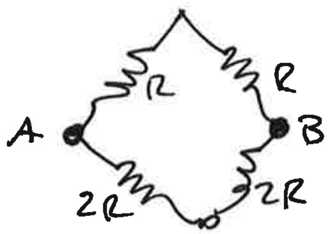
PH102 Spring 2015
LeClair Exam 2

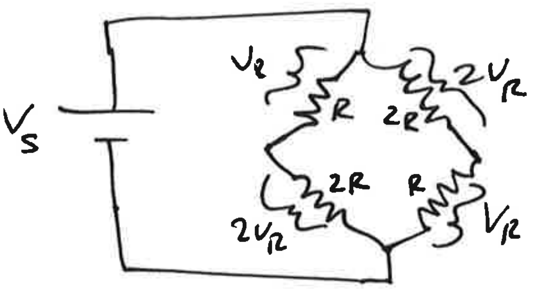
1. a) based on symmetry, there is no voltage drop across the center R



- from top to bottom, same net resistance going on L or R branch
- thus, I same thru L or R
- thus, voltage at A and B must be the same

b) still, net current in either branch is the same!

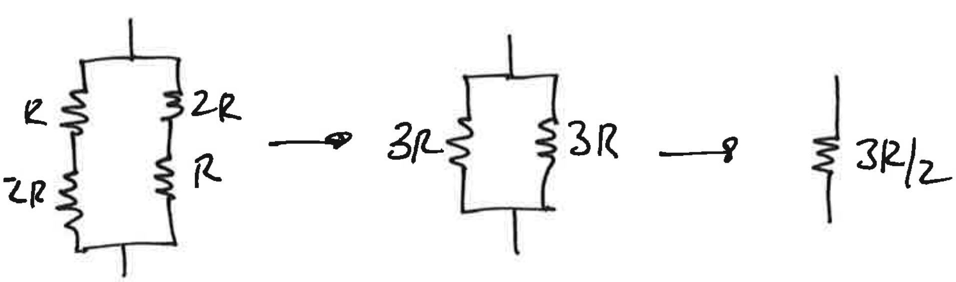
- the R's have half the voltage drop of the 2R's
- we can just use proportions. Let V_R be the voltage drop on an "R"



the voltage splits into a 2:1 ratio in each branch. That means the net V_s is split into 3. The 2R resistor takes $\frac{2V_s}{3}$, the R takes $\frac{V_s}{3}$

$\Rightarrow$ across the middle, we have the difference between $\frac{V_s}{3}$ and $\frac{2V_s}{3}$, or $\boxed{\Delta V = \frac{2V_s}{3} - \frac{V_s}{3} = \frac{V_s}{3}}$ with the LHS being positive

c) redraw



equivalent is $\frac{3R}{2}$, so

$\cancel{I = \frac{V_s}{R_{eq}} = \frac{9V_s}{3R/2} = \frac{18V}{3R} = \frac{\ldots}{3R}}$

$$I = \frac{V_s}{R_{eq}} = \frac{V_s}{3R/2} = \frac{2V_s}{3R}$$

2

a) $R = \frac{\rho l}{A} = \frac{\rho l}{\pi (\frac{d}{2})^2} \simeq \boxed{0.0611\,\Omega}$

b) $I = \frac{\Delta V}{R} \simeq \boxed{1963\,A}$ outlandishly large. a household breaker handles 15A typically.

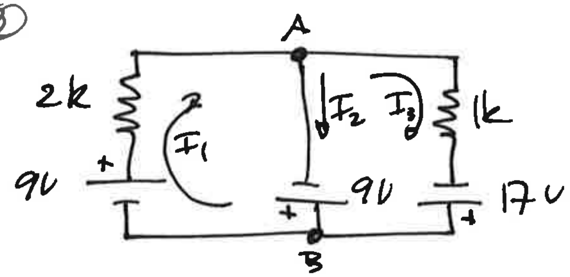
c) $P = I\Delta V = I^2 R = 2.3\times10^5\,W = \boxed{235.5\,kW}$ this will vaporize the wire. it was stupid to connect a bare wire to our 120V source, and something is broken now.

d) $I = nqv_d A$ $\quad l = v_d t$ (not covered)

$t = \frac{l}{v_d} = \frac{l}{I/nqA} = \frac{lnq\pi d^2}{4I} \simeq \boxed{16.2\,sec}$

note $A = \frac{\pi d^2}{4}$ $\quad$ note $q = e$

3



LHS loop: $9V - 2000 I_1 + 9V = 0 \Rightarrow 18 = 2000 I_1 \Rightarrow I_1 = 9mA$

RHS loop: $9V - 17V + 1000 I_3 = 0 \Rightarrow 8V = 1000 I_3 \Rightarrow I_3 = 8mA$

top or bottom junction (A or B): $I_1 = I_2 + I_3$

$$\Rightarrow \boxed{I_2 = I_1 - I_3 = 9mA - 8mA = 1mA}$$

4. from LHS box:

$R_{ab} = 20$ par to $(30+50) \Rightarrow \frac{1}{R_{ab}} = \frac{1}{20} + \frac{1}{80} = \frac{1}{16} \Rightarrow R_{ab} = 16\Omega$

Similarly, $R_{ac} = 25$ and $R_{bc} = 21$

note now $R_{ab} = R_1 + R_2 \quad R_{ac} = R_1 + R_3 \quad R_{bc} = R_2 + R_3$

we have then

$$\left.\begin{array}{l} R_1 + R_3 = 25 \\ R_1 + R_2 = 16 \end{array}\right\} \rightarrow R_3 - R_2 = 9$$

$$R_2 + R_3 = 21 \rightarrow R_3 + R_2 = 21$$

$$\rightarrow 2R_3 = 30 \Rightarrow R_3 = 15$$

$R_1 + R_3 = 25 \Rightarrow R_1 = 10$

$R_2 + R_3 = 21 \Rightarrow R_2 = 6$

$$\boxed{\begin{array}{l} R_1 = 10\Omega \\ R_2 = 6\Omega \\ R_3 = 15\Omega \end{array}}$$