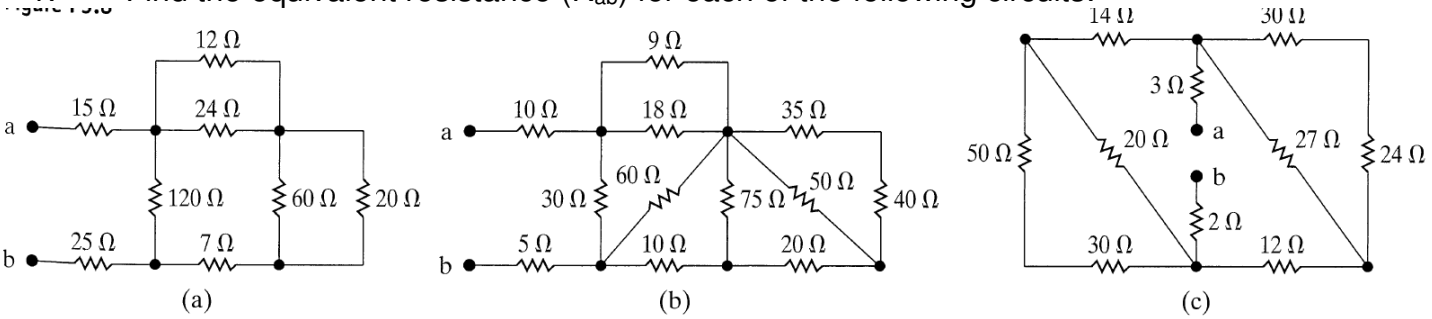
Homework Set #6
DUE Tuesday, March 21, 2017 – COB

1. Find the equivalent resistance (R_{ab}) for each of the following circuits:



[a] $60\|20 = 1200/80 = 15\,\Omega$ $\quad 12\|24 = 288/36 = 8\,\Omega$

$15 + 8 + 7 = 30\,\Omega$ $\quad 30\|120 = 3600/150 = 24\,\Omega$

$R_{ab} = 15 + 24 + 25 = 64\,\Omega$

[b] $35 + 40 = 75\,\Omega$ $\quad 75\|50 = 3750/125 = 30\,\Omega$

$30 + 20 = 50\,\Omega$ $\quad 50\|75 = 3750/125 = 30\,\Omega$

$30 + 10 = 40\,\Omega$ $\quad 40\|60 + 9\|18 = 24 + 6 = 30\,\Omega$

$30\|30 = 15\,\Omega$ $\quad R_{ab} = 10 + 15 + 5 = 30\,\Omega$

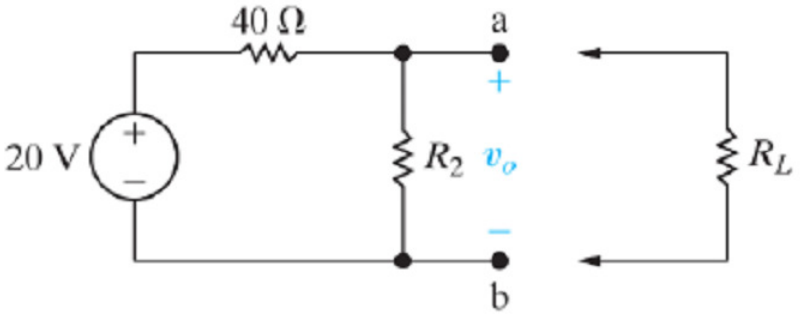
[c] $50 + 30 = 80\,\Omega$ $\quad 80\|20 = 16\,\Omega$

$16 + 14 = 30\,\Omega$ $\quad 30 + 24 = 54\,\Omega$

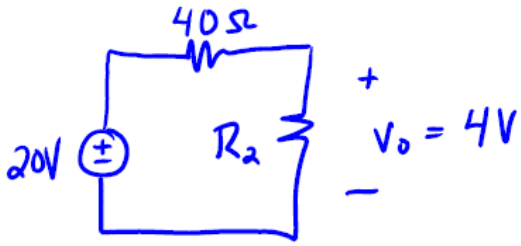
$54\|27 = 18\,\Omega$ $\quad 18 + 12 = 30\,\Omega$

$30\|30 = 15\,\Omega$ $\quad R_{ab} = 3 + 15 + 2 = 20\,\Omega$

2. The output of the voltage divider is 4 V when R_L is not connected. When R_L is connected it drops to 3 V. Find R_L.



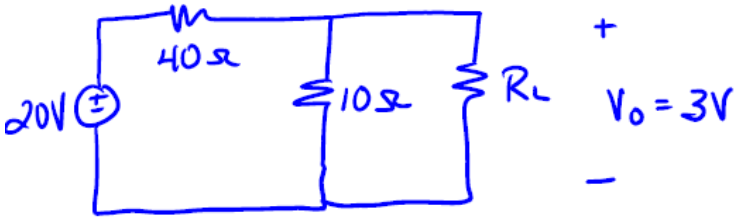
No-load circuit



Volt div) $\quad 4 = 20\left(\frac{R_2}{40+R_2}\right)$

$\Rightarrow R_2 = 10$

loaded circuit



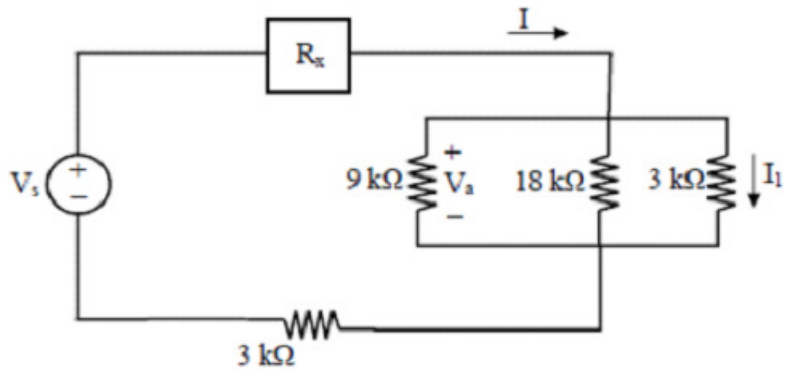
$$3 = 20\,\frac{10 \parallel R_L}{(40 + 10 \parallel R_L)}$$

$$\frac{3}{20} = \frac{10\,R_L}{(10 + R_L)} \cdot \frac{1}{\left(40 + \frac{10\,R_L}{10 + R_L}\right)}$$

$$\Rightarrow \boxed{R_L = 24\,\Omega}$$

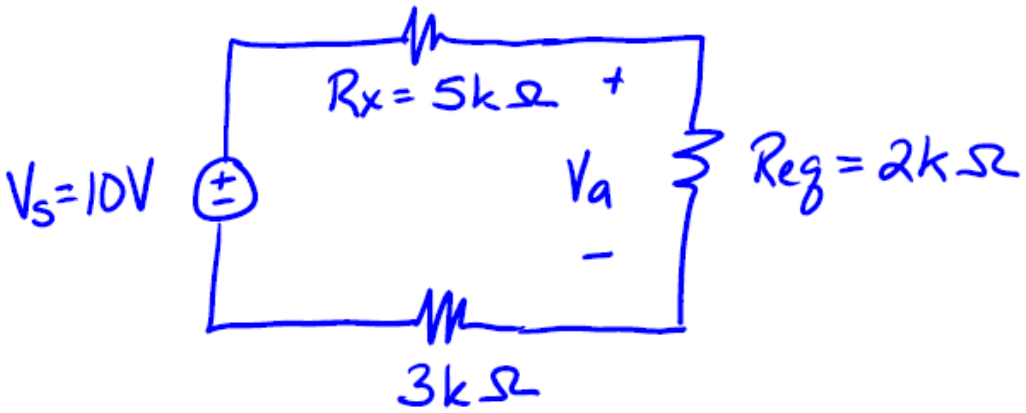
3.

a. Find the equivalent resistance (R_{eq}) for the three resistors in parallel.
b. Calculate the voltage V_a if V_s = 10 Volts and R_x = 5 kΩ.
c. Parameters in the circuit are changed such that V_s and R_x are not known and I_1 = 3mA. Calculate the current I.



a) $R_{eq} = 9k \| 18k \| 3k = 2k\Omega$

b) equivalent ckt



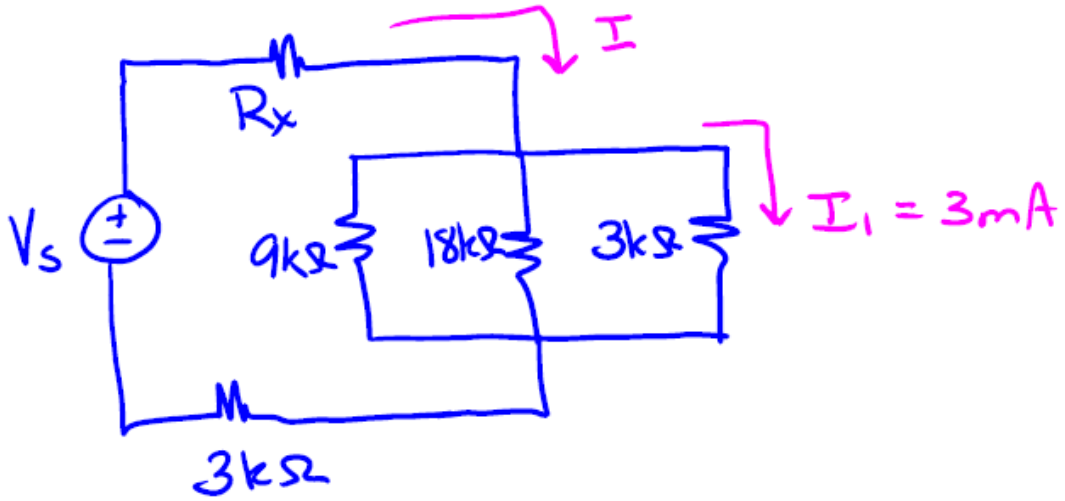
using voltage divider:

$$V_a = \frac{V_s \cdot R_{eq}}{R_x + R_{eq} + 3k}$$

$$= \frac{(10)(2k)}{5k + 2k + 5k} = 1\,2/3$$

$$\boxed{V_a = 1\,2/3\ V}$$

c) Find I and I_1



use current divider

$$I_1 = \frac{I\,(9k \parallel 18k \parallel 3k)}{3k}$$

$$I = \frac{(3m)(3k)}{(2k)}$$

$$\boxed{I = 4.5\,mA}$$