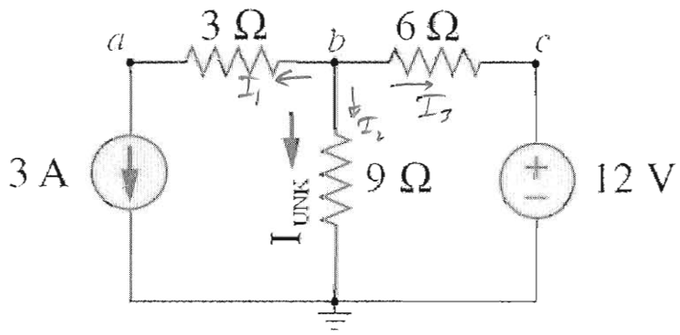
EE301 Nodal Analysis Part II Homework Assignment

1. Given the following circuit:



a. Write the equations for the three branch currents at node b. DRAW the current arrows corresponding to these equations on the circuit above.

$I_1 =$ 3

$I_2 =$ $\frac{V_b}{9}$

$I_3 =$ $\left(\frac{V_b - 12}{6}\right)$

b. Write the resulting Nodal Analysis equation for node b and solve for the unknown voltage V_b. Calculate I_{UNK}.

$$I_1 + I_2 + I_3 = 0$$

$$3 + \frac{V_b}{9} + \frac{V_b - 12}{6} = 0$$

$$V_b\left(\frac{1}{9} + \frac{1}{6}\right) = 2 - 3$$

$$V_b = \frac{-1}{0.2778} = -3.6\,V$$

$$I_{UNK} = \left(\frac{V_b - 0}{9}\right) = \frac{-3.6 - 0}{9} = -400\,mA$$

$V_b =$ $-3.6\,V$

$I_{UNK} =$ $-400\,mA$

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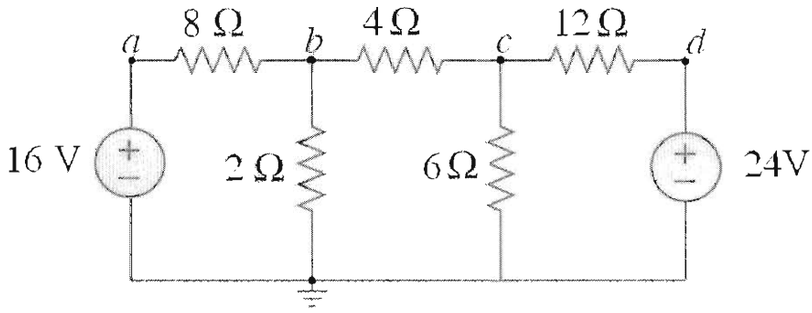
2. Given the following circuit:



c. Identify the voltage at each of the four nodes (either as a value or as UNKNOWN if it must be calculated)

V_a = 16V

V_b = UNK

V_c = UNK

V_d = 24V

d. Write the nodal analysis equation for nodes b and c.

Node b: $\frac{V_b-16}{8} + \frac{V_b}{2} + \frac{V_b-V_c}{4} = 0$

Node c: $\frac{V_c-V_b}{4} + \frac{V_c}{6} + \frac{V_c-24}{12} = 0$

e. Solve for the unknown node voltages.

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In[70]:= Solve [{(b - 16) / 8 + (b / 2) + (b - c) / 4 == 0,  (c - b) / 4 + c / 6
           + (c - 24) / 12 == 0}, {b, c}]

Out[70]=
         {{b → 4, c → 6}}
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$V_b = 4V$

$V_c = 6V$

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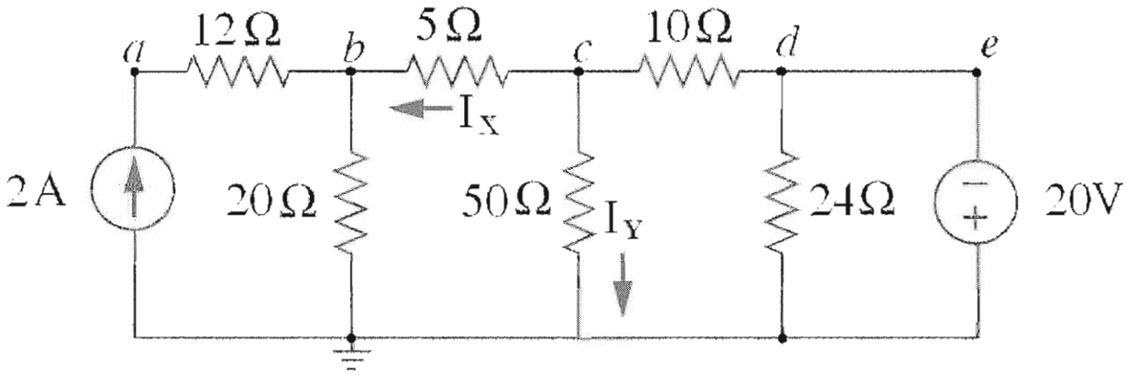
3. Use Nodal Analysis to determine the currents I_X and I_Y in the circuit below.



$$-2 + \left(\frac{V_b}{20}\right) + \left(\frac{V_b - V_c}{5}\right) = 0$$

$$\left(\frac{V_c - V_b}{5}\right) + \frac{V_c}{50} + \frac{V_c - (-20)}{10} = 0$$

In[110]:=

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Solve [{-2 + (b / 20) + (b - c) / 5 == 0,  (c - b) / 5 + c / 50
    + (c + 20) / 10 == 0}, {b, c}]
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Out[110]=

$$\left\{\left\{b \to 6,\ c \to -\frac{5}{2}\right\}\right\}$$

$$I_x = \left(\frac{V_c - V_b}{5}\right) = \left(\frac{-2.5 - 6}{5}\right) = \boxed{-1.7A = I_x}$$

$$I_y = \left(\frac{V_c}{50}\right) = \frac{-2.5}{50} = \boxed{-50\,mA = I_y}$$