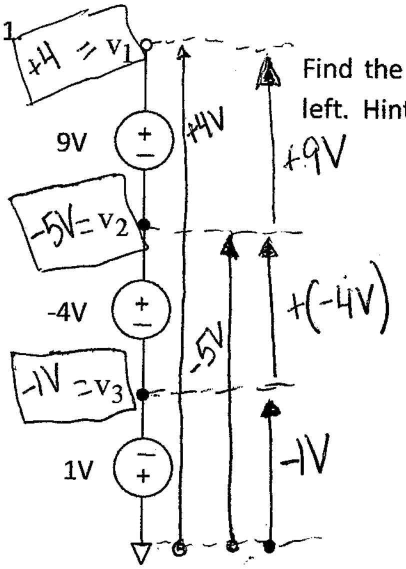
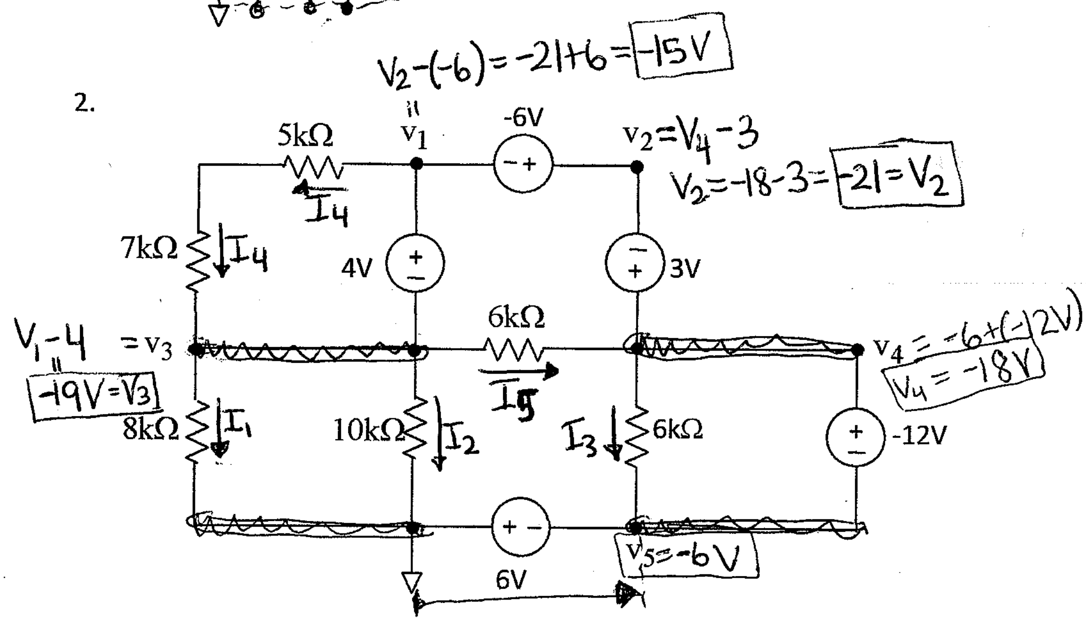
1. Find the absolute voltages at all the labeled nodes in the circuit at the left. Hint: Start at the bottom and work upwards.



2.



Find the absolute voltages at all the labeled nodes in the above circuit. Hint: This may be done by inspection.

3. Using Ohm's law and the node voltages found in Problem 2, find the currents for all the resistors in Problem 2.

For the directions drawn above:

$I_1 = \frac{-19-0}{8K} = \boxed{-\frac{19}{8}mA}$ (the negative means current flows from bottom to top)

$I_2 = \frac{-19}{10K} = \boxed{-1.9mA}$

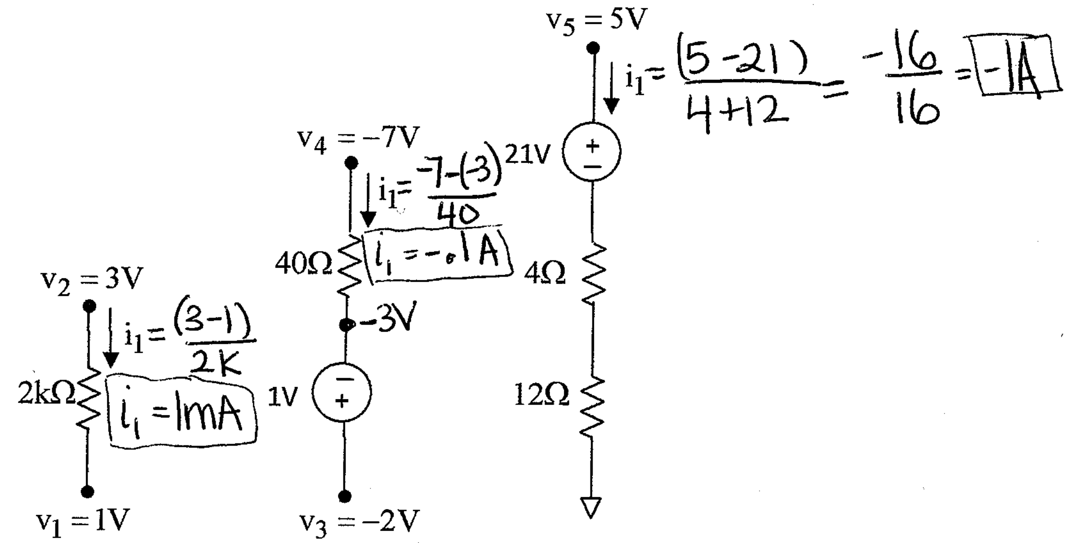
$I_3 = \frac{-18-(-6)}{6K} = \frac{-12}{6K} = \boxed{-2mA}$

$I_4 = (V_2 - V_3)/(7K+5K) = \frac{-15-(-19)}{12K} = +\frac{4}{12K} = \boxed{\frac{1}{3}mA}$

$I_5 = \frac{(V_3 - V_4)}{6K} = \frac{-19-(-18)}{6K}$

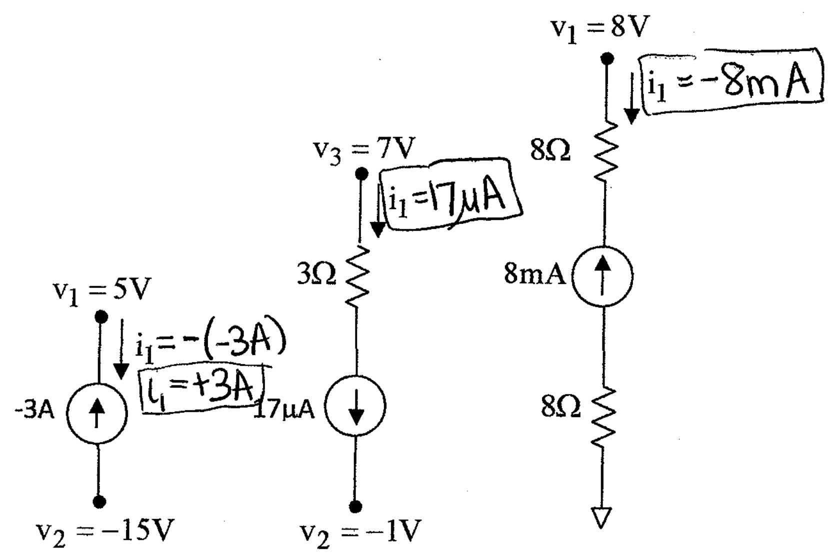
$I_5 = \boxed{-\frac{1}{6}mA}$

4.



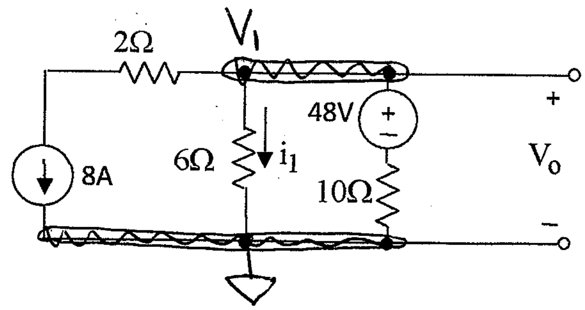
Find the value of current, i_1, for each of the above circuits.

5.



Find the value of current, i_1, for each of the above circuits.

6.



Use the node-voltage method to find i_1 and V_o.

$$V_1 = V_o$$

at V_1 node: $+8 + \frac{V_1}{6} + \frac{(V_1 - 48)}{10} = 0$

$$V_1\left(\frac{1}{6} + \frac{1}{10}\right) = -8 + 4.8$$

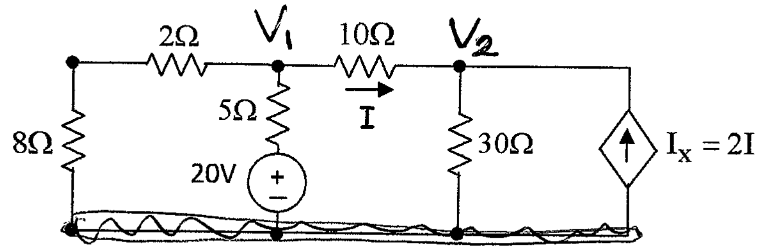
$$V_1\left(\frac{10}{60} + \frac{6}{60}\right) = -3.2$$

$$V_1 = -3.2\left(\frac{60}{16}\right) = -12V$$

$$\therefore \quad i_1 = \frac{V_1}{6\Omega} = -\frac{12}{6} = \boxed{-2A}$$

$$V_o = V_1 = \boxed{-12V}$$

7.



Use the node-voltage method to determine I_x.

① $\dfrac{V_1-20}{5} + \dfrac{V_1}{10} + \dfrac{(V_1-V_2)}{10} = 0$

② $-\dfrac{(V_2-V_1)}{10} + \dfrac{V_2}{30} - 2I = 0$

$I = \dfrac{(V_1-V_2)}{10}$

Rewrite ②

$\dfrac{(V_1-V_2)}{10} + \dfrac{V_2}{30} - \dfrac{2(V_1-V_2)}{10} = 0 \Rightarrow V_1\left(\frac{1}{10}-\frac{2}{10}\right) + V_2\left(\frac{1}{30}-\frac{1}{10}+\frac{2}{10}\right) = 0$

Rewrite ①

$V_1\left(\frac{1}{5}+\frac{1}{10}+\frac{1}{10}\right) = 4 + \frac{V_2}{10}$

$V_1\left(\frac{2+1+1}{10}\right) = 4 + \frac{V_2}{10}$

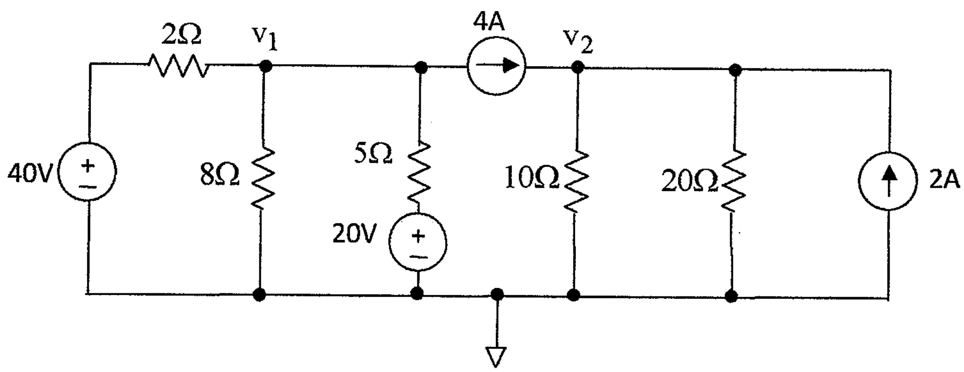
$V_1 = \dfrac{4+\frac{V_2}{10}}{\left(\frac{4}{10}\right)} = 4\left(\frac{10}{4}\right) + \frac{V_2}{10}\left(\frac{10}{4}\right) = 10 + \frac{V_2}{4}$

① → ② $\left(10+\frac{V_2}{4}\right)\left(-\frac{1}{10}\right) + V_2\left(\frac{1-3+6}{30}\right) = 0 \Rightarrow V_2\left(-\frac{3}{120}+\frac{16}{120}\right) = +1$

$V_2 = \frac{120}{13} \Rightarrow V_1 = 10 + \frac{120}{13(4)} \cong 12.3 \Rightarrow I = \left(\frac{12.3-9.2}{10}\right) = \boxed{0.3A}$

$= 9.2V$

8.



a. Use the node-voltage method to find v_1 and v_2.

b. Determine the amount of power supplied by the voltage source.

① $\frac{(V_1 - 40)}{2} + \frac{V_1}{8} + \frac{(V_1 - 20)}{5} + 4 = 0$

② $-4 + \frac{V_2}{10} + \frac{V_2}{20} - 2 = 0$

$V_2\left(\frac{1}{10} + \frac{1}{20}\right) = 6 \Rightarrow V_2 = \frac{6}{\frac{3}{20}} = 20(2) = \boxed{40V}$

① $V_1\left(\frac{1}{2} + \frac{1}{8} + \frac{1}{5}\right) = 20 + 4 - 4$

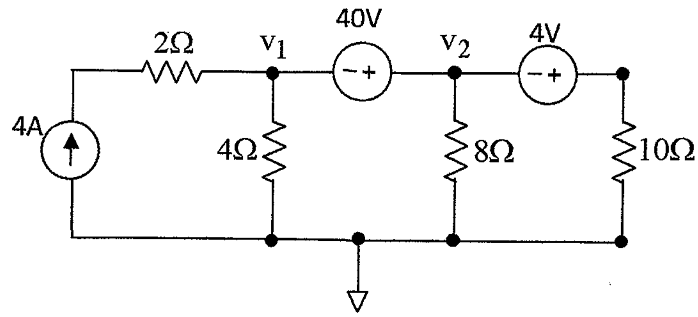
$V_1\left(\frac{20+5+8}{40}\right) = 20$

$V_1 = 20\left(\frac{40}{33}\right) = \boxed{\frac{800}{33}V}$

$power\_40V = 40 \times \frac{(V_1 - 40)}{2} = 40 \times \left(\frac{800}{2(33)} - 20\right) \cong \boxed{-315W}$ (remember - means supplying)

$power\_20V = 20 \times \frac{(V_1 - 20)}{5} = 20 \times \left(\frac{800}{5(33)} - 4\right) \cong \boxed{+17\ W}$

9.



Use the node-voltage method to find v_1 and v_2.

$$-4 + \frac{V_1}{4} + \frac{V_2}{8} + \frac{(V_2+4)}{10} = 0$$

$$(V_2 - V_1) = 40$$

$$V_2 = V_1 + 40$$

$$-4 + (V_1+40)\left(\frac{1}{8}+\frac{1}{10}\right) + \frac{V_1}{4} + \frac{4}{10} = 0$$

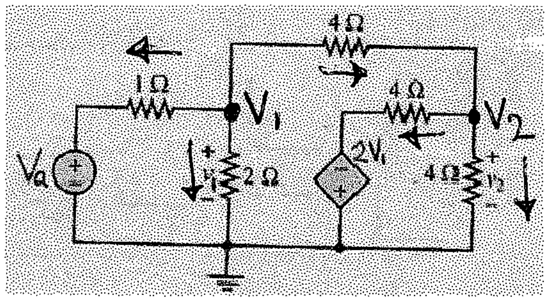
$$\frac{-40+4}{10} + V_1\left(\frac{5+4+10}{40}\right) + 40\left(\frac{10+8}{80}\right) = 0$$

$$V_1\left(\frac{19}{40}\right) = \frac{36}{10} + \frac{-40(18)}{80}$$

$$V_1 = \left[\frac{36}{10} - \frac{40(18)}{80}\right]\left(\frac{40}{19}\right) \simeq \boxed{-11.4\,V}$$

$$V_2 = V_1 + 40 \approx \boxed{+28.6V}$$

10.



Use the node-voltage method to find v_1 and v_2.

① $\frac{(V_1 - V_a)}{1} + \frac{V_1}{2} + \frac{(V_1 - V_2)}{4} = 0$

② $-\frac{(V_1 - V_2)}{4} + \frac{(V_2 + 2V_1)}{4} + \frac{V_2}{4} = 0$

① $V_1\left(1 + \frac{1}{2} + \frac{1}{4}\right) + (-V_a) - \frac{V_2}{4} = 0$

$V_1\left(\frac{4+2+1}{4}\right) = V_a + \frac{V_2}{4}$

$V_1 = V_a\left(\frac{4}{7}\right) + \frac{V_2}{4}\left(\frac{4}{7}\right)$

①→②: $V_1\left(-\frac{1}{4} + \frac{2}{4}\right) + V_2\left(\frac{1}{4} + \frac{1}{4} + \frac{1}{4}\right) = 0$

$\left[V_a\left(\frac{4}{7}\right) + \frac{V_2}{\cancel{4}}\left(\frac{\cancel{4}}{7}\right)\right]\left(\frac{1}{4}\right) + V_2\left(\frac{3}{4}\right) = 0$

$V_2\left(\frac{1}{28} + \frac{21}{28}\right) = -V_a\left(\frac{4}{7}\right)\left(\frac{1}{4}\right)$

$V_2 = -V_a\left(\frac{1}{7}\right)\left(\frac{28}{22}\right) \cong \boxed{-\frac{2}{11}V_a}$

$V_1 = V_a\left(\frac{4}{7}\right) + \frac{-2V_a}{7(11)} = \left(\frac{44-2}{77}\right)V_a$

$\boxed{V_1 = +\frac{6}{11}V_a}$