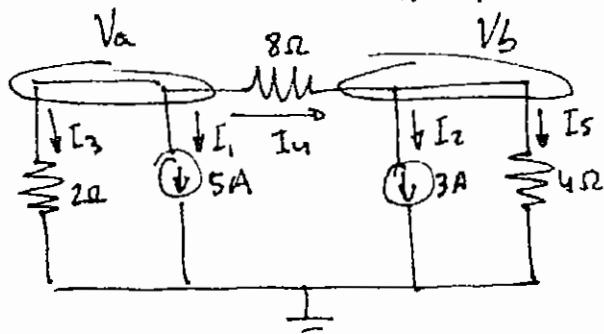


HW # 11

8-40



$$\text{V} = \frac{V_{\text{tail}} - V_{\text{tip}}}{R}$$

Node a

$$\sum I_{\text{in}} = \sum I_{\text{out}}$$

$$0 = I_3 + I_1 + I_4 = \frac{V_a}{2} + 5A + \frac{V_a - V_b}{8} \quad \left. \begin{array}{l} 0 = 4V_a + 40 + V_a - V_b \\ V_a - V_b = 24 + 2V_b \end{array} \right\}$$

Node b

$$\sum I_{\text{in}} = \sum I_{\text{out}}$$

$$I_4 = I_2 + I_5 \Rightarrow \frac{V_a - V_b}{8} = 3A + \frac{V_b}{4} \quad \left. \begin{array}{l} V_a = 24 + 3V_b \\ V_a = 24 + 3V_b \end{array} \right\}$$

$$0 = 4(24 + 3V_b) + 40 + 24 + 3V_b - V_b = 96 + 12V_b + 64 + 2V_b$$

$$0 = 160 + 14V_b \quad V_b = -\frac{160}{14} = -11.43V = V_b$$

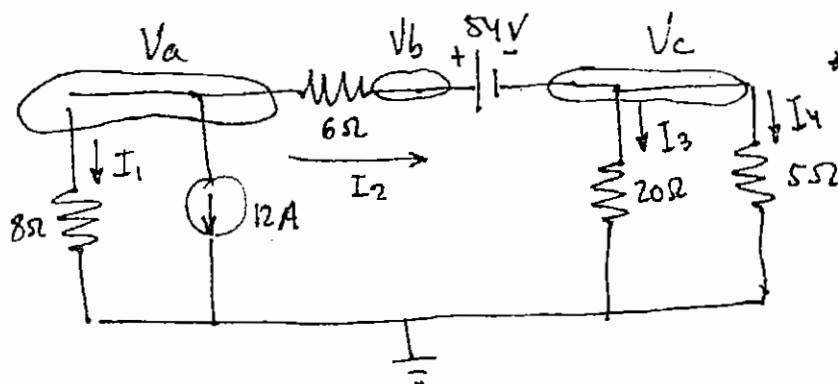
$$V_a = 24 + 3(-11.43) = -10.29V = V_a$$

$$V_{8\Omega} = V_a - V_b = 1.14V = V_{8\Omega}$$

$$I_3 = \frac{V_a}{2\Omega} = \frac{10.29}{2\Omega} = -5.15A$$

$$I_5 = \frac{V_b}{4\Omega} = \frac{-11.43V}{4\Omega} = -2.86A$$

8-41



* ANSWERS ARE ALL
BASED ON CURRENT
DIRECTIONS AS
SHOWN.

Node a

$$\sum I_{\text{in}} = \sum I_{\text{out}}$$

$$0 = \frac{V_a}{8\Omega} + 12A + \frac{V_a - V_b}{6\Omega}$$

Node b

$$V_b = V_c + 54V$$

Node c

$$\sum I_{in} = \sum I_{out} \quad I_2 = I_3 + I_4$$

$$\frac{V_a - V_b}{6\Omega} = \frac{V_c}{20\Omega} + \frac{V_c}{5\Omega}$$

* $0 = 3V_a + 288 + 4V_a - 4V_b \quad , \quad 0 = 288 + 7V_a - 4V_b$

* $V_b = V_c + 54$

* $10V_a - 10V_b = 3V_c + 12V_c \quad , \quad 10V_a - 10V_b = 15V_c$

$$2V_a - 2V_b = 3V_c$$

Solve 3 equations, 3 unknowns

$$V_a = -29.3V$$

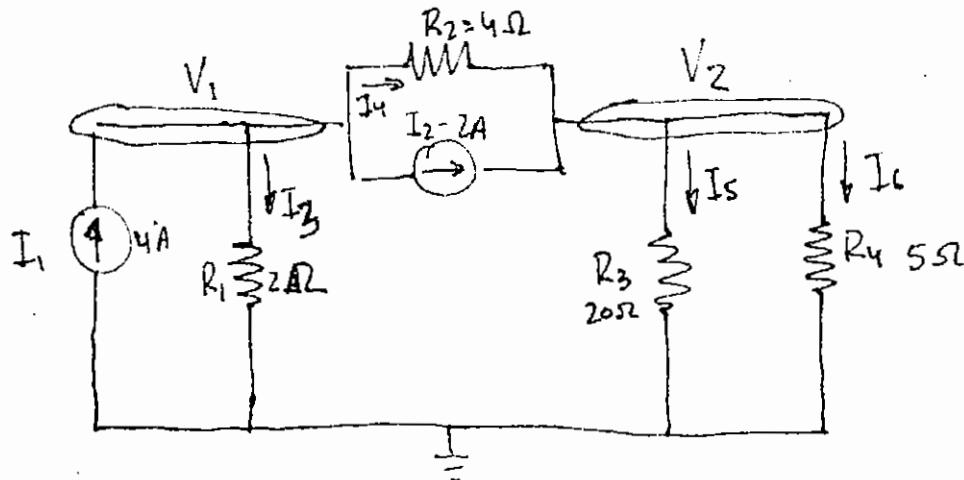
$$V_b = 20.7V$$

$$V_c = -33.3V$$

$$I_3 = \frac{V_c - 0}{20\Omega} = \frac{-33.3}{20} = -1.67A$$

$$|I_{20\Omega}| = 1.67A$$

8-42



Node V1

$$\sum I_{in} = \sum I_{out}$$

$$I_1 = I_3 + I_2 + I_4$$

$$4A = \frac{V_1}{2} + 2A + \frac{V_1 - V_2}{4} \quad , \quad 16 = 2V_1 + 8 + V_1 - V_2 \quad , \quad V_2 = 3V_1 - 8$$

Node V₂

$$\sum I_{in} = \sum I_{out}$$

$$I_2 + I_4 = I_S + I_C$$

$$2 + \frac{V_1 - V_2}{4} = \frac{V_2}{20} + \frac{V_2}{5} \quad , \quad 40 + 5V_1 - 5V_2 = V_2 + 4V_2$$

$$40 + 5V_1 = 10V_2$$

$$8 + V_1 = 2V_2$$

$$V_1 = 2V_2 - 8$$

$$V_2 = 3V_1 - 8$$

$$V_2 = 3(2V_2 - 8) - 8$$

$$V_2 = 6V_2 - 24 - 8$$

$$-5V_2 = -32$$

$$\boxed{\begin{aligned} V_2 &= 6,4 \text{ V} \\ V_1 &= 4,8 \text{ V} \end{aligned}}$$

c) I₁ : $P = V_1 I_1 = 4,8 \text{ V} \cdot 4 \text{ A} = 19,2 \text{ W}$

I₂ : $P = (V_1 - V_2) I_2 = (4,8 - 6,4) 2 \text{ A} = 3,2 \text{ W}$