Assignment 10 Solutions

1. Current $I = 10^{10} \frac{\text{elect}}{\text{sec}} \times 1.6 \times 10^{-19} \frac{C}{\text{elect}} = 1.6 \times 10^{-9}$ amp.

2. A kettle draws 3 A of DC current when it is connected to a 10 V battery.
   a) What is the kettle resistance?

$$\text{Resistance } R = \frac{V}{I}$$

$$= \frac{10\,V}{3\,A}$$

$$= 3.33 \text{ ohm.}$$

   b) What power is supplied to the kettle?

$$\text{Power } P = VI$$

$$= 10 \text{ volts} \times 3\,A$$

$$= 30 \text{ watts}$$

   c) If the kettle has 1 liter of water initially at a temperature of 20 C, how long will it take for the water to be heated to 90C?

Energy supplied in time t = Energy heat 1 l H_2O by (90-20)C

$$P\,t = 1000 \text{ gm} \times 70\,C \times 1 \frac{\text{calorie}}{c\,\text{gm}} \times 4.18 \frac{J}{\text{cal.}}$$

(P: 30 watts)

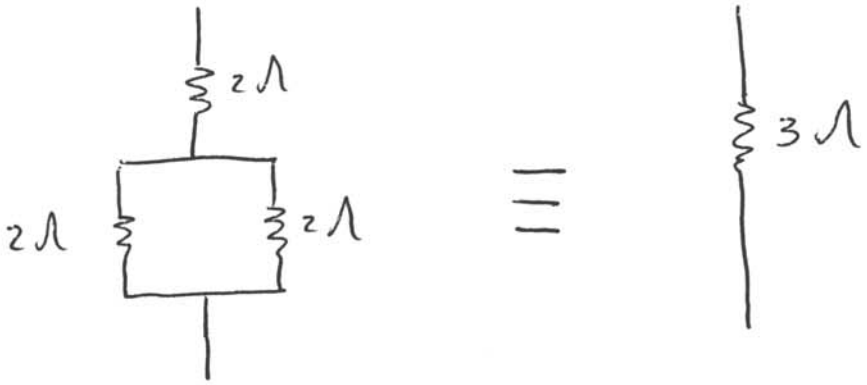
$$\therefore t = 9.75 \times 10^{3} \text{ sec.}$$

$$= 2.7 \text{ hrs.}$$

This is far from acceptable. One then should go to Tim Horton!

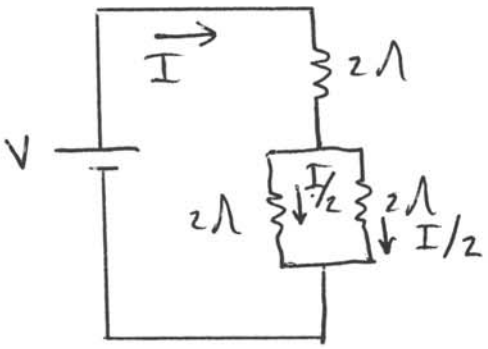
3 A laboratory only as 2 ohm resistors.

a) Draw the circuit required to create a 3 ohm resistance

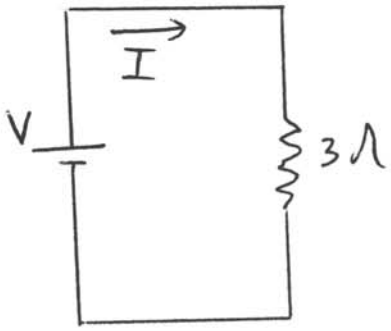


b) Show that the total power dissipated in the above circuit is the same as when a single 3 ohm resistor is available.

Circuit a



Circuit b



In both circuits $I = \frac{V}{3}$.

Circuit a Power dissipation $= I^2R + \left(\frac{I}{2}\right)^2 R \times 2$

$= \frac{3}{2} I^2 R$

$= \frac{3}{2}\left(\frac{V}{3}\right)^2 \times 2$

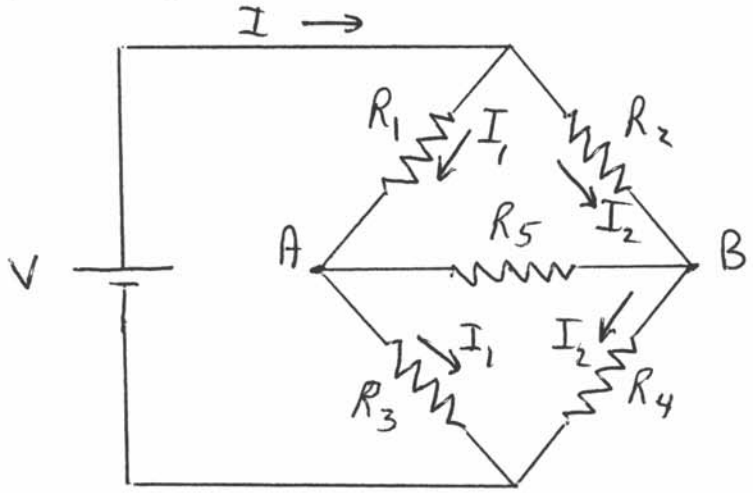
$P_a = \frac{V^2}{3}$

Circuit b Power dissipation $= I^2 \times 3$

$P_b = \frac{V^2}{3}$

$\therefore P_a = P_b$.

4 Consider the Wheatstone bridge circuit shown below. Show that no current passes through R_5 if $R_1 / R_3 = R_2 / R_4$



No current through $R_5 \Rightarrow V_{AB} = 0$.

$\therefore$ voltage across R_1 = voltage across R_2

$$I_1 R_1 = I_2 R_2 \quad (1)$$

Also voltage across R_3 = voltage across R_4

$$I_1 R_3 = I_2 R_4 \quad (2)$$

$(1) \div (2) \Rightarrow \quad \frac{R_1}{R_3} = \frac{R_2}{R_4}$