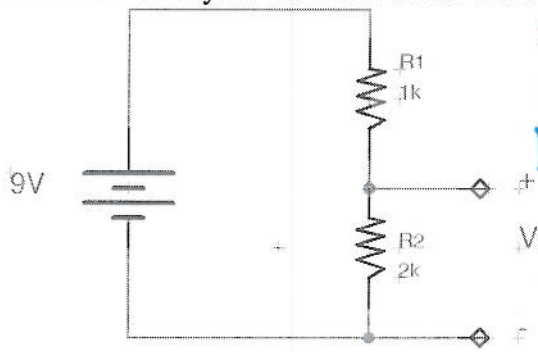
DANIELLE CLASS KEY

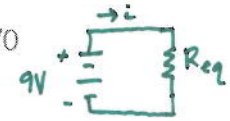
1. (1 pt.) Using Ohm's Law, find the value of V0. All resistances are in Ohms (Ω), be sure to include units in your answers! **Note: all k's are short for kΩ for rest of HW.**



$R_{eq,series} = R_1 + R_2$

$R_{eq} = 1k\Omega + 2k\Omega$

$\boxed{R_{eq} = 3k\Omega}$

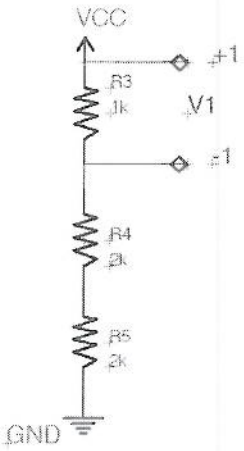


$V_o = \frac{R_2}{R_{eq}} \cdot V_{cc}$

$V_o = \frac{2k\Omega}{3k\Omega} \cdot 9V$

$\boxed{V_o = 6V}$

2. (2 pts.) Draw the equivalent circuit using only one resistor (R_{eq}), and find its value. Then find the value of V1. **Assume that VCC = 9v for the rest of the HW.**



$R_{eq,series} = R_3 + R_4 + R_5$

$R_{eq} = 1k\Omega + 2k\Omega + 2k\Omega$

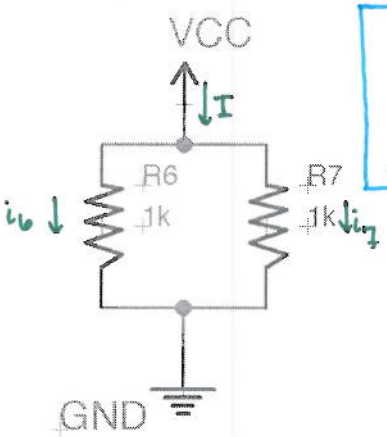
$\boxed{R_{eq} = 5k\Omega}$

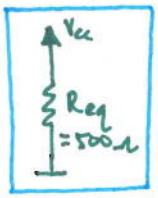
$V_1 = \frac{R_3}{R_{eq}} \cdot V_{cc}$

$V_1 = \frac{1k\Omega}{5k\Omega} \cdot 9V$

$\boxed{V_1 = \frac{9}{5}V}$

3. (2 pts.) Find the current that flows through each R6 and R7. Then draw the equivalent one resistor circuit and label the value of R_{eq}.





$R_{eq,parallel} = \frac{R_6 R_7}{R_6 + R_7} = \frac{(1k\Omega)(1k\Omega)}{2k\Omega} = \frac{1k\Omega \cdot k\Omega}{2k\Omega}$

$\boxed{R_{eq} = \frac{1}{2}k\Omega = 500\Omega}$

$V_{cc} = IR_{eq}$

$I = \frac{V_{cc}}{R_{eq}}$

$I = \frac{9V}{500\Omega}$

$I = \frac{9}{500}A = \frac{18}{1000}A = 18mA$

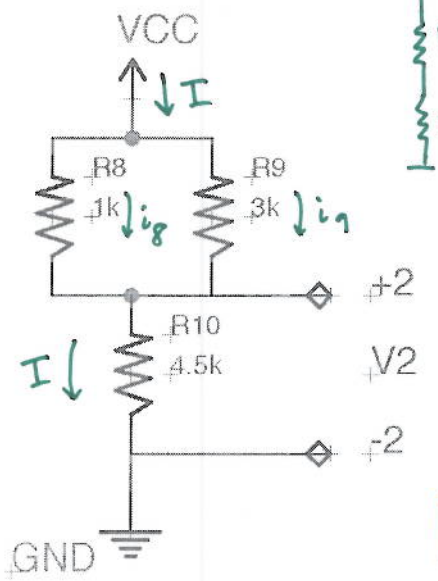
$I = 18mA$

$i_6 = i_7 = \frac{1}{2}I$

$i_6 = i_7 = \frac{1}{2}(18mA)$

$\boxed{i_6 = i_7 = 9mA}$

4. (3 pts.) Find the value of V2, calculate R_{eq} for the entire circuit, find the current that flows through R9.



$i_8 + i_9 = I$

$R_{eq} = \frac{1k\Omega \cdot 3k\Omega}{1k\Omega + 3k\Omega} = \frac{3\ k\Omega \cdot k\Omega}{4\ k\Omega} \rightarrow R_{eq} = \frac{3}{4}\ k\Omega$

$R_{eq} = 750\Omega$

$R_{EQ} = R_{eq} + R_{10} = \frac{3}{4}\ k\Omega + 4.5\ k\Omega$

$R_{EQ} = 5.25\ k\Omega$

$I = \frac{V_{cc}}{R_{EQ}} = \frac{9V}{5.25k\Omega} \rightarrow I = 1.714mA$

$V_2 = \frac{R_{10}}{R_{EQ}} \cdot V_{cc}$

$V_2 = \frac{4.5k\Omega}{5.25\ k\Omega} \cdot 9V$

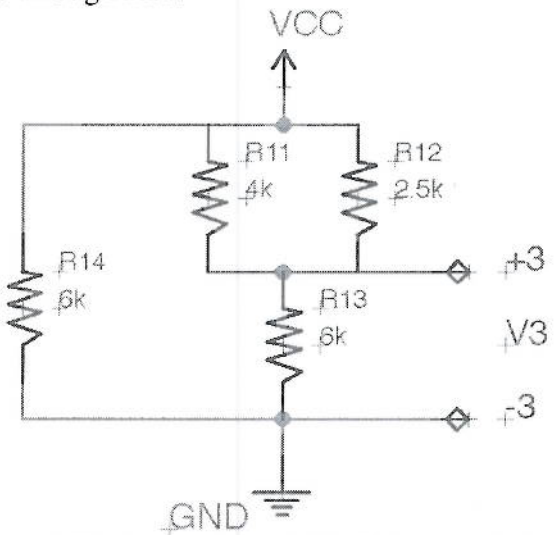
$V_2 = 7.71V$

$i_9 = I \cdot \frac{R_8}{R_8 + R_9} = I \cdot \frac{R_8}{R_{eq}\ \text{denom.}}$

$i_9 = (1.714mA) \cdot \frac{1k\Omega}{4k\Omega} = \frac{1}{4}(1.714mA)$

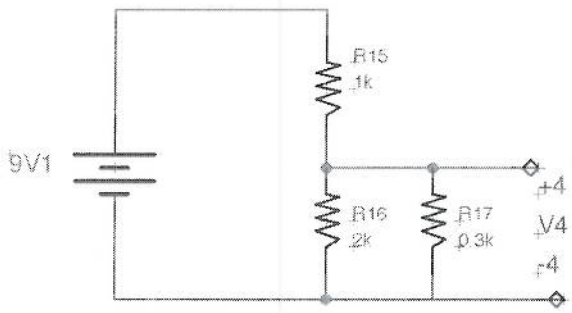
$i_9 = 429mA$

5. CQ (optional) (3 pts.) Find R_{eq} for the entire circuit, calculate V3, and find the current that flows through R11.



see next page for solution.

6. (2 pts.) Find the value of V4. What would happen to V4 if R17 = 30 Ω? 5 Ω?



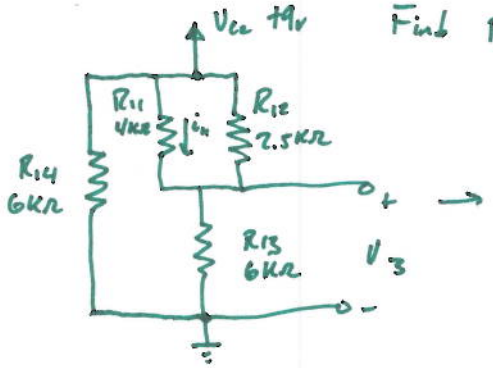
$R_{eq} = \frac{R_{16} \cdot R_{17}}{R_{16} + R_{17}}$

$V_4 = V_{cc} \cdot \frac{R_{eq}}{R_{eq} + R_{15}}$

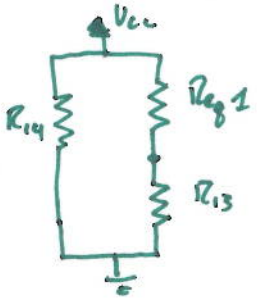
$R_{eq}(R_{17} = 0.3k\Omega) = \frac{2k\Omega \cdot 0.3k\Omega}{2k\Omega + 0.3k\Omega} = 260.87\Omega \rightarrow V_4 = 1.862V$

$R_{eq}(R_{17} = 30\Omega) = \frac{(2k\Omega) \cdot (30\Omega)}{2k\Omega + 30\Omega} = 29.5567\Omega \rightarrow V_4 = 0.258V$

$R_{eq}(R_{17} = 5\Omega) = \frac{2k\Omega \cdot 5k\Omega}{2k\Omega + 5k\Omega} = 4.98753\Omega \rightarrow V_4 = 0.0446V$

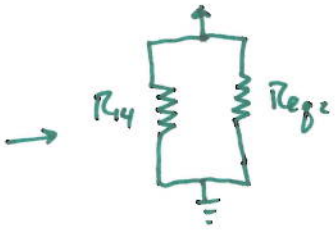
5. 

Find R_{eq}, V_3, & i_{11}



$$R_{eq1} = \frac{R_{11} R_{12}}{R_{11} + R_{12}}$$

$$R_{eq1} = \frac{(4k\Omega)(2.5k\Omega)}{(4k\Omega)+(2.5k\Omega)} = 1.54k\Omega$$



$$R_{eq2} = R_{eq1} + R_{13}$$

$$R_{eq2} = \frac{R_{11} R_{12}}{R_{11} + R_{12}} + R_{13}$$

$$R_{eq,T} = \frac{R_{eq2} R_{14}}{R_{eq2} + R_{14}}$$

$$R_{eq2} = (1.54k\Omega) + (6k\Omega)$$

$$R_{eq2} = 7.54k\Omega$$

$$R_{eqT} = \frac{\left(\frac{R_{11} R_{12}}{R_{11}+R_{12}} + R_{13}\right) R_{14}}{\left(\frac{R_{11} R_{12}}{R_{11}+R_{12}} + R_{13}\right) + R_{14}}$$

$$R_{eqT} = \frac{(7.54k\Omega)(6k\Omega)}{(7.54k\Omega)+(6k\Omega)}$$

$$R_{eqT} = 3.34k\Omega$$

b. V_3

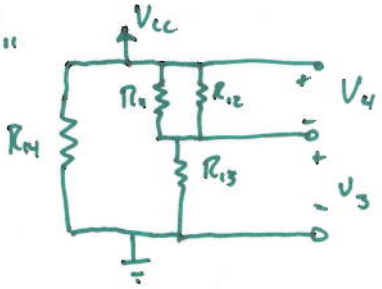
$$V_3 = V_{cc} \frac{R_{13}}{R_{13} + R_{eq1}}$$

$$V_3 = V_{cc} \frac{R_{13}}{R_{13} + \left(\frac{R_{11} R_{12}}{R_{11}+R_{12}}\right)}$$

$$V_3 = V_{cc}(9v) \cdot \frac{(6k\Omega)}{(6k\Omega)+(1.54k\Omega)}$$

$$V_3 = 7.16v$$

c. i_{11}



$$V_{cc} = V_4 + V_3$$

$$V_4 = V_{cc} - V_3$$

$$V = IR$$

$$V_4 = i_{11} R_{11}$$

$$i_{11} = \frac{V_4}{R_{11}}$$

$$i_{11} = \frac{(V_{cc} - V_3)}{R_{11}}$$

$$i_{11} = \frac{(9v) - (7.16v)}{(4k\Omega)}$$

$$i_{11} = 0.46mA$$