
Al's Electronic Class Room

Advance Circuit Analysis

What will be covered

- Kirchhoff's Current Law
- Kirchhoff's Voltage Law
- Method of Branch Currents
- Node-Voltage Analysis
- Method Of Mesh Currents
- Circuit Applications Of Kirchhoff's Law

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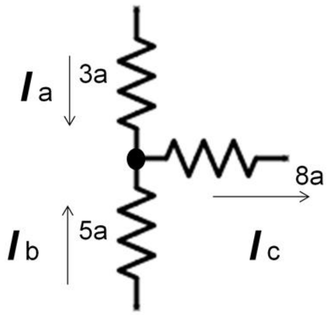

Kirchhoff's Current Law

$I_a + I_b - I_c = 0$

$3a + 5a - 8a = 0$

Or

$I_a + I_b = I_c$

$3a + 5a = 8a$

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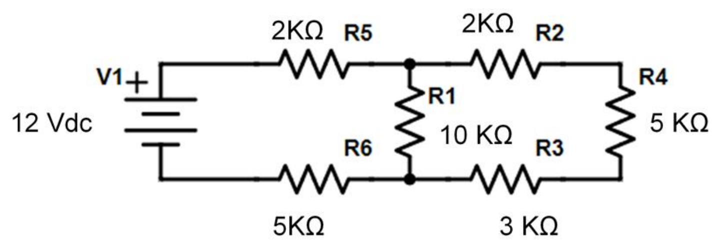
Kirchhoff's Voltage Law

Voltage around a close loop must equal Zero



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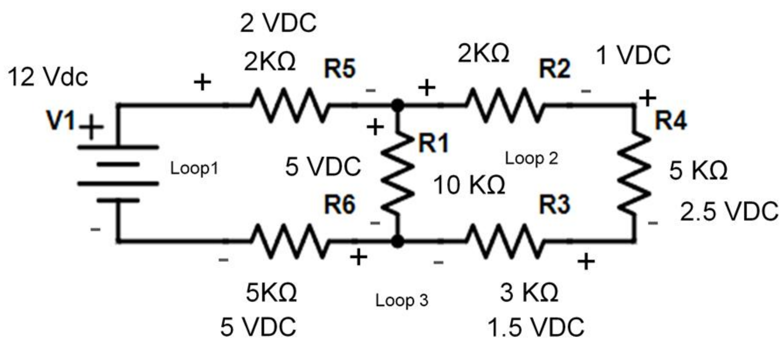
Kirchhoff's Voltage Law



Loop1= 2 Vdc + 5 Vdc + 5 Vdc + (-12 Vdc) = 0 Vdc

Loop 2= 5 Vdc +(– 1.5 Vdc) + (– 2.5 Vdc)+ (-1 Vdc) = 0 Vdc

Loop 3= - 5 Vdc +(– 1.5 Vdc) + (– 2.5 Vdc)+ (-1 Vdc) +(- 2Vdc) + 12 VDC = 0 Vdc

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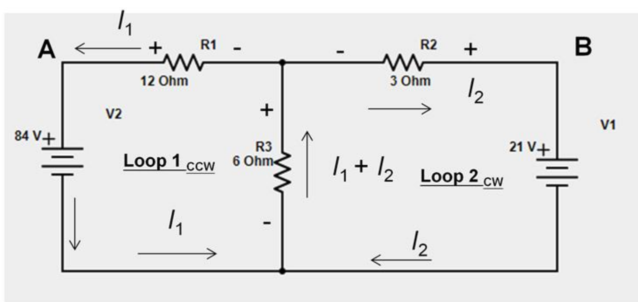
Method of Branch Currents



1 Loop 1 From A

84 – VR3 –VR1 = 0

Loop 2 From B

21- VR3 – VR2 = 0

2 84 – R3 ($I1$ +$I2$) - R1($I1$)=0

84- 6I1 - 6I2 – 12I1=0

84 – 18 I1 – 6I2 =0

-18 I1 – 6 I2 = -84

3

21 - R3 (I1 + I2) – R2 (I2) =0

21 – 6(I1 + I2) -3I2=0

21- 6I1 – 6I2 – 3I2 =0

21 – 9I2 -6I1 = 0

-6I1 – 9I2 =-21

4

3I1 + 1I2 =14 $\div -6$

2I1 + 3I2 = 7 $\div -3$

5

9I1 + 3I2 = 42 *X3*

2I1 + 3I2 = 7 *(Sub)*

6

7I1 = 35 *Find I1*

I1 = 5 Amps

7

2I1 + 3I2 = 7

2(5) + 3I2 = 7

3I2 = 7 -10

I2 = -1 amp

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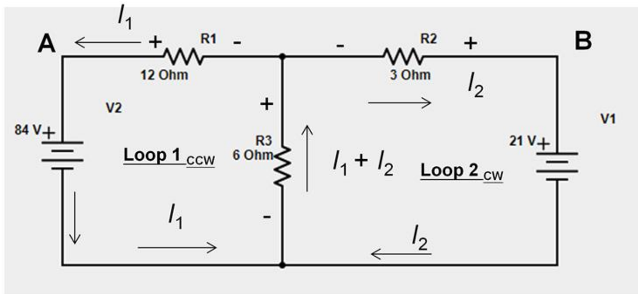
Method of Branch Currents



I1 = 5 Amps
I2 = -1 amp
I3 = I1 + I2 = 5 + (-1) = 4 amps
VR1= 12 x 5 = 60 Vdc
VR2 = 3 X 1 = -3Vdc
VR3 = 6 x 4 = 24 Vdc

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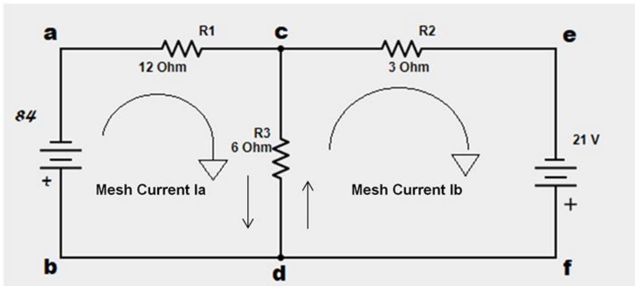
Method Of Mesh Currents



- Mesh Currents are not Branch currents they stay the same.
- Voltages created by its mesh current add, and voltages created by non native Branch current subtracts.

Mesh Current *Ia*
18 *Ia* – 6 *Ib* = *84 V*

Mesh Current *Ib*
- 6 Ia + 9Ib = -21 V

Mesh Current *Ia* ÷ 2
18 *Ia* – 6 *Ib* = *84 V*
9 *Ia* – 3 *Ib* =42

Mesh Current *Ib* ÷ 3
- *6 Ia + 9Ib = -21 V*
- *2 Ia + 3Ib = -7V*

9 *Ia* – 3 *Ib* =42
-2 Ia + 3Ib = -7V
7 Ia = 35
1a = 5 amps

-2 (5) + 3Ib = -7V
3Ib = -7V +10
3Ib = 3
1b = 1 amp

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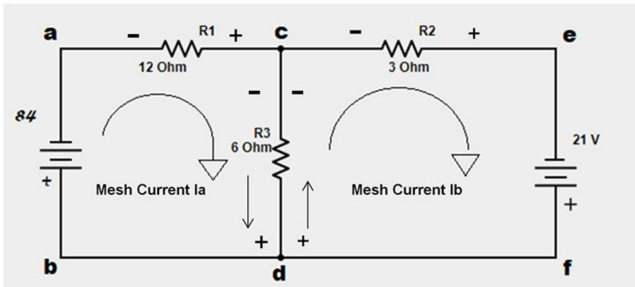
Method Of Mesh Currents



- Mesh Currents are not Branch currents they stay the same.
- Voltages created by its mesh current add, and voltages created by non native Branch current subtracts.

1a = 5 amps

1b = 1 amp

Mesh Ia

(- 60 Vdc) + (– 24 Vdc) + 84 = 0

Mesh Ib

(-3 vdc) + (-21 Vdc) + 24 Vdc =0

VR1= 5 amps x 12 ohms= 60 Vdc

VR2 = 1 amp x 3 ohms = 3 Vdc

VR3 = (5 amp x 6 ohms) + (-1 amp x 6 ohms)
VR3 = 30Vdc – 6volts = 24 volts

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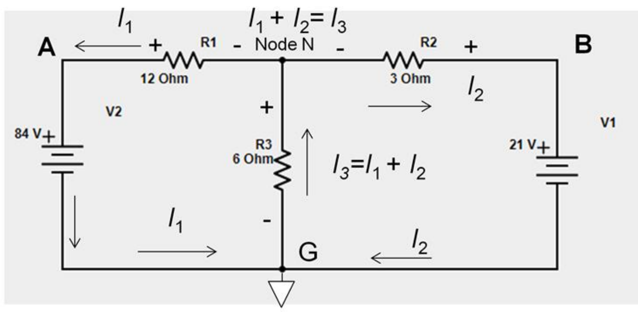
Node Voltage Analysis



$I_1 + I_2 = I_3$

$\frac{V1}{R1} + \frac{V2}{R2} = \frac{VN}{R3}$

$\frac{V1}{12} + \frac{V2}{3} = \frac{VN}{6}$

$\frac{84 - Vn}{12} + \frac{21 - Vn}{3} = \frac{Vn}{6}$

$84 - Vn + 4(21 - Vn) = 2\,Vn$

84 –Vn + 84 – 4Vn = 2vn

168 -5Vn =2vn

168 = 7vn

168/7 = Vn

Vn = 24 Vdc

V1= 84 – vn
V1 =84 -24
Vn= 60 Vdc

V2= 21 – Vn
V2 = 21 – 24
V2 = - 3Vdc

I1= $\frac{60vdc}{12\ ohms}$ *5 Amps*

I2 = $\frac{-3vdc}{3\ ohms}$ *-1 amp*

I3= 5 Amp – 1 Amp
4 Amp

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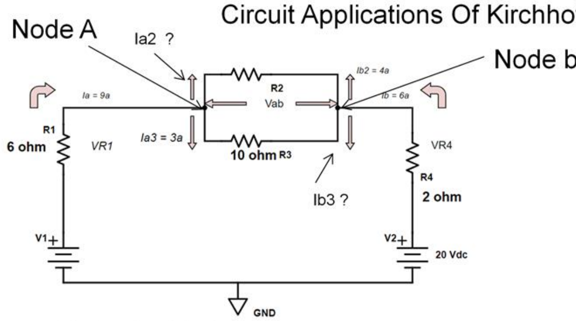
Circuit Applications Of Kirchhoff's Law



Ia2= 9a – 3a ; Ia2= 6a
Ib3 = 6a -4a ; Ib3 = 2a

Vab = Ia3 – Ib3 = 3a – 2a = 1a
The Current flow thru R3 is from left to right & the total current flow is 1a (3a from Lft. to Rt. & 2a Rt to Lft)
Vab = 1a x 10 ohm = 10 Volts
VR2 = 10 Volts / (6a – 4 a) = 10 Volts / 2 a = 5 ohms

VR1 = 9a x 6 ohms = 54 Vdc
VR4 = 6a x 2 ohms = 12 Vdc

V1 = + VR1 + Vab - VR4 + V2
-72v = 54V dc - 10 Vdc +12Vdc -20vdc

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