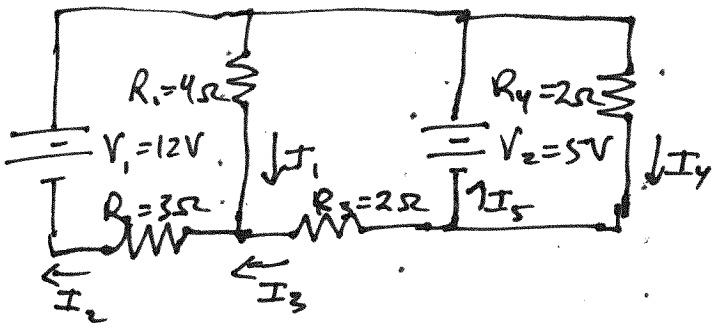
Ch.10 Prob. 41

a) Find $I_1, I_2, I_3, I_4 + I_5$



Use Kirchoff's Rules

Current Node

~~$I_1 + I_3 = I_2$~~ $I_1 + I_3 = I_2$ (#1)

$I_4 = I_3 + I_5$ (#2)

Voltage Loop

$12 - 4I_1 - 3I_2 = 0$ (#3)

Drop units for now

$5 - 4I_1 + 2I_3 = 0$ (#4)

$5 - 2I_4 = 0$ (#5)

from (#5) $5 = 2I_4 \rightarrow I_4 = 5/2 = \boxed{2.5\ A = I_4}$

Sub (#1) into (#3)

$12 - 4I_1 - 3(I_1 + I_3) = 0$

$12 - 4I_1 - 3I_1 - 3I_3 = 0 \rightarrow 12 - 7I_1 - 3I_3 = 0$

solve for I_3 $\quad 12 - 7I_1 = 3I_3 \quad I_3 = \frac{12 - 7I_1}{3}$ (#6)

$I_3 = 4 - \frac{7}{3}I_1$

Sub (#6) into (#4)

$5 - 4I_1 + 2\left(4 - \frac{7}{3}I_1\right) = 0$

$5 - 4I_1 + 8 - \frac{14}{3}I_1 = 0$

$13 - \left(4 + \frac{14}{3}\right)I_1 = 0 \rightarrow 13 - \left(\frac{12}{3} + \frac{14}{3}\right)I_1 = 0$

$13 = \frac{26}{3}I_1 \rightarrow \frac{39}{26} = I_1 \rightarrow \boxed{I_1 = 1.5\ A}$

Use (#2) $I_5 = I_4 - I_3$ $= 2.5A - 0.5A$ $I_5 = 2.0A$

Now use (#6)

$I_3 = 4 - \frac{7}{3}(1.5) = 4 - 3.5 = \boxed{0.5\ A = I_3}$

Use (#1) $I_2 = 1.5\ A + 0.5\ A = \boxed{2.0\ A = I_2}$

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Use #2

$$I_5 = I_4 - I_3$$
$$= 2.5A - 0.5A = \boxed{2.0A = I_5}$$

b) Find power supplied by power supply

$$P_{V_1} = I_2 \cdot V_1 = (2.0A)(12V) = \boxed{24W} \rightarrow +$$
$$P_{V_2} = I_5 \cdot V_2 = (2.0A)(5V) = \boxed{10W} \rightarrow \boxed{34W}$$

c) Find power ~~dissipated~~ consumed dissipated by resistors

$$P_{R_1} = I_1^2 \cdot R_1 = (1.5A)^2(4\Omega) = \boxed{9W} \rightarrow +$$
$$P_{R_2} = I_2^2 R_2 = (2.0A)^2(3\Omega) = \boxed{12W} \rightarrow \boxed{34W}$$
$$P_{R_3} = I_3^2 R_3 = (0.5A)^2(2\Omega) = \boxed{0.5W} \nearrow$$
$$P_{R_4} = I_4^2 R_4 = (2.5A)^2(2\Omega) = \boxed{12.5W} \nearrow$$

~~P_{R_5}~~