Mesh Current Analysis Example 1

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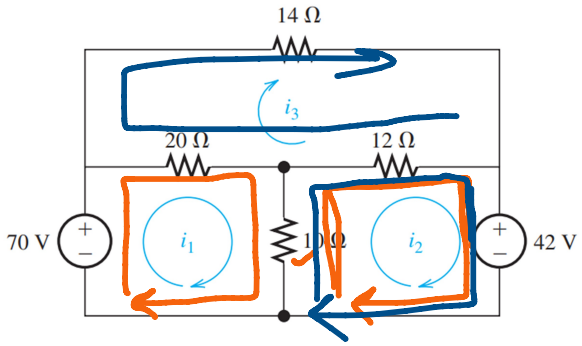
Solve for the current in each element of the circuit shown in Figure



Mesh Currents - 3

I1, i2, i3

Loop 1:
-70 + 20 (i1-i3) + 10 (i1-i2) = 0

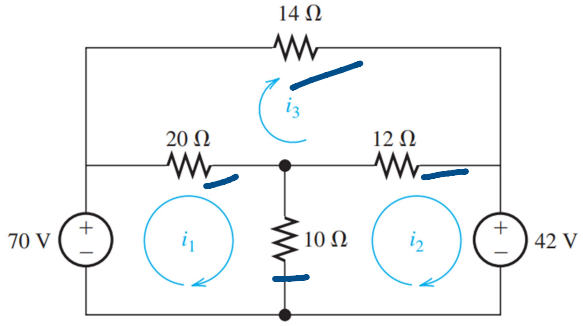
Loop 2:
(i2-i1)10 + (i2-i3)12 +42 =0

Loop 3:
(i3-i1)20 + 14(i3) + (i3-i2)12 = 0

(30) i1 + (-10) i2 + (-20) i3 = 70
(-10) i1 + (22) i2 + (-12) i3 = -42
(-20) i1 + (-12) i2 + (46) i3 = 0

$$\begin{bmatrix} 30 & -10 & -20 \\ -10 & 22 & -12 \\ -20 & -12 & 46 \end{bmatrix} \begin{bmatrix} I1 \\ I2 \\ I3 \end{bmatrix} = \begin{bmatrix} 70 \\ -42 \\ 0 \end{bmatrix}$$

I1 = 4 A
I2 = 1 A
I3 = 2 A



20 Ohms = i1-i3 = 2A
10 Ohms = i1-i2 = 3A
12 Ohms = i3-i2 = 1A
14 Ohms = i3 = 2A

Example 2

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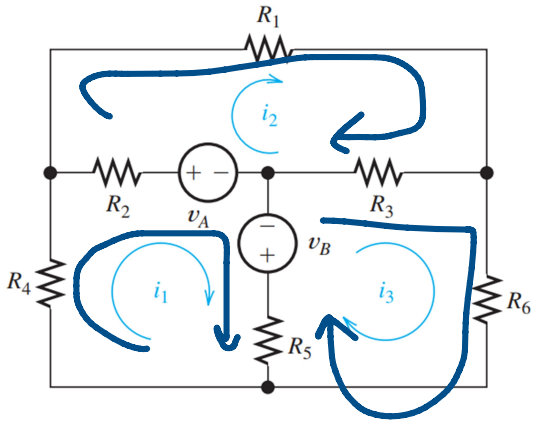
- **Write Mesh-Current Equations in Matrix form**



Loop 1:

I1 R4 + (i1-i2)R2 + Va - Vb +(i1-i3)R5 =0

Loop 2:

(i2)R1 + (i2-i3)R3 - Va + (i2-i1)R2 =0

Loop 3:

(i3-i2)R3 + (i3)R6 + (i3-i1)R5 + Vb = 0

(R2+R4+R5) i1 + (-R2) i2 + (-R5) i3 = -Va + Vb
(-R2) i1 + (R1+R2+R3) i2 + (-R3) i3 = Va
(-R5) i1 + (-R3) i2 + (R3+R5+R6) i3 = -Vb

$$\begin{bmatrix} (R2+R4+R5) & (-R2) & (-R5) \\ (-R2) & (R1+R2+R3) & (-R3) \\ (-R5) & (-R3) & (R3+R5+R6) \end{bmatrix} \begin{bmatrix} I1 \\ I2 \\ I3 \end{bmatrix} = \begin{bmatrix} Vb-Va \\ Va \\ -Vb \end{bmatrix}$$

Example 3 - Mesh Currents in Circuits Containing Current Sources

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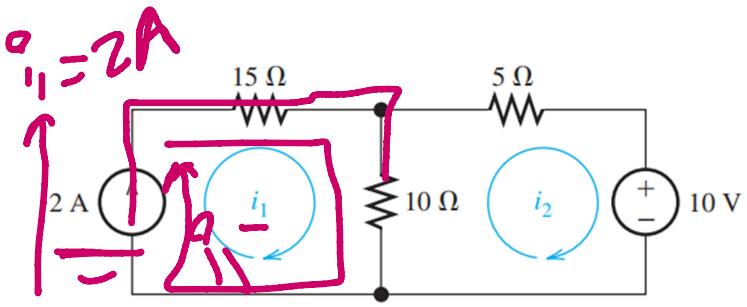

- **Solve for mesh-currents**

Loop 2:

(i2-i1)10 + (i2) 5 +10 =0

Loop 1:

I1= 2A

(-10) i1 + (15) i2 = -10

I2 = 0.67A

Example 4

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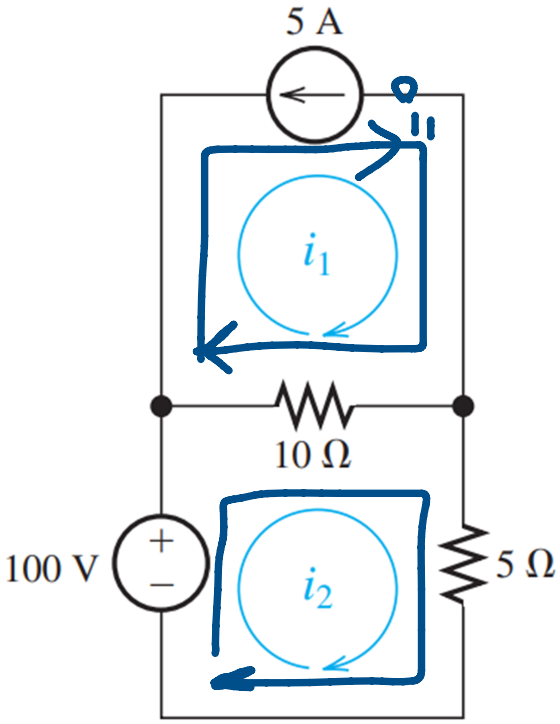

Solve for Mesh Currents

Loop 1:

I1= -5A

Loop 2:
(i2-i1)10 + 5(i2) -100 =0

-10 i1 + 15 i2 = 100

I2 = 3.33 A

Example 5

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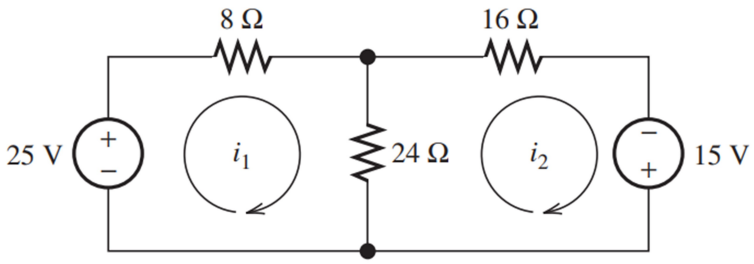
- Solve for the power delivered to the 24 Ohms resistor and for the mesh currents shown in Figure



Loop 1:

8 i1 + 24 (i1-i2) -25 =0

Loop 2:
(i2-i1)24 + (i2) 16 -15 =0

P|24Ohms = V * I

= V * (I1-I2)

= ((I1-I2)*24)(I1-I2)

= 3.84 W

(32) i1 + (-24) i2 = 25
(-24) i1 + (40) i2 = 15

I1 = 1.93 A
I2 = 1.53 A

Example 6

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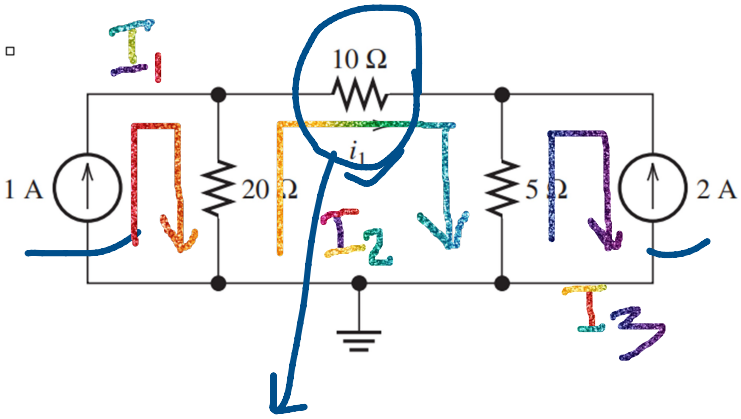
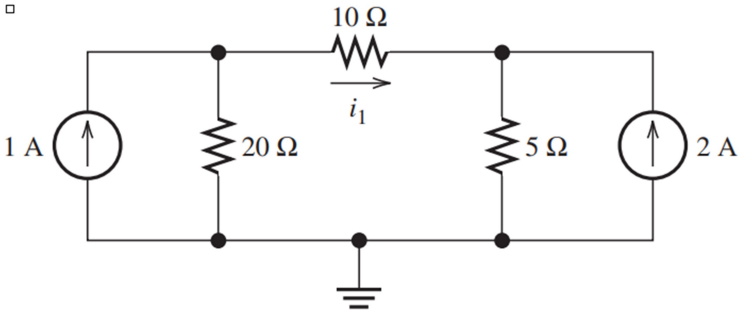
- **Use mesh-current analysis to find the value of i1 in the circuit of Figure**



i1 = I2 = 0.28A



Loop 1:

I1 = 1A

Loop 2:

(I2-I1)20 + 10I2 + (I2-I3)5=0

Loop 3:

I3 = -2A

(-20) I1 + (35) I2 + (-5) I3 =0

(-20*1) + (35)I2 +(-5*-2)=0

-20+35I2+10=0

35I2=10

I2=10/35 = 0.28A

Example 7

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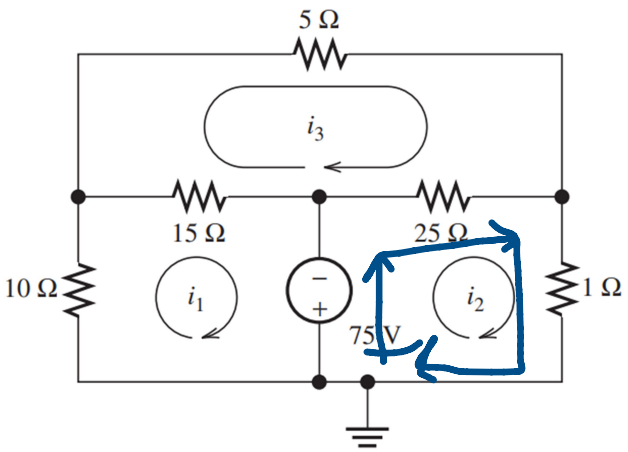

- **Solve for the power delivered by the voltage source in Figure, using the mesh current method.**

Loop 1:

10i1 + (i1-i3)15 -75 = 0

Loop 2:
25(i2-i3) + (i2)1 + 75 =0

Loop 3:
(i3-i1)15 + (i3)5 + (i3-i2)25 =0

(25) i1 + (0) i2 + (-15) i3= 75
(0) i1 + (26) i2 + (-25) i3= -75
(-15) i1 + (-25) i2 + (45) i3= 0

I1 = 1.64 A
I2 = -5.06 A
I3 = -2.27 A

P|75V = V * I
= 75 * (I2-i1)

= 75 (-5.06-1.64)

= W

Example 8

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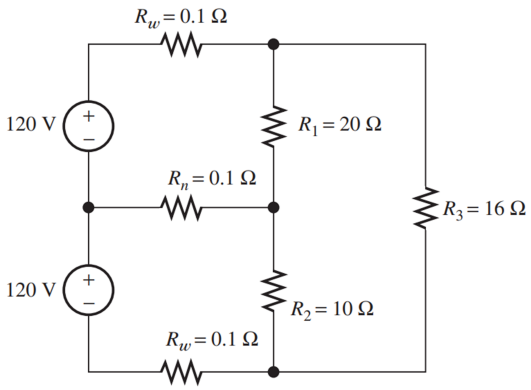

- Use mesh-current analysis to determine the voltage magnitude for each resistor