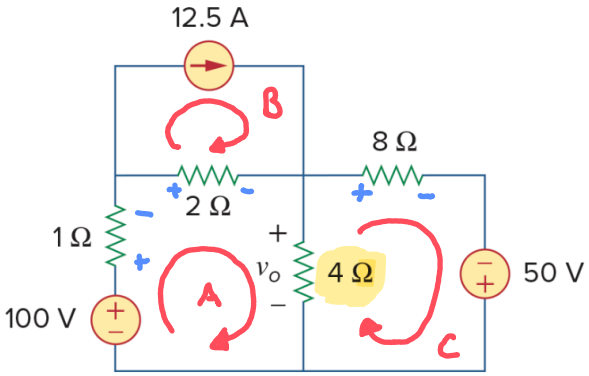
Homework 3
Due: Friday, February 10th, 2023 by 7PM.

Note: In order to receive full credit, you must show your work and carefully justify your answers. The correct answer without any work will receive little or no credit.

1. Use mesh current analysis to find the voltage vo across the 4Ω resistor.



$i_B = 12.5\ A$

KVL @ A:

$100 = v_1 + v_2 + v_4$

$100 = i_1 + 2i_2 + 4i_4$

$100 = i_A + 2i_A - 2i_B + 4i_A - 4i_C$

$100 = 7i_A - 2i_B - 4i_C$

$100 = 7i_A - 4i_C - 25$

$125 = 7i_A - 4i_C$

KVL @ C:

$50 + v_4 = v_8$

$50 + 4i_4 = 8i_8$

$50 + 4i_A - 4i_C = 8i_C$

$50 + 4i_A - 12i_C = 0$

$i_1 = i_A$

$i_2 = i_A - i_B$

$i_4 = i_A - i_C$

$i_8 = i_C$

$i_A = 25$

$i_C = \frac{25}{2}$

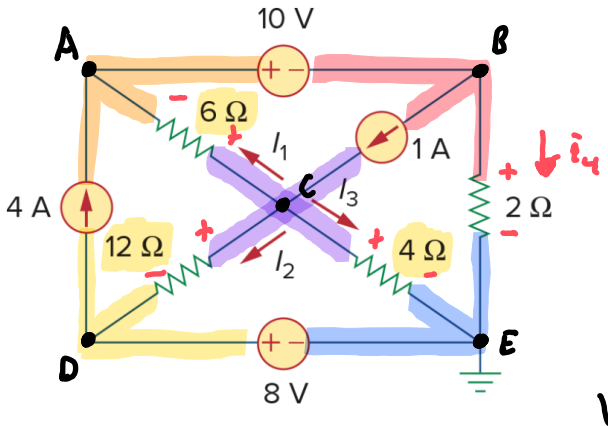
$i_4 = 25 - \frac{25}{2} = \frac{25}{2}$

$V_4 = \frac{25}{2} \cdot 4 =$ **50 V**

1 0

2. Use either node-voltage or mesh-current analysis to find the current across the 6Ω, 4Ω, and 12Ω resistors.

2



$V_E = 0V$

$V_D = 8V$

$V_A - V_B = 10V$

KCL@C:

$I = i_1 + i_2 + i_3$

$I = \frac{V_1}{6} + \frac{V_2}{12} + \frac{V_3}{4}$

$I = \frac{V_C - V_A}{6} + \frac{V_C - V_D}{12} + \frac{V_C - V_E}{4}$

$I = \frac{V_C}{2} - \frac{V_A}{6} - \frac{8}{12}$

KCL@ Super-Node AB:

$4 + i_1 = i_4 + 1$

$4 + \frac{V_1}{6} = \frac{V_4}{2} + 1$

$4 + \frac{V_C}{6} - \frac{V_A}{6} = \frac{V_B}{2} + 1$

$V_C = 8V$ $V_B = 4V$ $V_A = 14V$

$I = \frac{V}{R}$

$V_1 = V_C - V_A$

$V_2 = V_C - V_D$

$V_3 = V_C - V_E$

$V_4 = V_B - V_E$

Aux.

$V_A - V_B = 10$

$V_1 = V_C - V_A = 14 - 8 = 6$

$V_2 = V_C - V_D = 8 - 8 = 0$

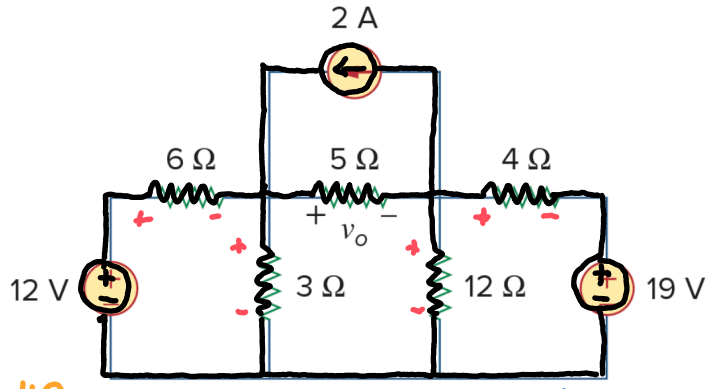
$V_3 = V_C - V_E = 8 - 0 = 8$

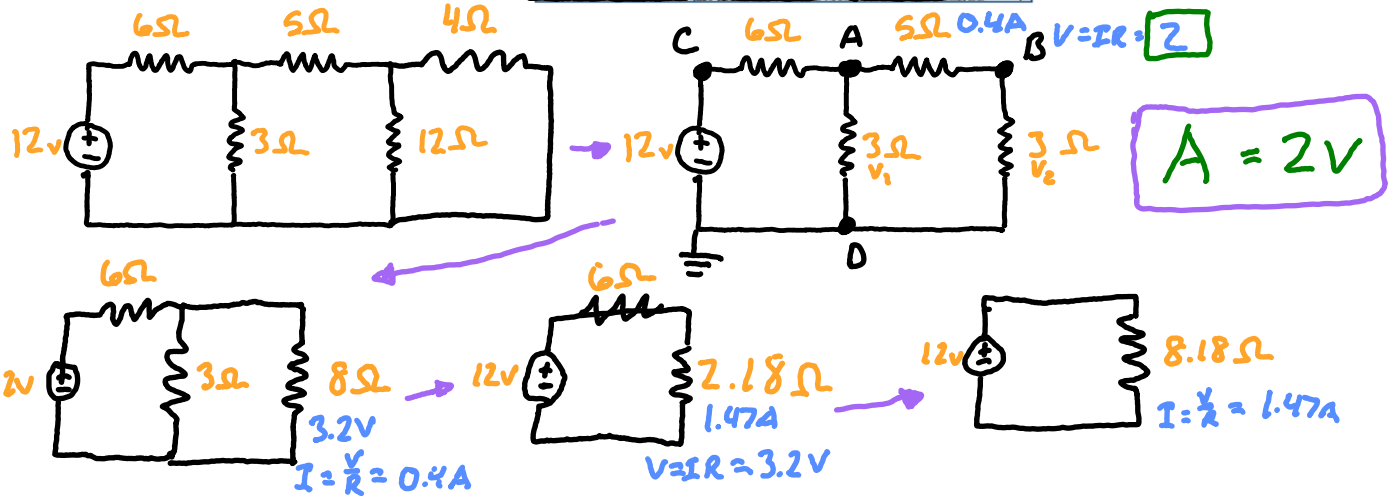
$I_1 = \frac{6}{6} = 1A$

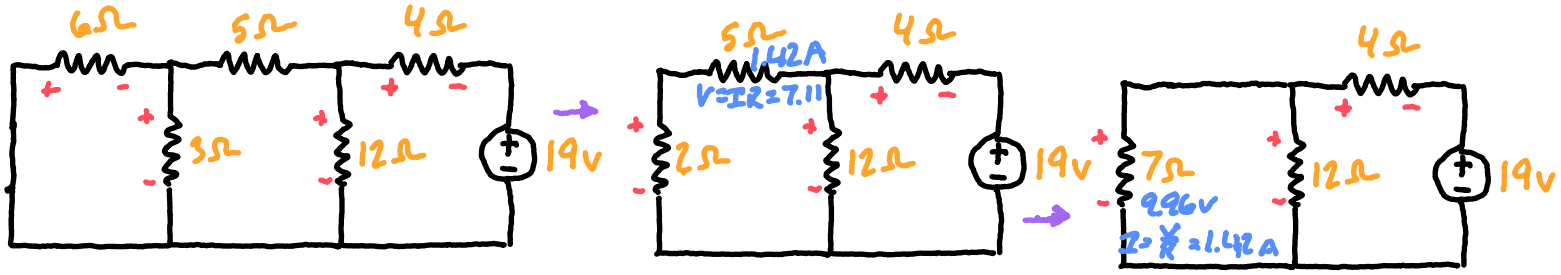
$I_2 = \frac{0}{12} = 0A$

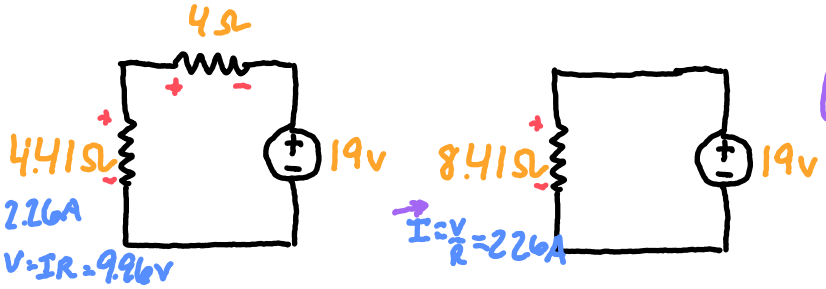
$I_3 = \frac{8}{4} = 2A$

3. Using the principle of superposition:
   A. Find the contribution of the 12V voltage source to the voltage across the 5Ω resistor.
   B. Find the contribution of the 19V voltage source to the voltage across the 5Ω resistor.
   C. Find the contribution of the 2A current source to the voltage across the 5Ω resistor. 5

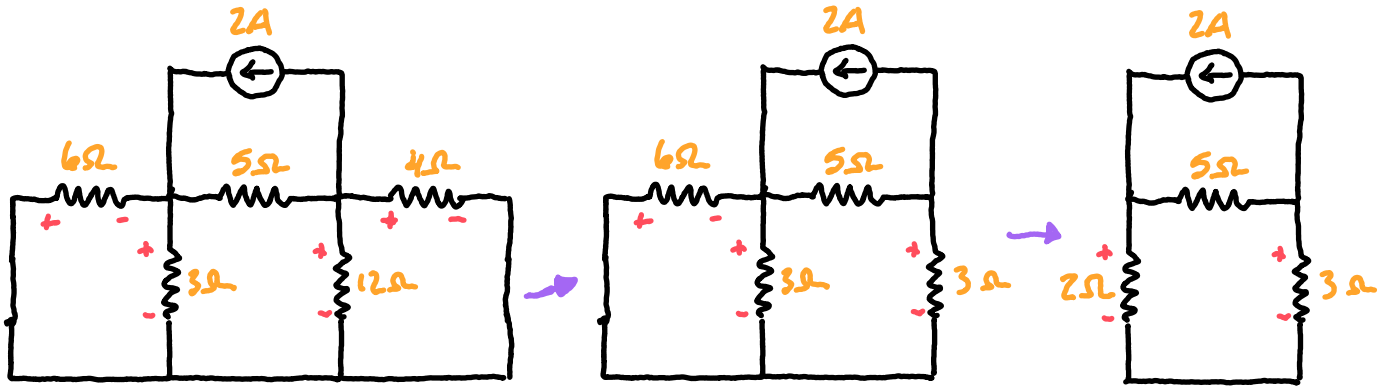


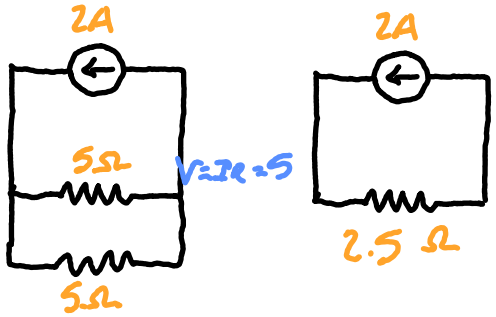






B = -7.11V





$$i_x = \frac{R_{eq}}{R_x} i_s = \frac{2.5}{5} \cdot 2 = 1$$

$$C = 5V$$