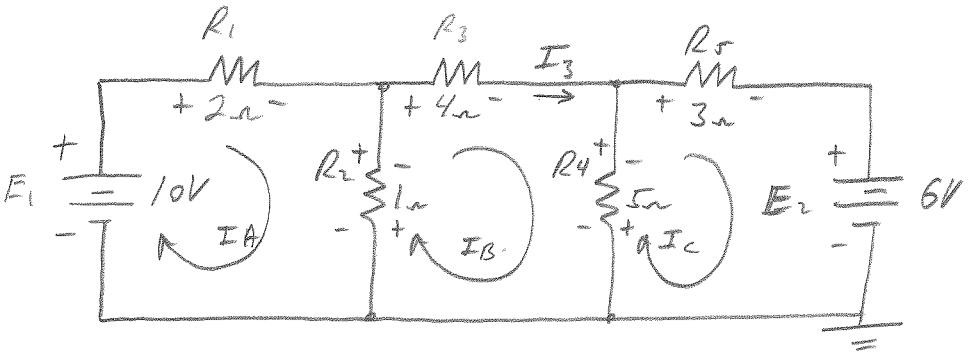
(24)

CH 8

(* USE CALC EQ SOLVER OR OCTAVE)



a) FIND THE MESH CURRENTS:

LOOP I_A: $10 - R_1 I_A - R_2 I_A + R_2 I_B = 0$

$-2I_A - I_A + I_B = -10$

$-3I_A + I_B = -10 \longrightarrow 3I_A - I_B + 0I_C = 10$ (1)

LOOP I_B: $R_2 I_A - R_2 I_B - R_3 I_B - R_4 I_B + R_4 I_C = 0$

$I_A - 10I_B + 5I_C = 0 \longrightarrow I_A - 10I_B + 5I_C = 0$ (2)

LOOP I_C: $R_4 I_B - R_4 I_C - R_5 I_C - E_2 = 0$

$5I_B - 8I_C = 6 \longrightarrow 0I_A + 5I_B - 8I_C = 6$ (3)

SOLVING:

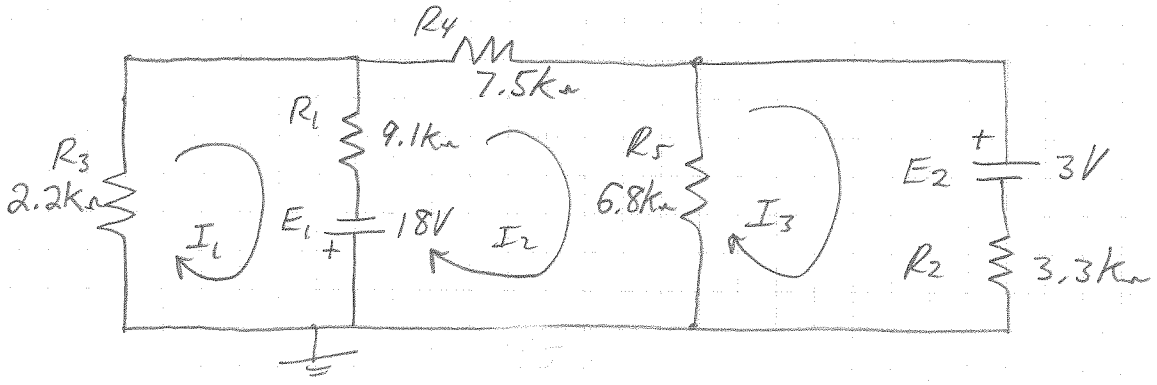
$I_A = 3.312\,A$

$I_B = -63.69\,mA$

$I_C = -789.8\,mA$

(a + b)

(25) USE MESH ANALYSIS TO SOLVE FOR THE LOOP CURRENTS (EACH CIRCUIT):



Loop 1: $-R_3 I_1 - R_1 I_1 + R_1 I_2 + E_1 = 0$

$(-11.3k) I_1 + (9.1k) I_2 + 0 I_3 = -18$ (1)

Loop 2: $-E_1 - R_1 I_2 + R_1 I_1 - R_4 I_2 - R_5 I_2 + R_5 I_3 = 0$

$(9.1k) I_1 - (23.4k) I_2 + (6.8k) I_3 = 18$ (2)

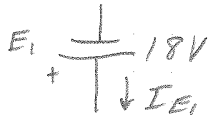
Loop 3: $-R_5 I_3 + R_5 I_2 - E_2 - R_2 I_3 = 0$

$(0) I_1 + (6.8k) I_2 - (10.1k) I_3 = 3$ (3)

SOLVING (1) - (3):

$I_1 = 1.206\ mA$
$I_2 = -480.6\ \mu A$
$I_3 = -620.6\ \mu A$

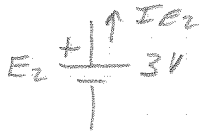
(c) THE CURRENT IN E_1



$I_{E1} = I_1 - I_2$

$I_{E1} = 1.687\ mA$

THE CURRENT IN E_2

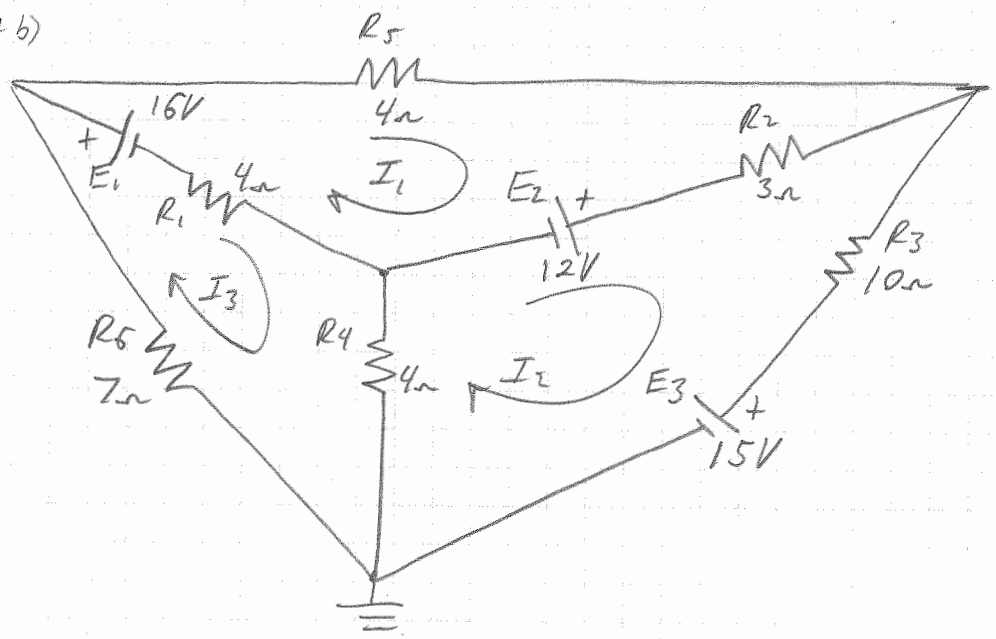


$I_{E2} = -I_3$

$\therefore I_{E2} = 620.6\ \mu A$

(p 25) C...

~~P26~~ (a+b)



Loop 1: $-R_1 I_1 + R_1 I_3 + E_1 - R_5 I_1 - R_2 I_1 + R_2 I_2 - E_2 = 0$

$-11 I_1 + 3 I_2 + 4 I_3 = -4$ (1)

Loop 2: $-R_4 I_2 + R_4 I_3 + E_2 - R_2 I_2 + R_2 I_1 - R_3 I_2 - E_3 = 0$

$3 I_1 - 17 I_2 + 4 I_3 = 3$ (2)

Loop 3: $-R_6 I_3 - E_1 - R_1 I_3 + R_1 I_1 - R_4 I_3 + R_4 I_2 = 0$

$4 I_1 + 4 I_2 - 15 I_3 = 16$ (3)

SOLVING YIELDS:

$$I_1 = -238.5 \text{ mA}$$
$$I_2 = -516.9 \text{ mA}$$
$$I_3 = -1.268 \text{ A}$$

(c) FIND THE CURRENT THROUGH R_5

$I_{R5} = I_1 = -238.5 \text{ mA}$

Question 8-26

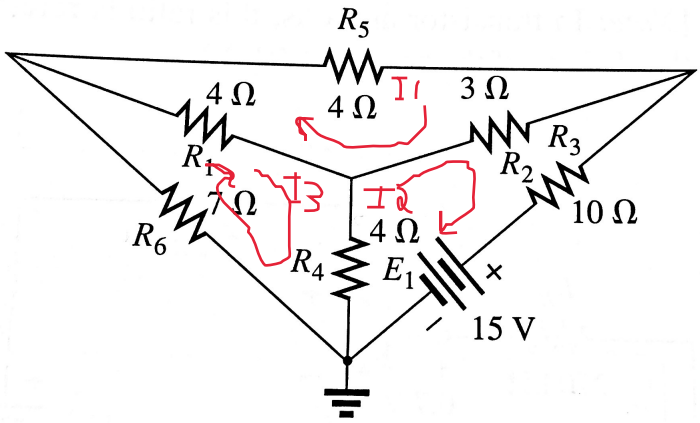


FIG. 8.123
Problem 26.

a. Write the mesh equations for the network of Fig. 8.123 using the general approach.
Loop 1: $-R_1I_1 + R_1I_3 - R_5I_1 - R_2I_1 + R_2I_2 = 0$
Loop 1: $-R_1(I_1 - I_3) - R_2(I_1 - I_2) - R_5I_1 = 0$
Loop 1: $-4I_1 - 3(I_1 + I_2) - 4(I_1 + I_3) = 0$

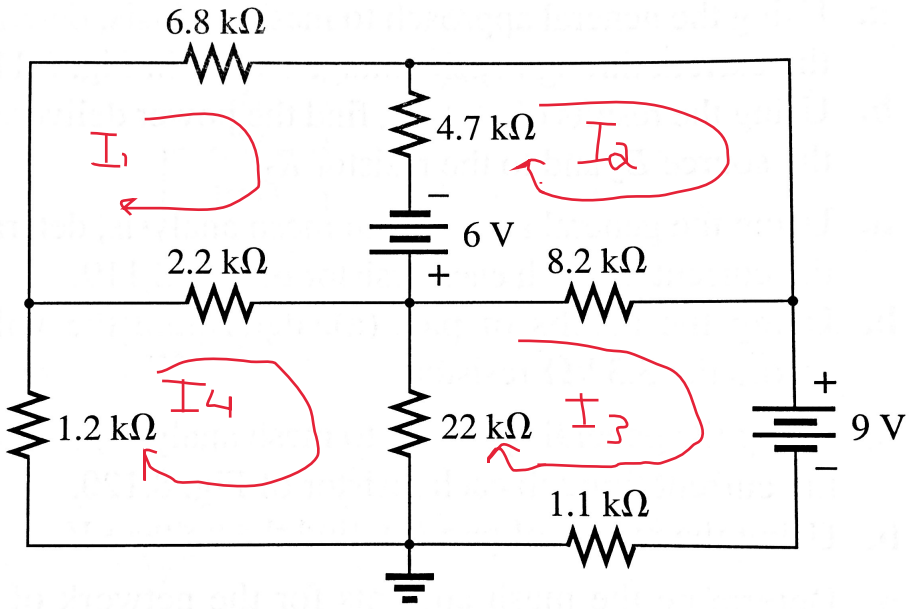
Loop 2: $-E_1 - R_4I_2 + R_4I_3 - R_2I_2 + R_2I_1 - R_3I_2 = 0$
Loop 2: $-R_4(I_2 - I_3) - R_2(I_2 - I_1) - R_3I_2 = E_1$
Loop 2: $-3(I_2 - I_1) - 10I_2 - 4(I_2 - I_3) = 15$

Loop 3: $-R_6I_3 - R_1I_3 + R_1I_1 - R_4I_3 + R_4I_2 = 0$
Loop 3: $-R_6I_3 - R_1(I_3 - I_1) - R_4(I_3 - I_2) = 0$
Loop 3: $-7I_3 - 4(I_3 - I_1) - 4(I_3 - I_2) = 0$

b. Using determinants, calculate the mesh currents.
$I_1 = -430.4mA$
$I_2 = -1.05A$
$I_3 = -395.1mA$

c. Using the results of part (b), calculate the current through the resistor R_5
$I_{R_5} = I_1 = -430.4mA$

Question 8-27



a. Write the mesh currents for the network of Fig. 8.124 using the general approach.
Loop 1: $-6.8k\Omega \cdot I_1 - 4.7k\Omega \cdot I_1 + 4.7k\Omega \cdot I_2 + 6V - 2.2k\Omega \cdot I_1 + 2.2k\Omega \cdot I_4 = 0$
Loop 1: $(-6.8k\Omega) \cdot I_1 - 4.7k\Omega \cdot (I_1 - I_2) - 2.2k\Omega \cdot (I_1 - I_4) = -6V$

Loop 2: $6V - 4.7k\Omega \cdot I_2 + 4.7k\Omega \cdot I_1 - 8.2k\Omega \cdot I_2 + 8.2k\Omega \cdot I_3 = 0$
Loop 2: $-4.7k\Omega \cdot (I_2 - I_1) - 8.2k\Omega(I_2 - I_3) = -6V$

Loop 3: $-22k\Omega \cdot I_3 + 22k\Omega \cdot I_4 - 8.2k\Omega \cdot I_3 + 8.2k\Omega \cdot I_2 - 9V - 1.1k\Omega \cdot I_3$
Loop 3: $-22k\Omega(I_3 - I_4) - 8.2k\Omega(I_3 - I_2) - 1.1k\Omega \cdot I_3 = 9V$

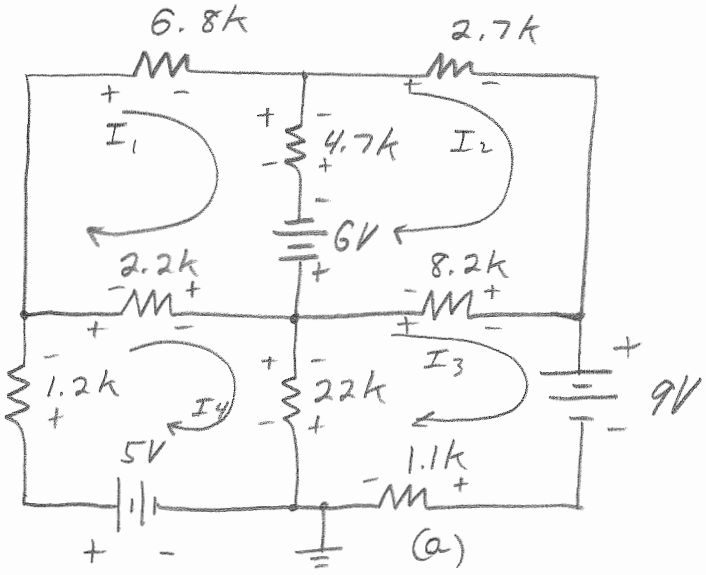
Loop 4: $-1.2k\Omega \cdot I_4 - 2.2k\Omega \cdot I_4 + 2.2k\Omega \cdot I_1 - 22k\Omega \cdot I_4 + 22k\Omega \cdot I_3$
Loop 4: $-1.2k\Omega \cdot I_4 - 2.2k\Omega \cdot (I_4 - I_1) - 22k\Omega \cdot (I_4 - I_3) = 0$

b. Using determinants, calculate the mesh currents.
$I_1 = -0.597mA$
$I_2 = -2.13mA$
$I_3 = -2.27mA$
$I_4 = -2.03mA$

c. Using the results of part (b), find the power delivered by the 6 V source.
$I_{6V} = I_1 - I_2 = -0.597mA - (-2.13mA) = 1.53mA$
$P_{6V} = E \cdot I_{6V} = 6V \cdot 1.53mA = 9.18mW$

(2) (a & b)

SOLVE FOR THE LOOP CURRENTS



I_1 loop: $-6.8k I_1 - 4.7k I_1 + 4.7k I_2 + 6 - 2.2k I_1 + 2.2k I_4 = 0$

$-13.7k I_1 + 4.7k I_2 + 0 I_3 + 2.2k I_4 = -6$ (1)

I_2 loop: $-6 - 4.7k I_2 + 4.7k I_1 - 2.7k I_2 - 8.2k I_2 + 8.2k I_3 = 0$

$4.7k I_1 - 15.6k I_2 + 8.2k I_3 + 0 I_4 = 6$ (2)

I_3 loop: $-22k I_3 + 22k I_4 - 8.2k I_3 + 8.2k I_2 - 9 - 1.1k I_3 = 0$

$0 I_1 + 8.2k I_2 - 31.3k I_3 + 22k I_4 = 9$ (3)

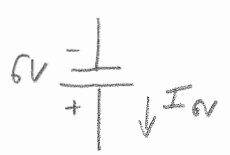
I_4 loop: $-1.2k I_4 - 2.2k I_4 + 2.2k I_1 - 22k I_4 + 22k I_3 + 5 = 0$

$2.2k I_1 + 0 I_2 + 22k I_3 - 25.4k I_4 = -5$ (4)

SOLVING YIELDS:

$I_1 = 32.11\,\mu A$
$I_2 = -883.9\,\mu A$
$I_3 = -968.2\,\mu A$
$I_4 = -639.0\,\mu A$

(c) FIND $P_{DELIV,\,6V}$ SOURCE



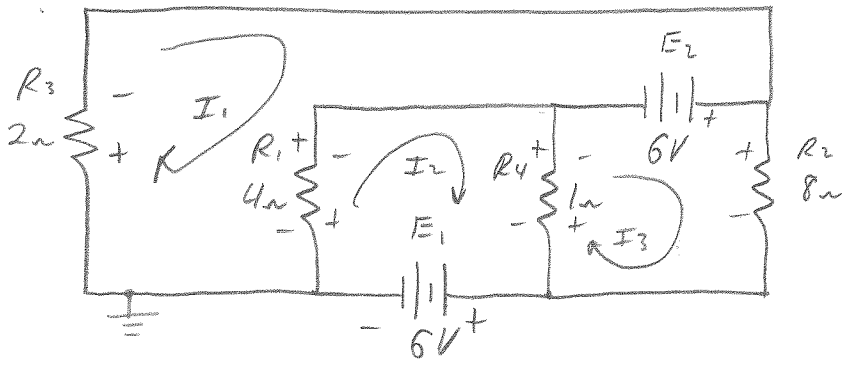
$P_{DELIV,6V} = (6V)(I_{6V})$

$I_{6V} = I_1 - I_2 = 916\,\mu A$

$\therefore P_{DELIVERED,\,6V\,SOURCE} = (6V)(916\,\mu A) = 5.5\,mW$

28) (a) REDRAW THE CIRCUIT (REMOVE THE CROSSOVER)

(b) & (c) WRITE THE MESH EQS & SOLVE



I_1: $-R_3 I_1 - E_2 - R_1 I_1 + R_1 I_2 = 0$

$-6I_1 + 4I_2 + 0I_3 = 6$ (1)

I_2: $-R_1 I_2 + R_1 I_1 - R_4 I_2 + R_4 I_3 - E_1 = 0$

$4I_1 - 5I_2 + I_3 = 6$ (2)

I_3: $-R_4 I_3 + R_4 I_2 + E_2 - R_2 I_3 = 0$

$0I_1 + I_2 - 9I_3 = -6$ (3)

SOLVING YIELDS:

$$I_1 = -3.80\,A$$

$$I_2 = -4.20\,A$$

$$I_3 = 200.0\,mA$$

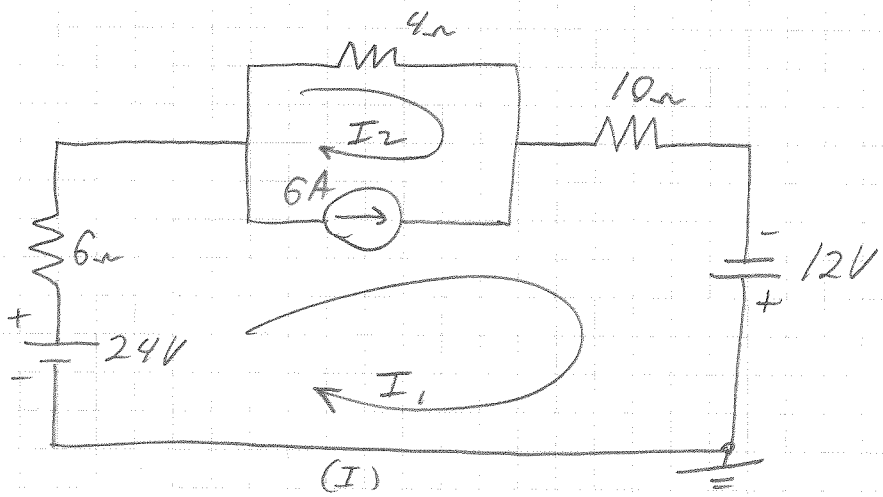
(d) FIND THE POWER DELIVERED BY THE SOURCES:

$P_{E1} = (E_1)(-I_2) = (6V)(4.20A) = \underline{25.2W}$

$P_{E2} = (E_2)(I_3 - I_1) = (6V)(4A) = \underline{24W}$

$\therefore$ TOTAL DELIVERED POWER = 49.2W

(30) FIND THE CURRENT THROUGH EACH NETWORK ELEMENT



* CAN'T WRITE A KVL EQ. W/ CURRENT SOURCE PRESENT

KVL (OUTER): $24 - 6I_1 - 4I_2 - 10I_1 + 12 = 0$

$$-16I_1 - 4I_2 = -36 \qquad (1)$$

RELATING THE CURRENT SOURCE TO THE LOOP CURRENTS:

$$6 = I_1 - I_2 \qquad (2)$$

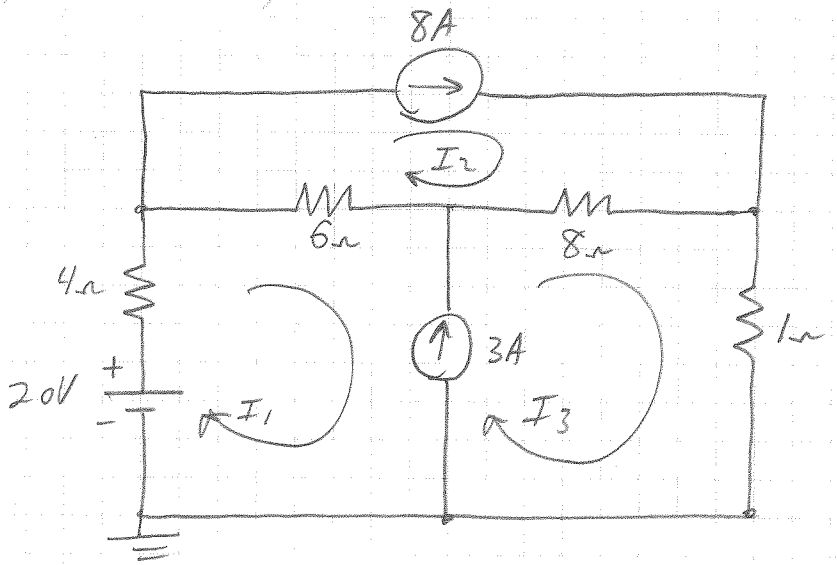
SOLVING: $I_1 = 3A$

$I_2 = -3A$

$\therefore$ $\boxed{I_{24V} = I_{6\Omega} = I_{10\Omega} = I_{12V} = 3A \circlearrowright}$

$\boxed{I_{4\Omega} = -3A \circlearrowright \quad \text{OR} \quad 3A \circlearrowleft}$

(31) FIND THE CURRENT THROUGH EACH ELEMENT



KVL (1,3): $20 - 4I_1 - 6I_1 + 6I_2 - 8I_3 + 8I_2 - I_3 = 0$

$$-10I_1 + 14I_2 - 9I_3 = -20 \quad (1)$$

ALSO KNOW: $I_2 = 8A$ → $0I_1 + I_2 + 0I_3 = 8$ (2)

$I_3 - I_1 = 3A$ → $-I_1 + 0I_2 + I_3 = 3$ (3)

SOLVING:

$$\begin{bmatrix} I_1 = 5.526A \\ I_2 = 8.0A \\ I_3 = 8.526A \end{bmatrix}$$

$I_{20V} = I_{4\Omega} = I_1 = 5.53A$ ↻

$I_{1\Omega} = I_{1\Omega} = I_3 = 8.53A$ ↻

$I_{6\Omega} = I_2 - I_1 = 2.47A$ ←

$I_{8\Omega} = I_3 - I_2 = 526\,mA$ →