from the right side by repeatedly replacing series 1 Ω resistors in parallel with a 2 Ω resistor by the equivalent 1 Ω resistor

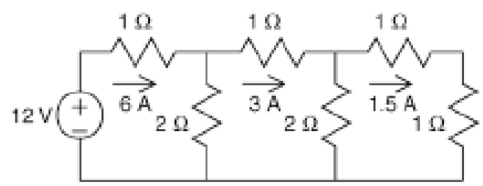


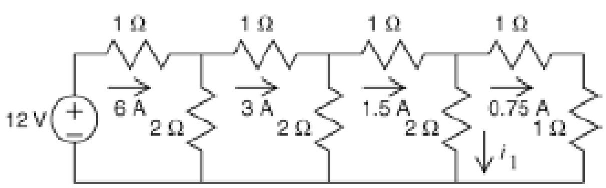




This circuit has become small enough to be easily analyzed. The vertical 1 Ω resistor is equivalent to a 2 Ω resistor connected in parallel with series 1 Ω resistors:







$$i_1 = \frac{1+1}{2+(1+1)}(1.5) = 0.75 \text{ A}$$