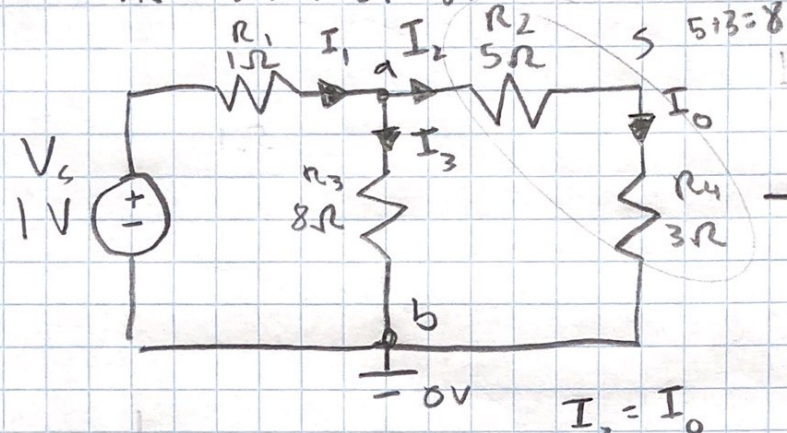
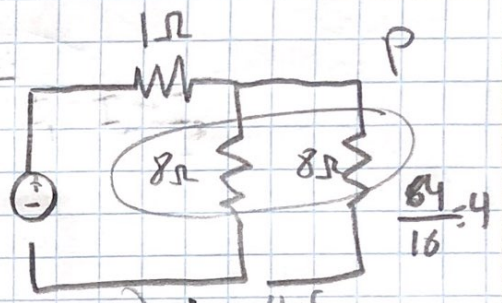
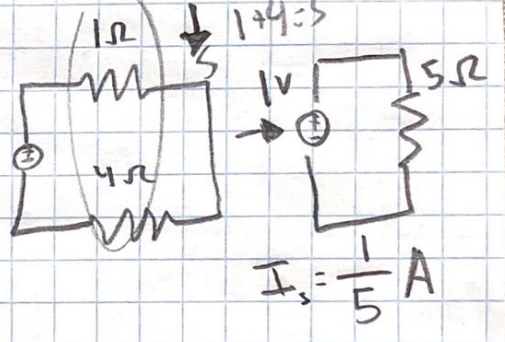
Chris Hunt Homework 4 ENGR201

4.1) Find I_o, then increase V_s to 12 V → what is the new value of I_o?







$I_s = \frac{1}{5}$ A

$I_2 = I_o$

$I_2 = I_3$

$\frac{1}{10}$ A

KCL:

$I_1 = I_2 + I_3 \rightarrow \frac{1}{5} = 2I_o \rightarrow$

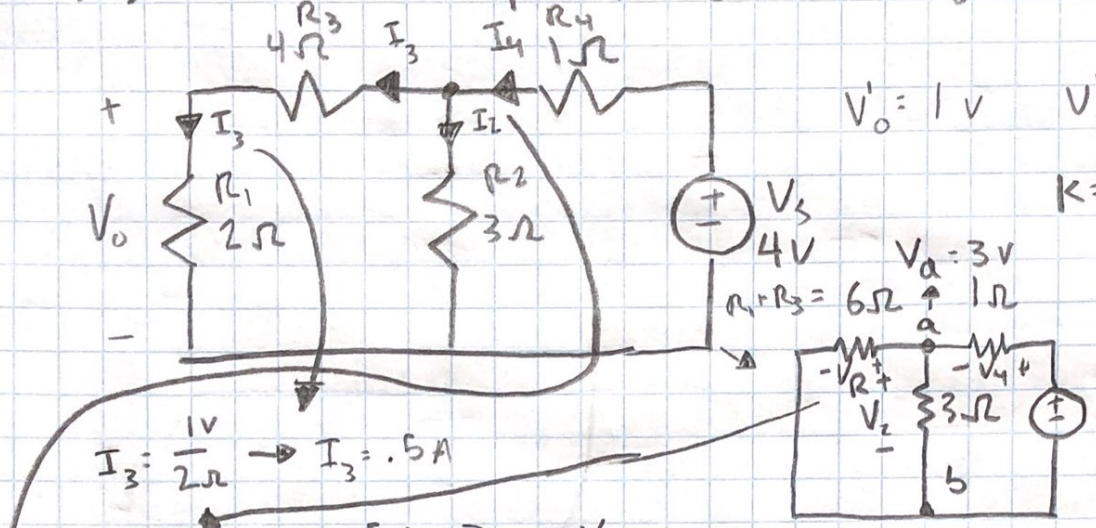
$\boxed{I_o = \frac{1}{10}\text{ A}}$

when V_s is increased to 12 V I_o while increase proportionaly due to linearity.

$12 \cdot 1\text{V} = 12\text{V}$ therefore $12 \cdot \frac{1}{10}\text{A} = \boxed{\frac{12}{10}\text{ A}}$

Chris Hunt Homework 4 ENGR 201

4.2) Use the unit output method to find V_o



$V_o' = 1\,V \qquad V_s' = 4.5\,V$

$K = \frac{1}{4.5}$

$I_3 = \frac{1V}{2\Omega} \rightarrow I_3 = .5A$

$V_2 = V_R = 6\Omega \cdot .5A = 3V = V_a$

$I_2 = \frac{3V}{3\Omega} = 1A$

$I_4 = I_3 + I_2 \rightarrow I_4 = 1.5\,A$

$V_4 = 1.5A \cdot 1\Omega = 1.5V \rightarrow V_s' = V_a + V_4 \rightarrow V_s' = 4.5V$

$V_o = V_s\left(\frac{V_o'}{V_s'}\right) \rightarrow V_o = 4\left(\frac{1}{4.5}\right) = \frac{4}{4.5} = .88V$

$\boxed{V_o = .88V}$

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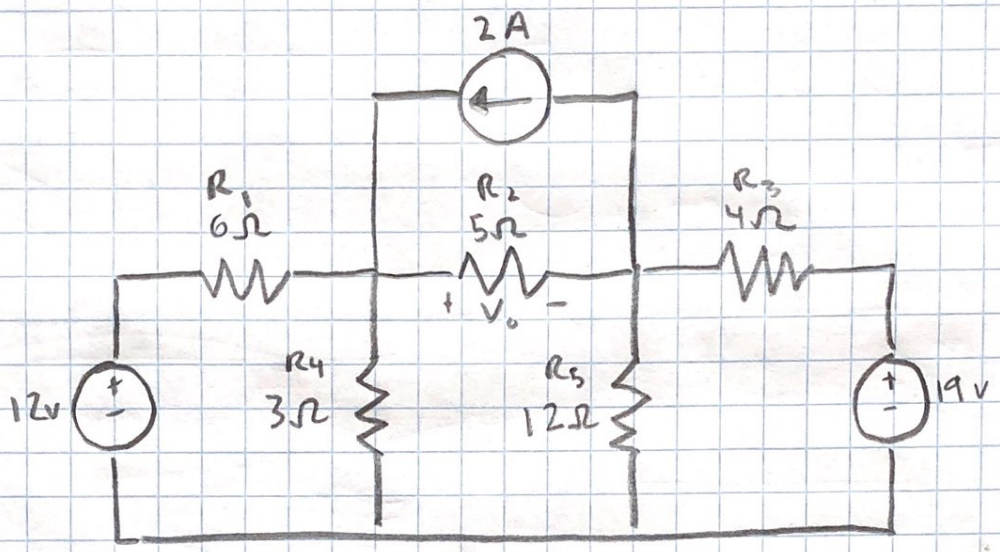
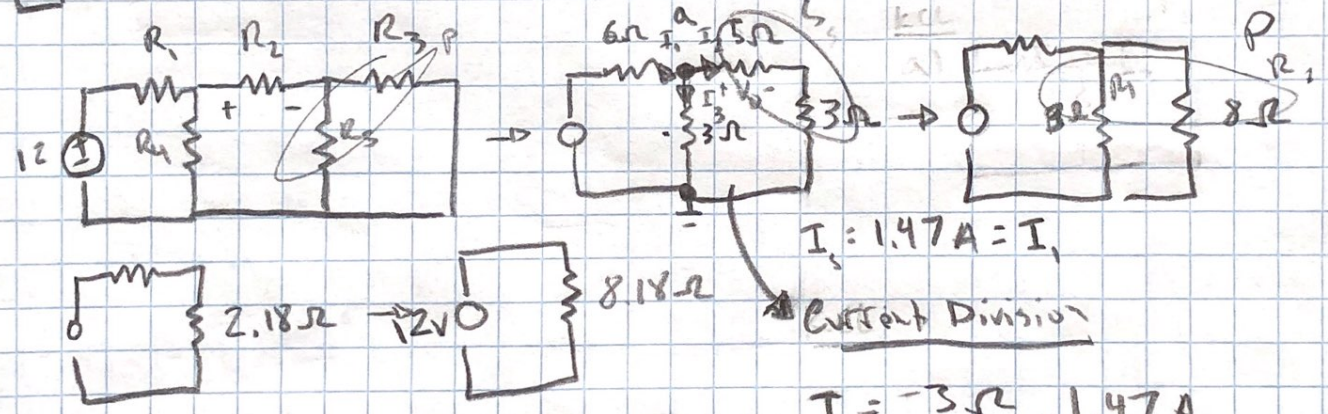
4.3) Find V_o using superposition



1



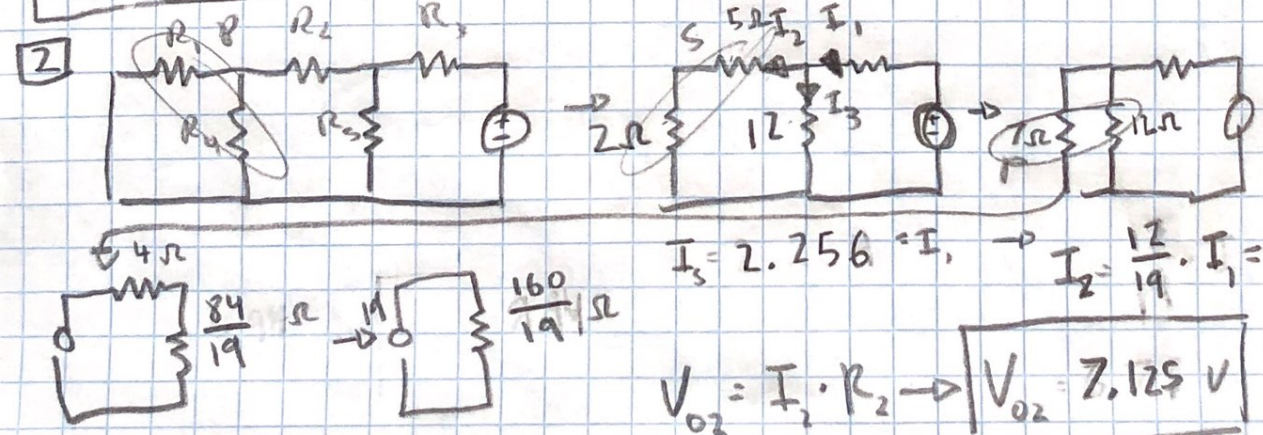
$I_3 = 1.47A = I_1$

Current Division

$$I_2 = \frac{3\Omega}{11\Omega} \cdot 1.47A$$

$I_2 = .4A$ ← $V_{01} = I_2 \cdot R_2$ ← $\boxed{V_{01} = 2V}$

2



$I_3 = 2.256 = I_1$ → $I_2 = \frac{12}{19} \cdot I_1 = 1.425A$

$V_{02} = I_2 \cdot R_2$ → $\boxed{V_{02} = 7.125V}$

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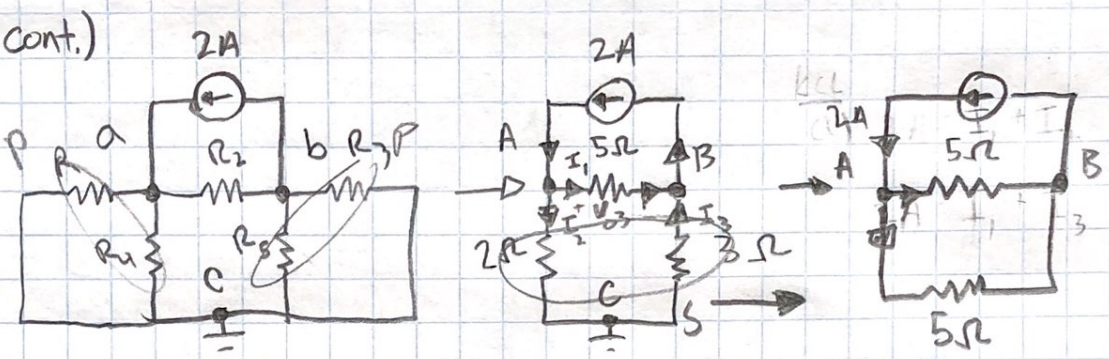
4.3 cont.)

3



Current Division

$$I_1 = \frac{R_2}{R_1+R_2} \cdot I \rightarrow I_1 = \frac{1}{2}(2A) \rightarrow I_1 = 1A$$

$$V_{03} = 1A \cdot 5\Omega \Rightarrow V_{03} = 5V$$

Superposition:

$$V_0 = V_{01} - V_{02} + V_{03}$$

$$V_0 = 2V - 7.125V + 5V$$

$$\boxed{V_0 = -.125V}$$

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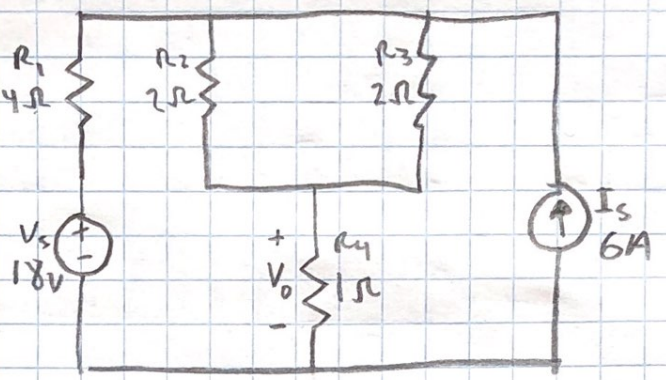
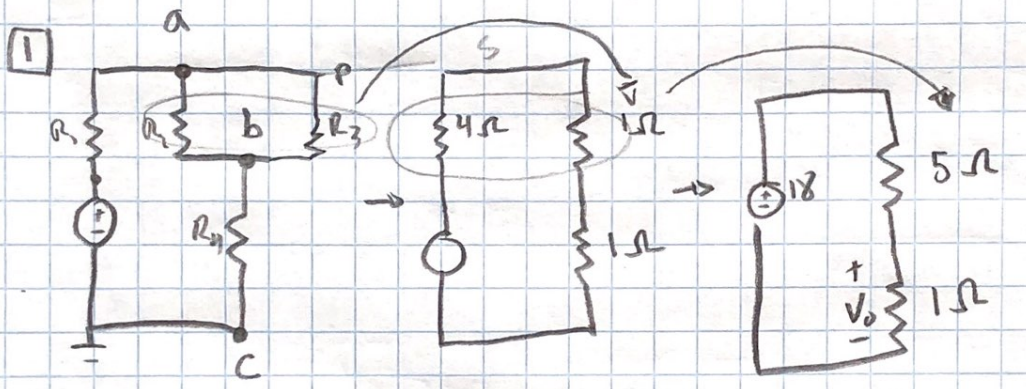
4.4) Find V_o



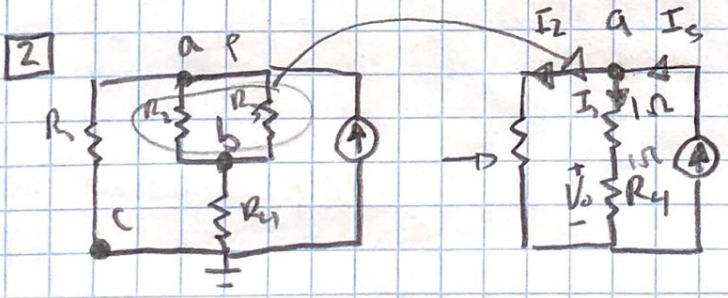
1



Voltage Division:

$$V_{o1} = \frac{1\Omega}{1+5\Omega} \cdot 18 \rightarrow \boxed{V_{o1} = 3V}$$

2



Current Division:

$$I_1 = \frac{4\Omega}{6\Omega} \cdot 6A$$

$$I_1 = 4A$$

$$V_{o2} = 1\Omega \cdot 4A$$

$$V_{o2} = 4V$$

$$V_o = 3V + 4V \Rightarrow \boxed{V_o = 7V}$$

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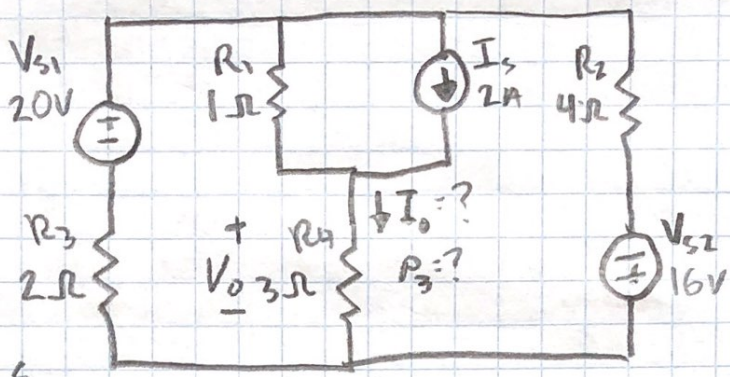
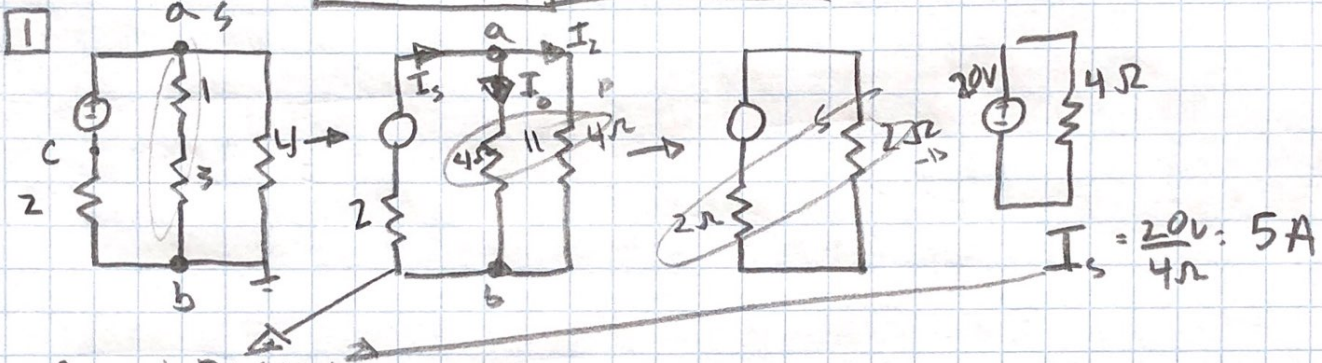
4.5)



Find I_o

Find P_3

1

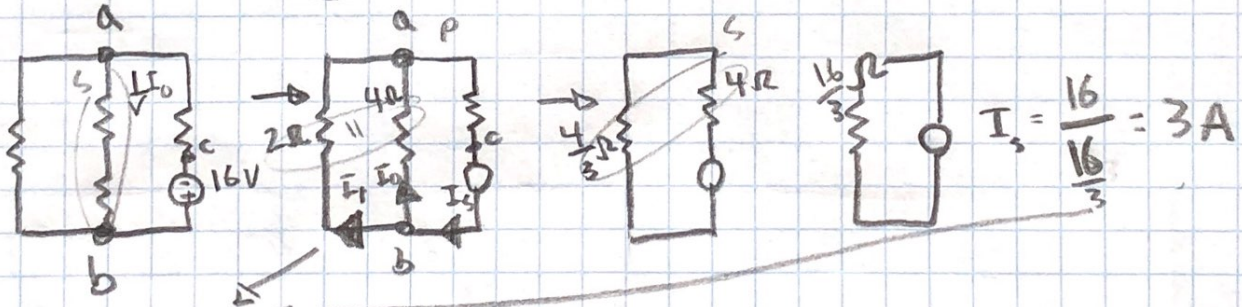


$I_s = \frac{20V}{4\Omega} = 5A$

Current Division:

$I_o = 5 \cdot \frac{4}{8} \Rightarrow$ **$I_{o1} = 2.5A$**

2



$I_s = \frac{16}{\frac{16}{3}} = 3A$

Current Division:

$I_{o2} = \frac{2}{6} \cdot 3A \Rightarrow$ **$I_{o2} = 1A$**

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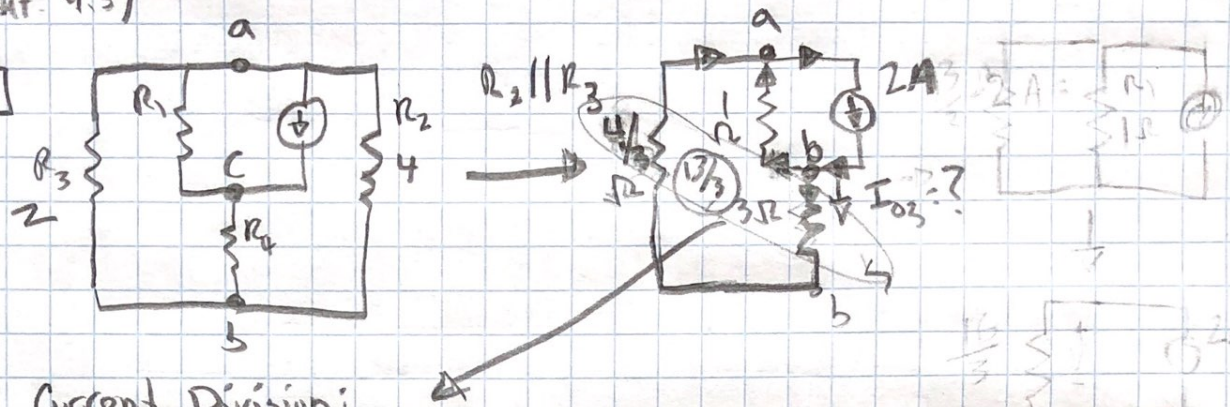
Cont. 4.5)

3



Current Division:

$$I_{03} = \frac{1\,\Omega}{13/3\,\Omega} \cdot 2A \rightarrow \boxed{I_{03} = 0.375A}$$

$$I_o = I_{01} - I_{02} + I_{03}$$

$$\boxed{I_o = 1.875\,A}$$

$$P = \frac{i^2}{G} = \frac{1.875^2}{1/3}$$

$$\boxed{P = 9.99\ W}$$

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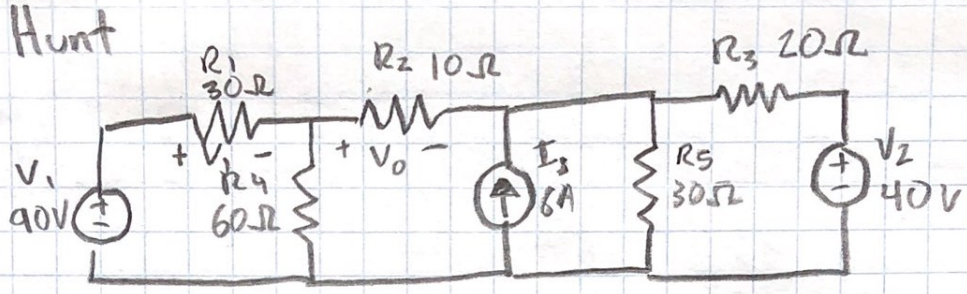
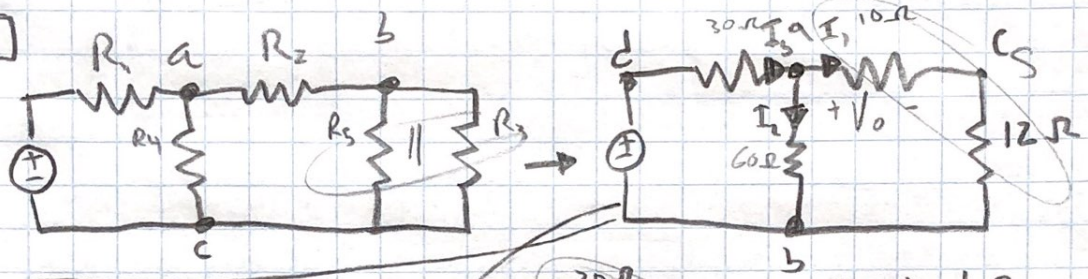
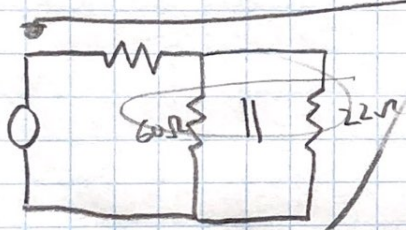
4.6)

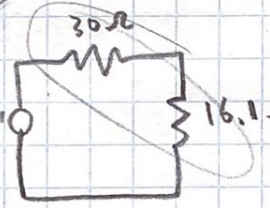


Find V_o

1







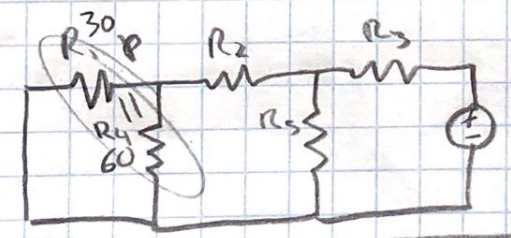
$R_{eq} = 46.1\,\Omega$

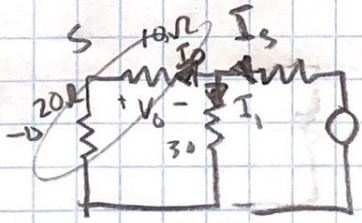
$I_s = \frac{V_1}{R_{eq}} \rightarrow I_s = 1.95\,A$

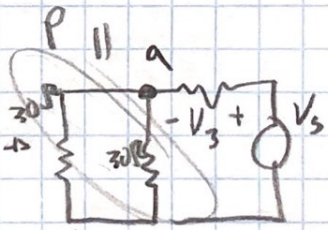
$V_a = V_s - V_1 = 90V - (1.95A \cdot 30\Omega) = 31.43\,V$

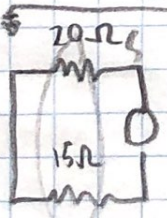
$V_o = V_a \cdot \frac{10\Omega}{22\Omega} \rightarrow \boxed{V_{o1} = 14.29\,V}$

2









$R_{eq} = 35\,\Omega$

$I_s = \frac{40V}{35\Omega} \rightarrow I_s = \frac{8}{7}\,A$

$V_a = V_s - V_3$

$V_a = 40V - 22.86V$

$V_a = 17.14$

$V_{o2} = V_a \cdot \frac{10\Omega}{30\Omega} \rightarrow \boxed{V_{o2} = 5.71\,V}$

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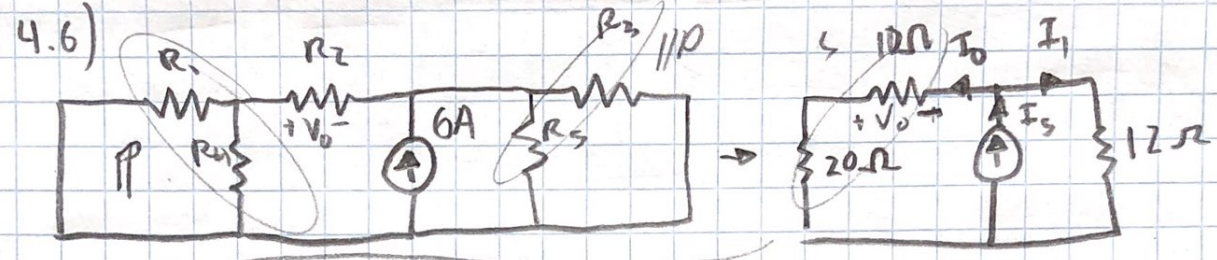
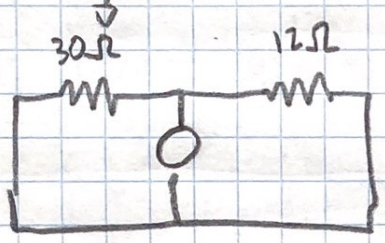
cont. 4.6)

3





Current Division

$I_o = \frac{12}{42} \cdot 6A$

$I_o = 1.71\ A$

$V_{o3} = 10\Omega \cdot 1.71A$

$\boxed{V_{o3} = 17.1\ V}$

$V_o = V_{o2} + V_{o3} - V_{o1}$

$\boxed{V_o = -8.52\ V}$

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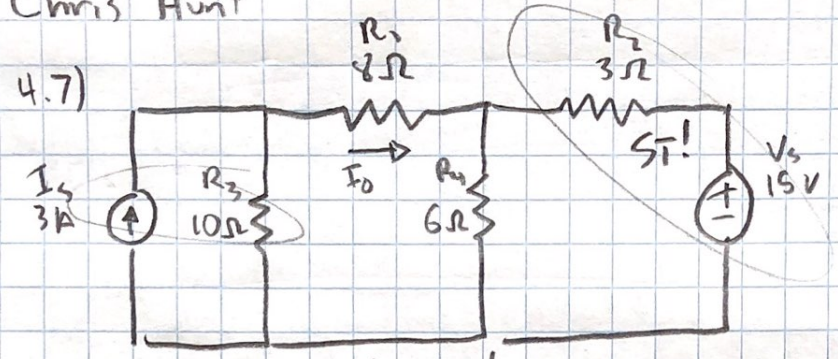
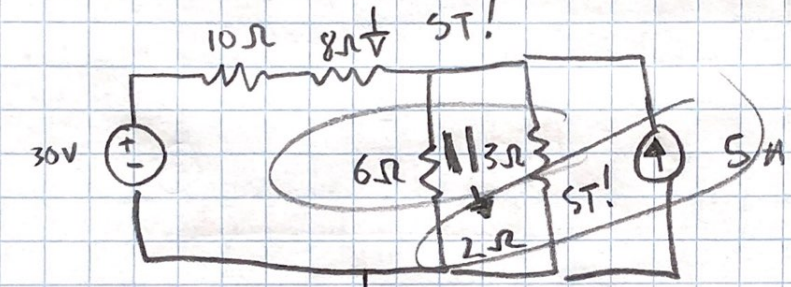
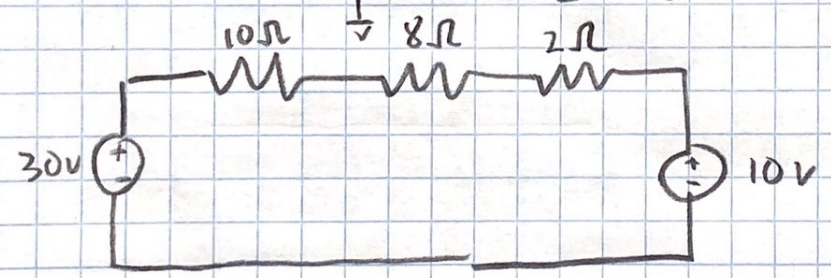
4.7)

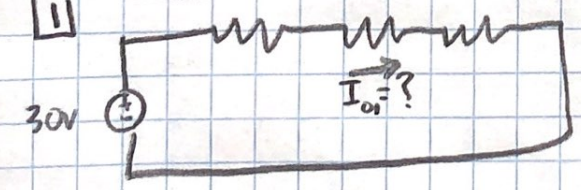






Superposition

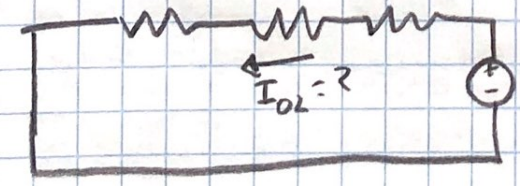
1



$R_{eq} = 10\Omega + 8\Omega + 2\Omega = 20\Omega$

$I_{o1} = \frac{30V}{20\Omega} \rightarrow \boxed{I_{o1} = \frac{3}{2}\ A}$

2



$I_{o2} = \frac{10V}{20\Omega} \rightarrow I_{o2} = -\frac{1}{2}\ A$

$I_o = \frac{3}{2}A - \frac{1}{2}A$

$\boxed{I_o = 1\ A}$

$P = \frac{I^2}{G} = \frac{1^2}{1/8}$

$\boxed{P = 8\ W}$

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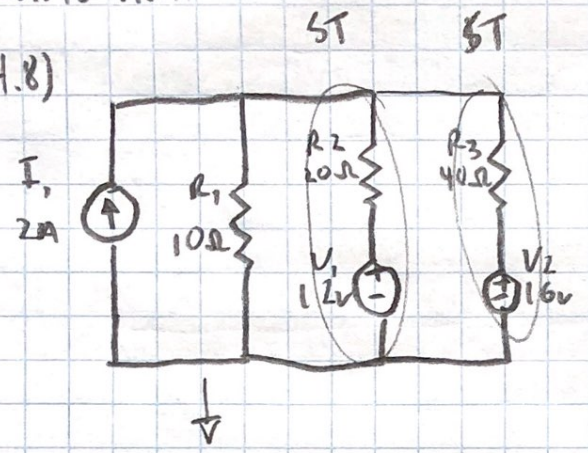
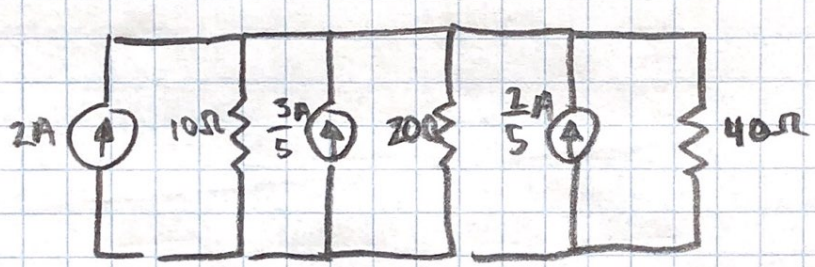
4.8)

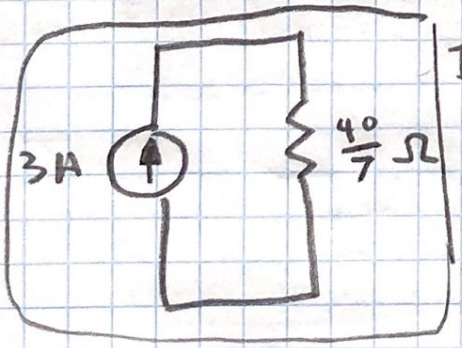




$$\left(\frac{1}{R_{eq}}\right)^{-1} \quad \frac{1}{10} + \frac{1}{20} + \frac{1}{40} \rightarrow \frac{4}{40} + \frac{2}{40} + \frac{1}{40} \rightarrow \left(\frac{7}{40}\right)^{-1}$$

$$R_{eq} = \frac{40}{7}\ \Omega$$

Add all current sources in parallel



$$I_{tot} = 2A + \frac{3}{5}A + \frac{2}{5}A \Rightarrow 3A$$