ECSE 200 - Electric Circuits 1
Tutorial 3

ECE Dept., McGill University

Recall

- **N Resistors in series**

$$R_{eq} = \sum_{i=1}^{i=N} R_i$$

The current passes through each resistor is the same. However, the voltage of ith component is

$$V_i = \frac{R_i}{R_{eq}} V_{total}$$

- **N Resistors in parallel**

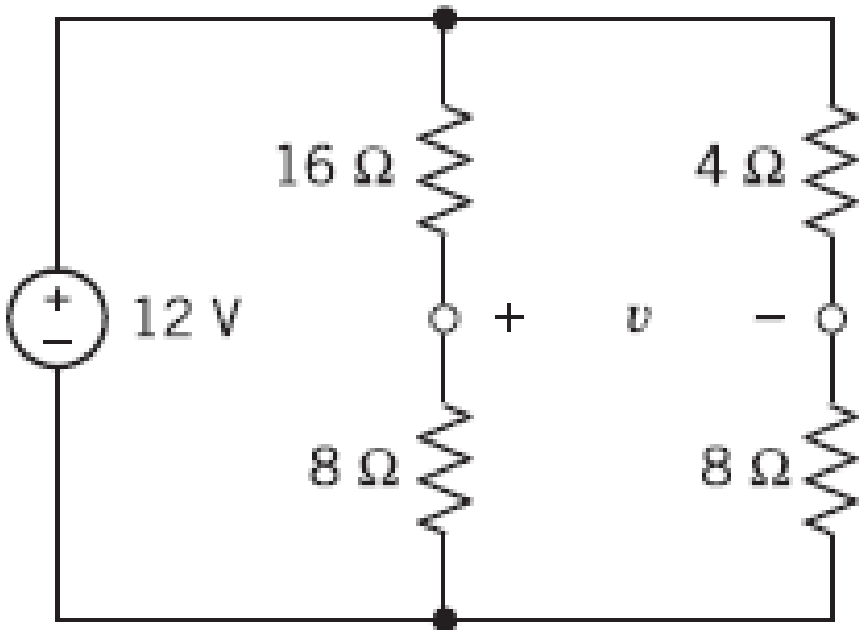
$$R_{eq} = \frac{1}{\sum_{i=1}^{i=N} \frac{1}{R_i}}$$

The voltage across each resistor is the same. However, the current of ith component is

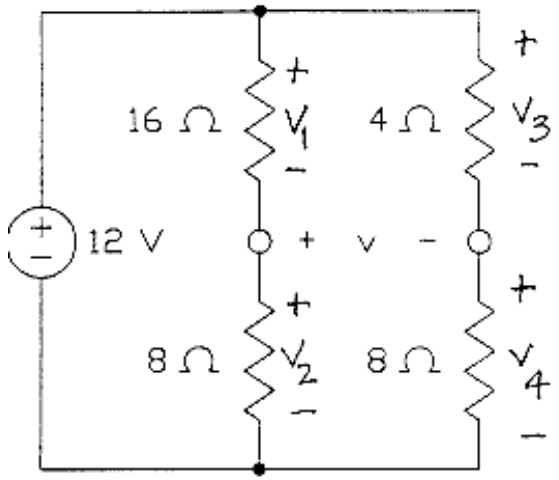
$$I_i = \frac{R_{eq}}{R_i} I_{total}$$

Problem P 3.3-4

Determine the voltage v in the circuit shown in the figure.



Problem P 3.3-4 Solution



Voltage division

$$v_1 = \frac{16}{16+8}12 = 8\ \text{V}$$

$$v_3 = \frac{4}{4+8}12 = 4\ \text{V}$$

KVL: $v_3 - v - v_1 = 0$

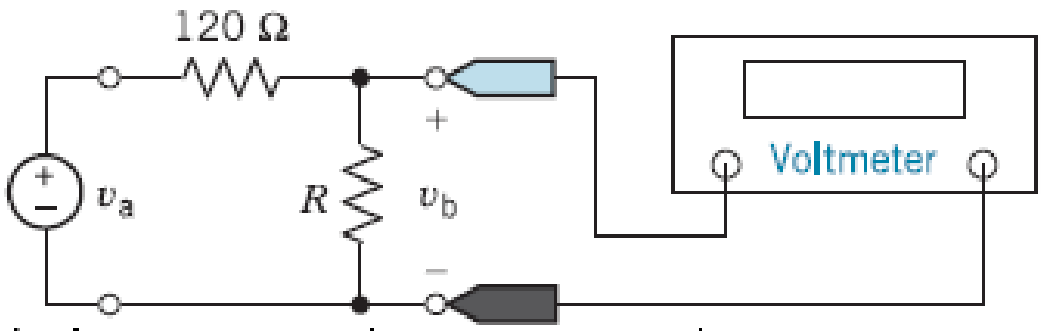
$$\underline{v = -4\ \text{V}}$$

Problem P 3.3-6

The input to the circuit shown in the figure is the voltage of the voltage source, va. The output of this circuit is the voltage measured by the voltmeter, vb. This circuit produces an output that is proportional to the input, that is $v_b = kv_a$ where k is the constant of proportionality.

- Determine the value of the output, v_b, when $R = 240\Omega$ and $v_a = 18(V)$.
- Determine the value of the power supplied by the voltage source when $R = 240\Omega$ and $v_a = 18(V)$.
- Determine the value of the resistance, R, required to cause the output to be $v_b = 2(V)$ when the input is $v_a = 18(V)$.
- Determine the value of the resistance, R, required to cause $vb = 0.2v_a$ (that is, the value of the constant of proportionality is $k = 0.2$)

Problem P 3.3-6 Solution



a.) $\left(\frac{180}{120+180}\right)18 = 10.8 \text{ V}$

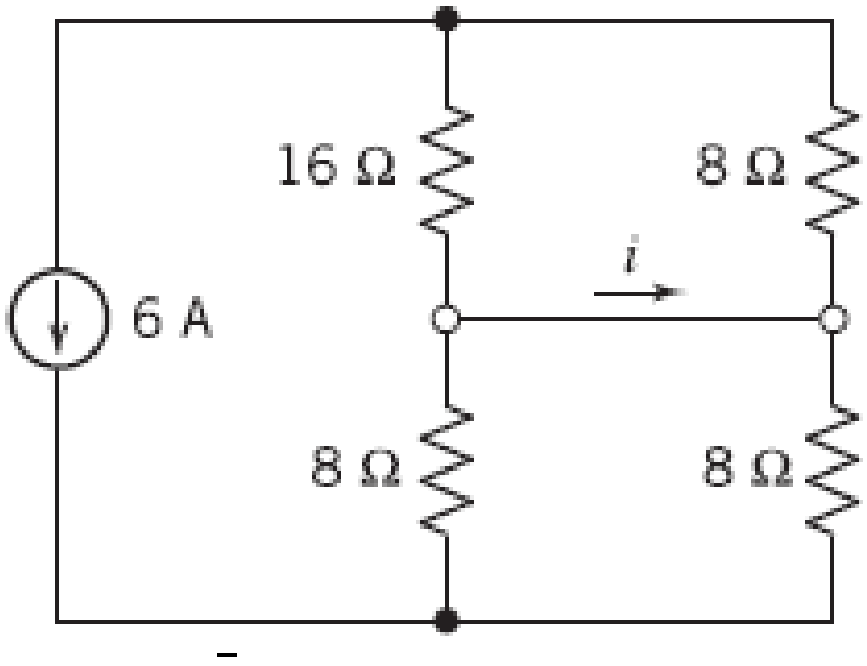
b.) $18\left(\frac{18}{120+180}\right) = 1.08 \text{ W}$

c.) $\left(\frac{R}{R+120}\right)18 = 2 \quad \Rightarrow \quad 18R = 2R + 2(120) \quad \Rightarrow \quad R = 15 \ \Omega$

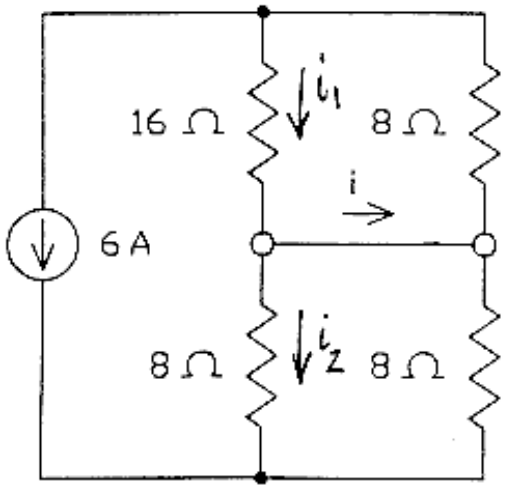
d.) $0.2 = \frac{R}{R+120} \quad \Rightarrow \quad (0.2)(120) = 0.8R \quad \Rightarrow \quad R = 30 \ \Omega$

Problem P 3.4-4

Determine the current i in the circuit shown in the figure.



Problem P 3.4-4 Solution



Current Division:

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

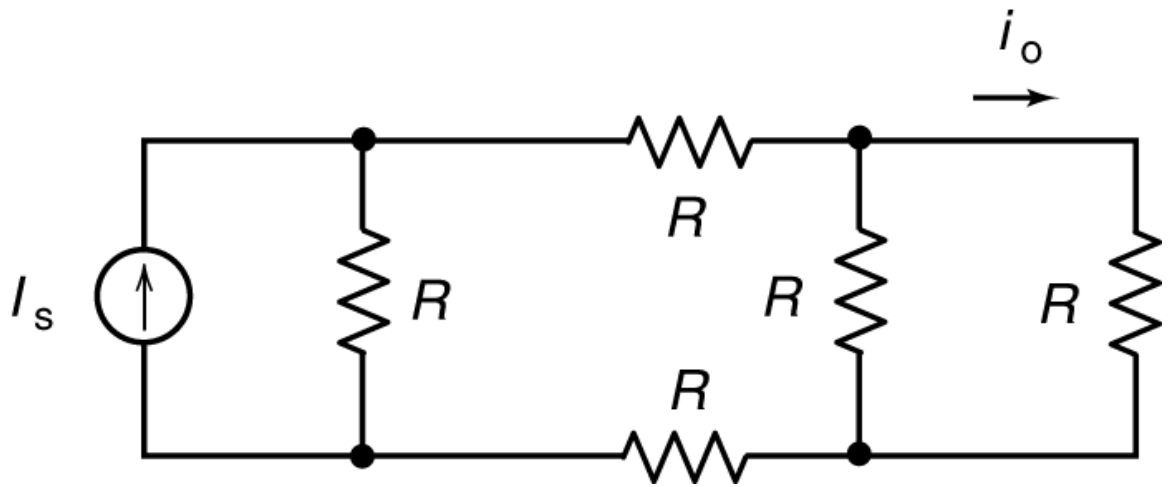
$$i_2 = \frac{8}{8+8}(-6) = -3(A)$$

KCL:

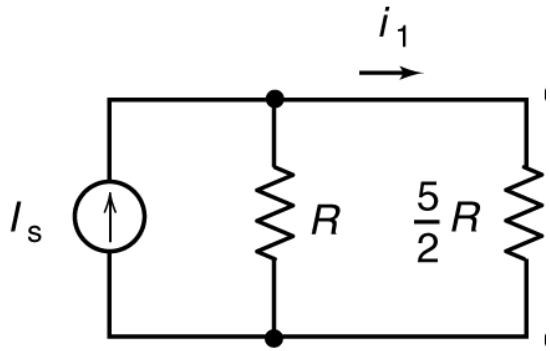
$$i = i_1 - i_2 = -2 - (-3) = 1(A)$$

Problem P 3.4-19

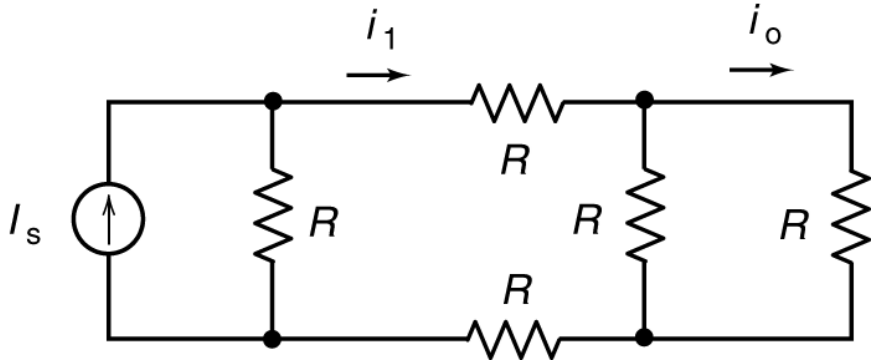
The input to the circuit shown in the figure is the current source current I_s. The output is the current i_o. The output of this circuit is proportion to the input, that is $i_o = kI_s$. Determine the value of the constant of proportionality, k.



Problem P 3.4-19 Solution



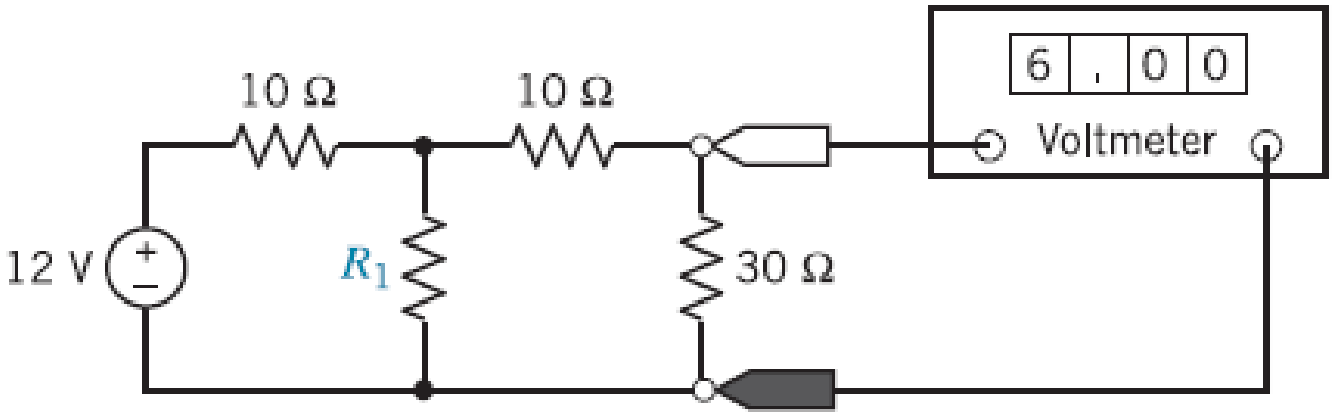
$$i_1 = \left(\frac{\frac{5}{2}R}{R + \frac{5}{2}R}\right) I_s = \frac{2}{7} I_s$$



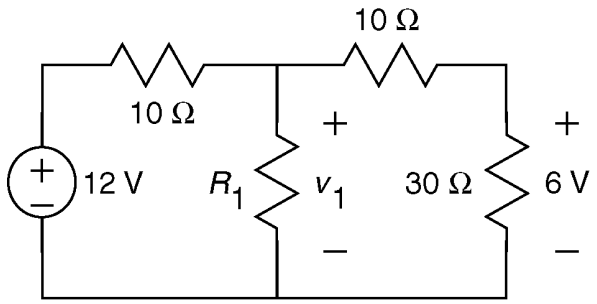
$$i_o = \frac{R}{R+R} I_1 = \frac{I_1}{2} = \frac{1}{7} I_s \Rightarrow k = \frac{1}{7}$$

Problem P 3.6-5

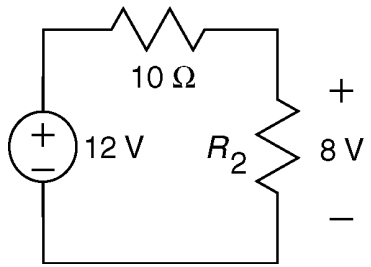
The voltmeter in the circuit shown in the figure shows that the voltage across the 30Ω resistor is 6 volts. Determine the value of the resistance R_1. **Hint:**Use the voltage division twice.



Problem P 3.6-5 Solution



$$6 = \frac{30}{10+30} v_1 \Rightarrow v_1 = 8(V)$$

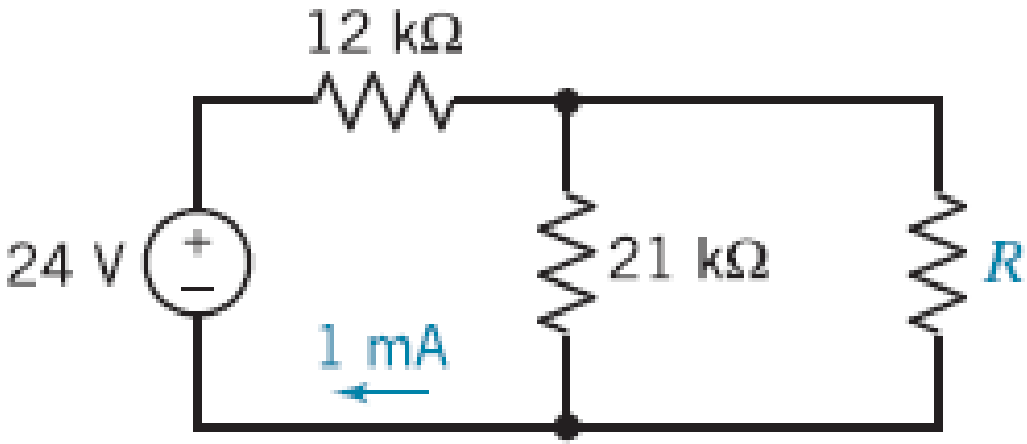


$$8 = \frac{R_2}{R_2+10} 12 \Rightarrow R_2 = 20\Omega \Rightarrow$$

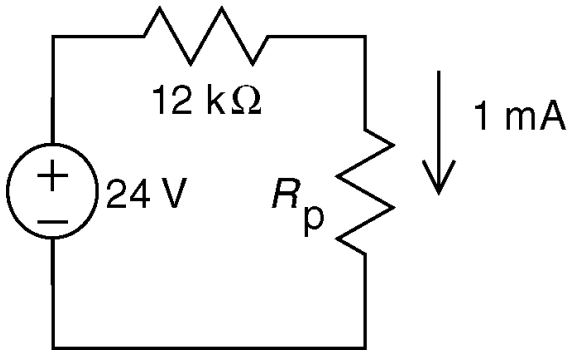
$$20 = \frac{R_1(10+30)}{R_1+10+30} \Rightarrow R_1 = 40\Omega$$

Problem P 3.6-7

Determine the value of the resistance R in the figure.



Problem P 3.6-7 Solution

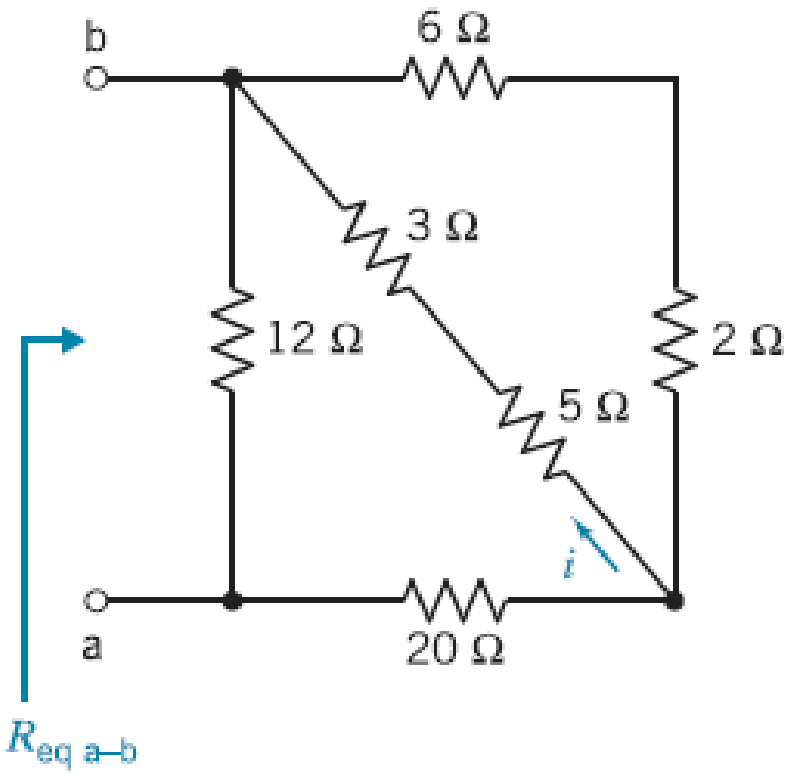


$$1\times10^{-3}=\frac{24}{12\times10^{3}+R_p}\quad\Rightarrow R_p=12\times10^{3}=12\ \text{k}\Omega$$

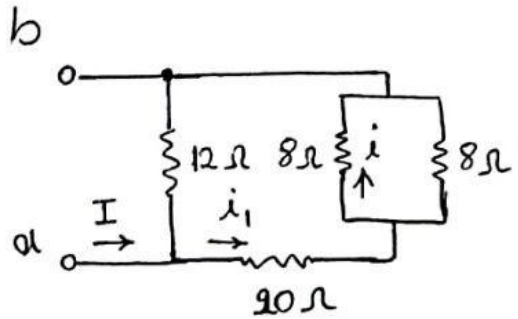
$$12\times10^{3}=R_p=\frac{\left(21\times10^{3}\right)R}{\left(21\times10^{3}\right)+R}\quad\Rightarrow\quad R=28\ \text{k}\Omega$$

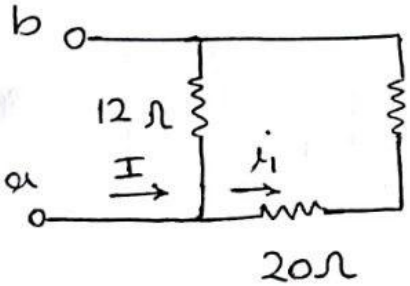
Problem P 3.6-11

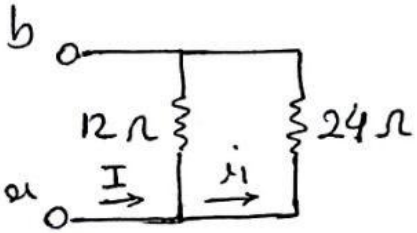
Find i and $R_{eq\ ab}$ if $v_ab = 40(V)$ in the circuit of the figure.



Problem P 3.6-11 Solution







$$R_{eq} = \frac{1}{\frac{1}{12}+\frac{1}{24}} = \frac{24}{\frac{24}{12}+1} = 8\ \Omega$$

$$I = \frac{V_{ab}}{R_{eq}} = \frac{40}{8} = 5\ (A)$$

$$i_1 = \frac{12}{12+24}\, I = \frac{5}{3}\ (A) \Rightarrow i = \frac{i_1}{2} = \frac{8}{8+8}\, i_1 = \frac{5}{6}\ (A)$$

(1/2)

Thank you !