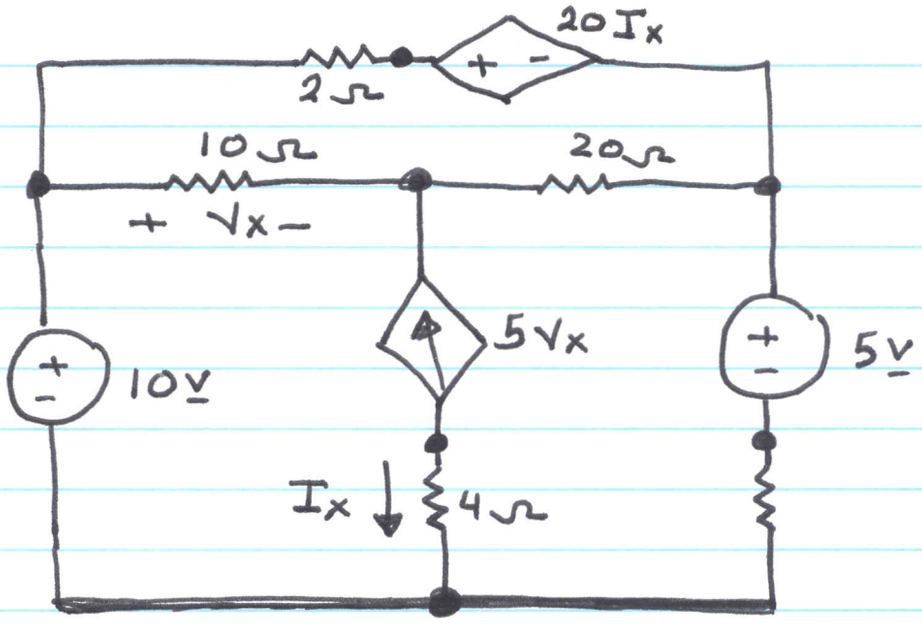
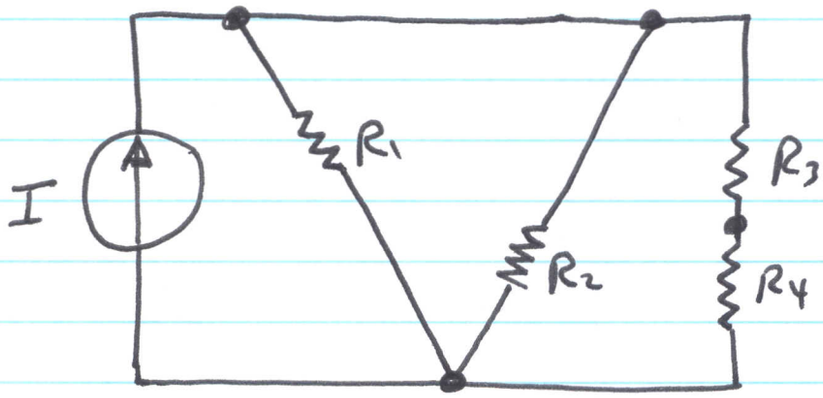
Voltage and Current Laws

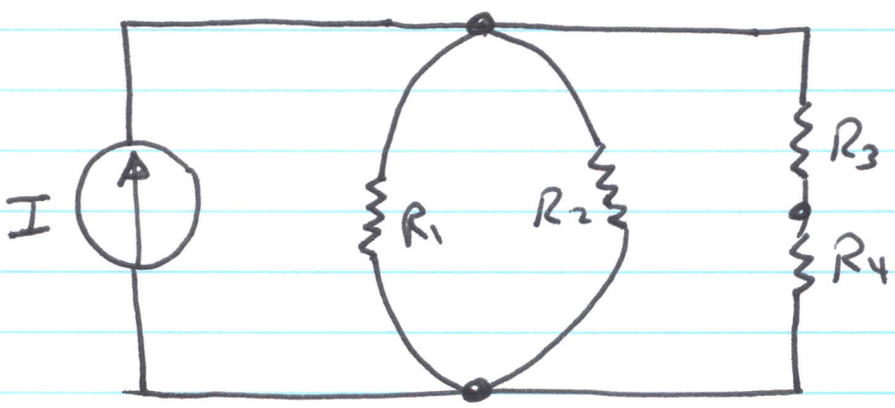
Node : A point of Connection of two or more Circuit elements.

Loop : Any closed path through the Circuit in which no node is crossed more than once

Mesh : Any Loop that does not Contain within it a nother Loop

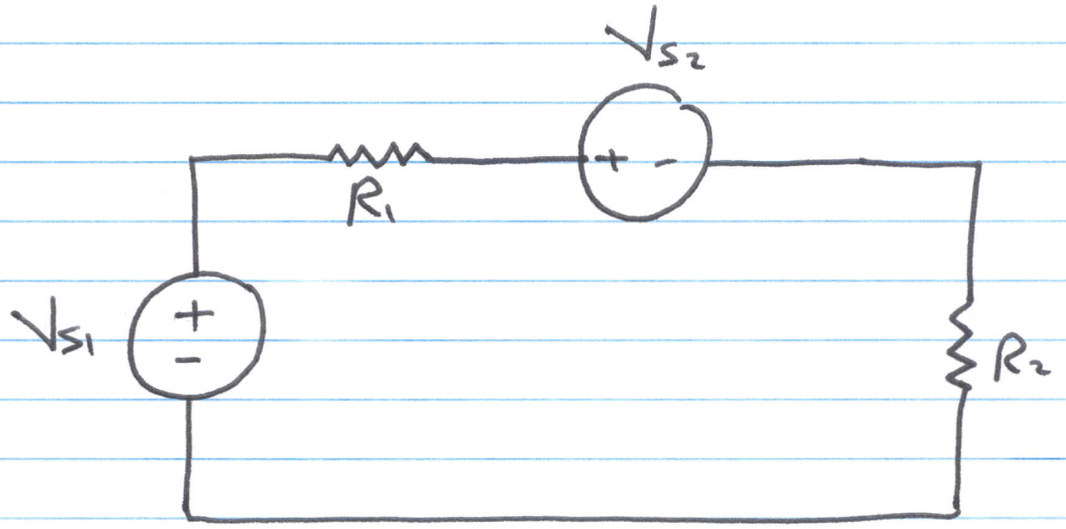






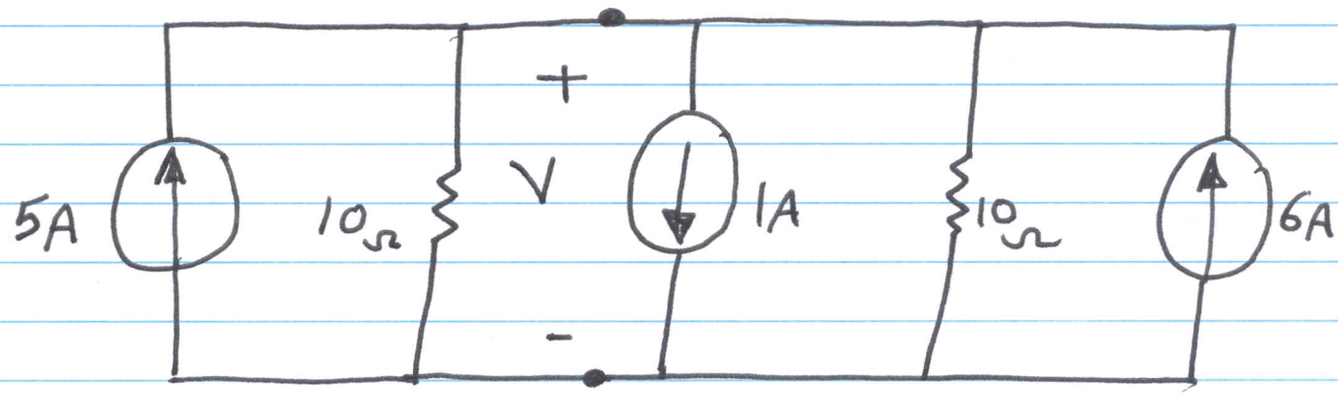
Serier Connections

ALL of the elements in a circuit that carry the same current are said to be connected in Series



Parallel Connections

Elements in a circuit having a common voltage across them are said to be connected in parallel.

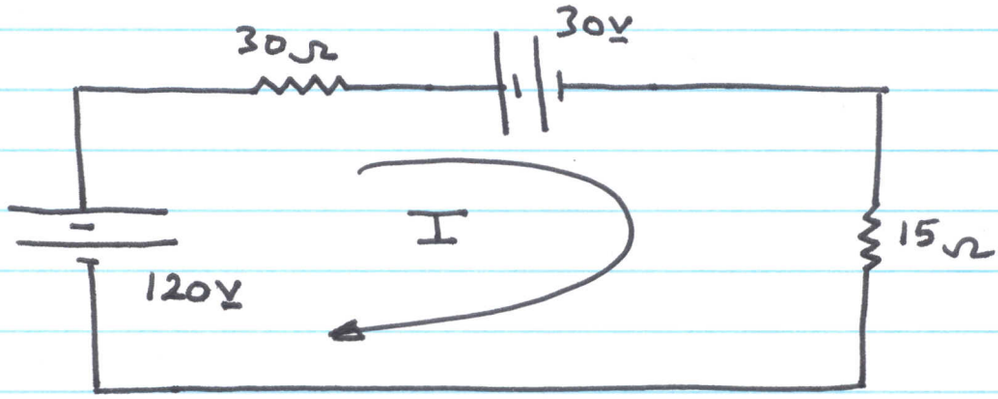


Kirchhoff's Voltage Law : KVL

KVL : The algebraic sum of the voltages around any Loop is Zero.

Analysis of a single. Loop circuit

Find I



$$30\,I + 30 + 15\,I - 120 = 0$$

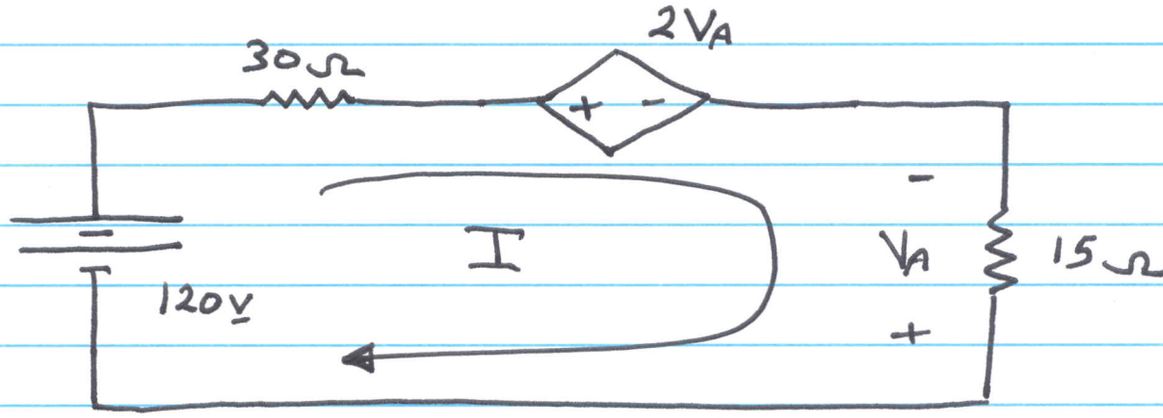
$$\therefore \quad I = 2A$$

$$V_{30\Omega} = 60\,V$$

$$V_{15\Omega} = 30\,V$$

Analysis of a Circuit containing a dependent source

Find I



$$30I + 2V_A + 15I - 120 = 0$$

$$V_A = -15I$$

$$\therefore \quad I = 8A$$
$$V_A = -120V$$

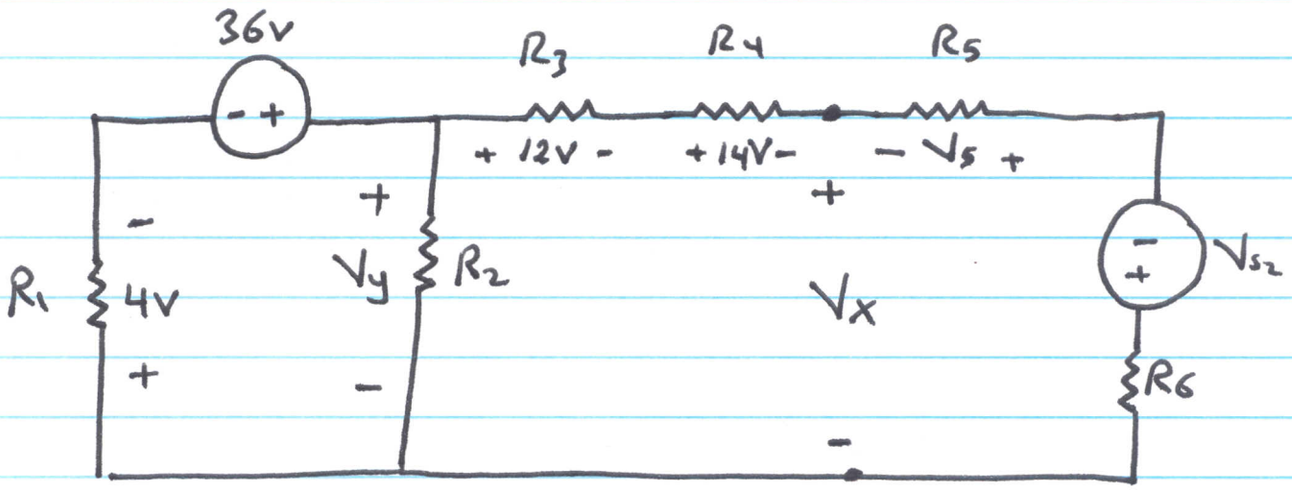
* Calculate the power absorbed by each Circuit element

Answers:

$$P_{120V} = -960W, \quad P_{30\Omega} = 1920W$$

$$P_{2V_A} = -1920W, \quad P_{15\Omega} = 960W$$

Applying KVL



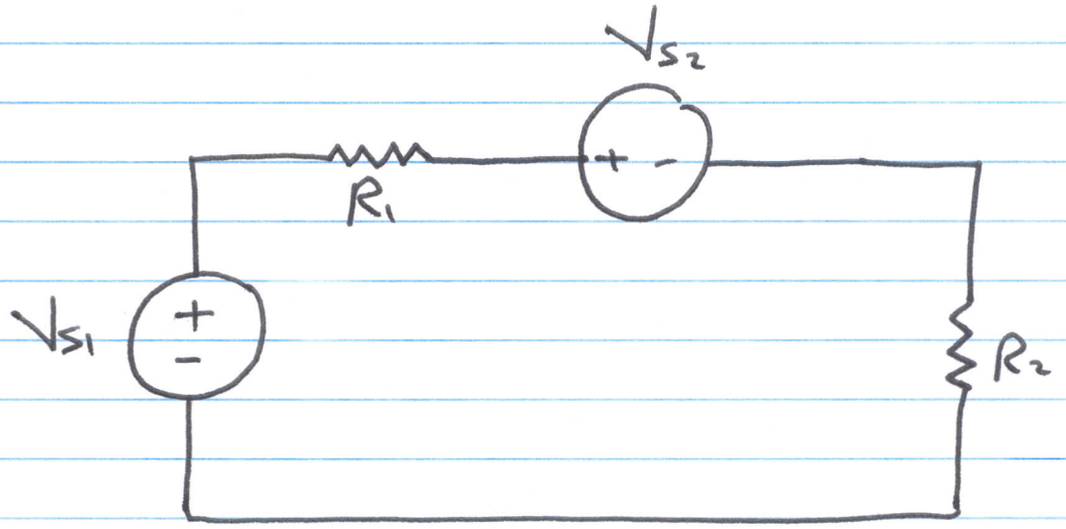
Find V_x and V_y

$V_y = 36 - 4 = 32\ V$

$V_x = -14 - 12 + 32 = 6\ V$

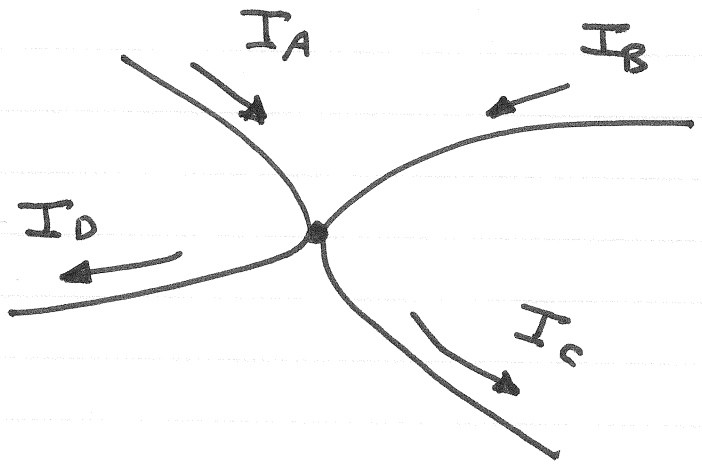
Serier Connections

ALL of the elements in a circuit that carry the same current are said to be connected in Series



Kirchhoff's Current Law : KCL

KCL : The algebraic sum of the current entering any node is Zero



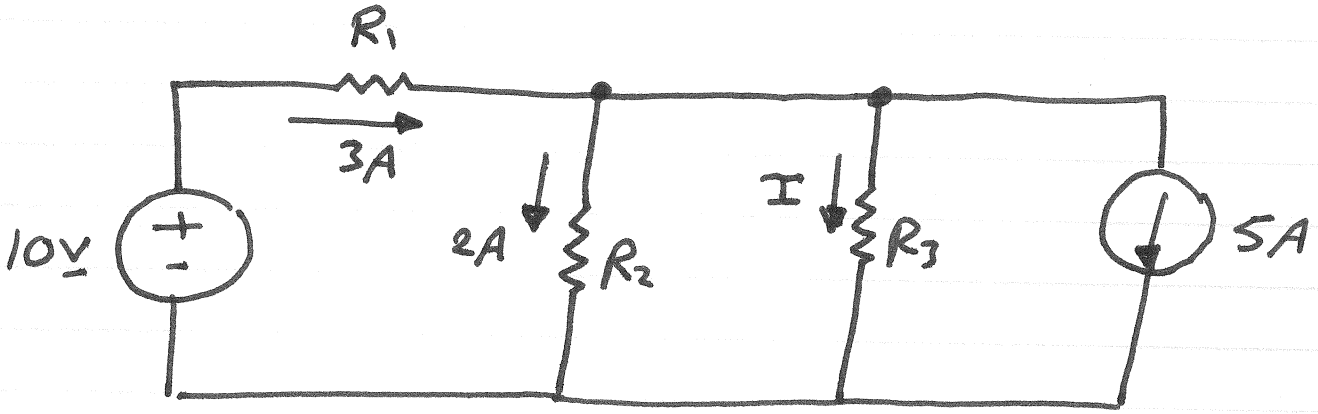
$$I_A + I_B - I_C - I_D = 0$$

KCL : Alternative Form

Current In = Current OUT

$$I_A + I_B = I_C + I_D$$

KCL Application



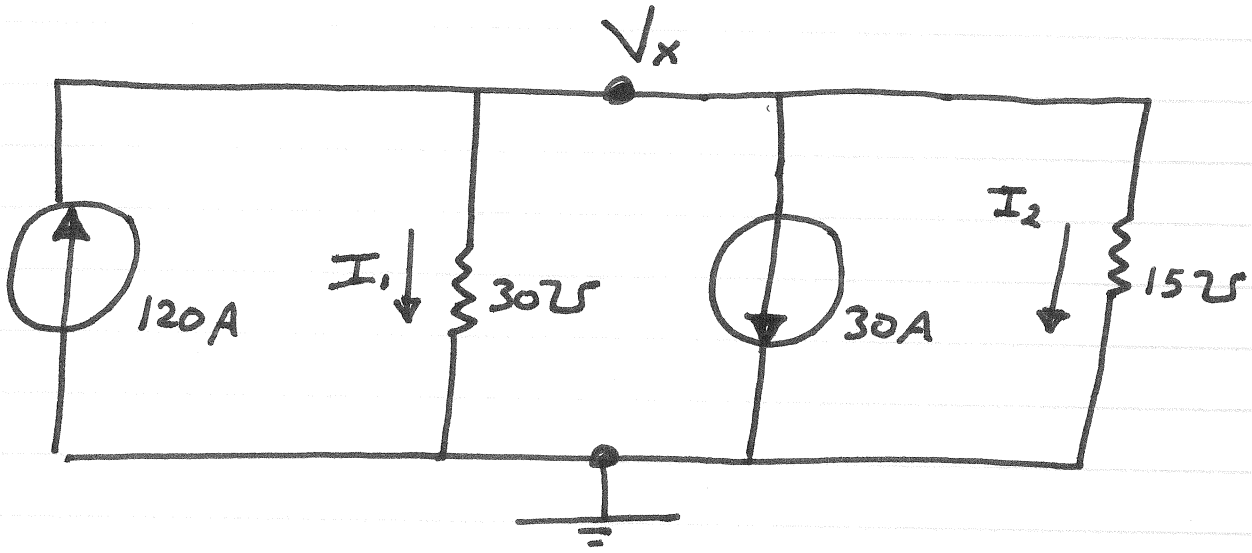
Find I

KCL : $3 = 2 + I + 5$

$\therefore I = -4\,A$

The single node-pair Circuit

Find V_x



$I = GV$

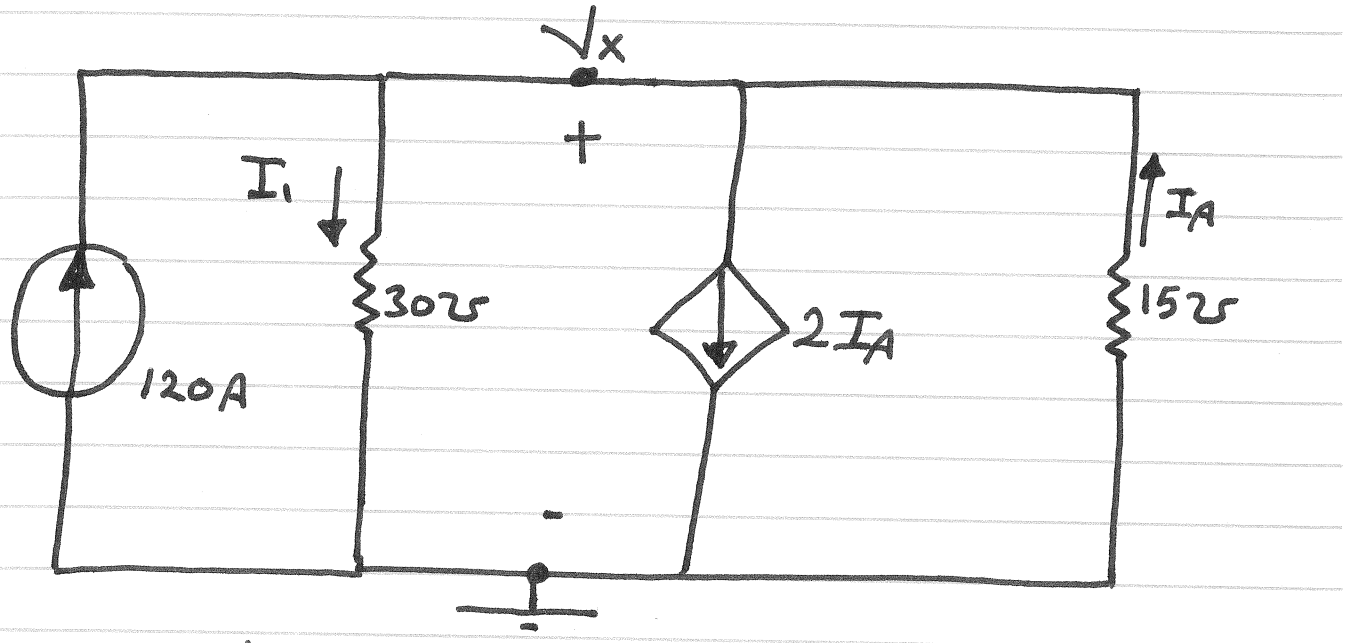
KCL : $120 = 30V_x + 30 + 15V_x$

$\therefore V_x = 2V$

$\therefore I_{30\Omega} = 60\,A$

$I_{15\Omega} = 30\,A$

Analysis of Circuit Containing dependent sources



Find V_x

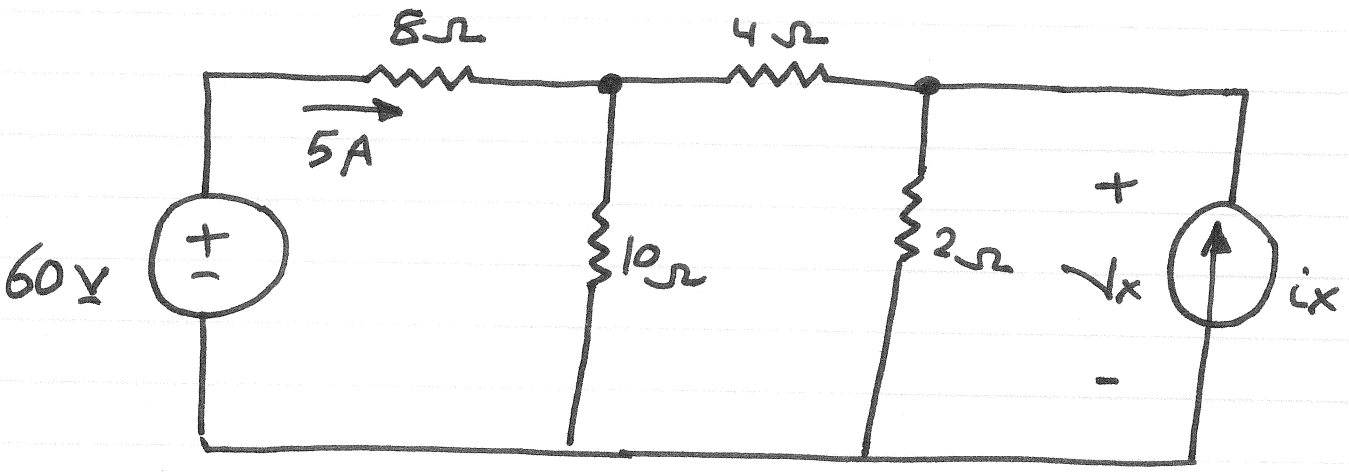
KCL : $120 + I_A = I_1 + 2I_A$

$I_A = -15V_x$

$I_1 = 30V_x$

$\therefore V_x = 8V$

Applying KVL and KCL

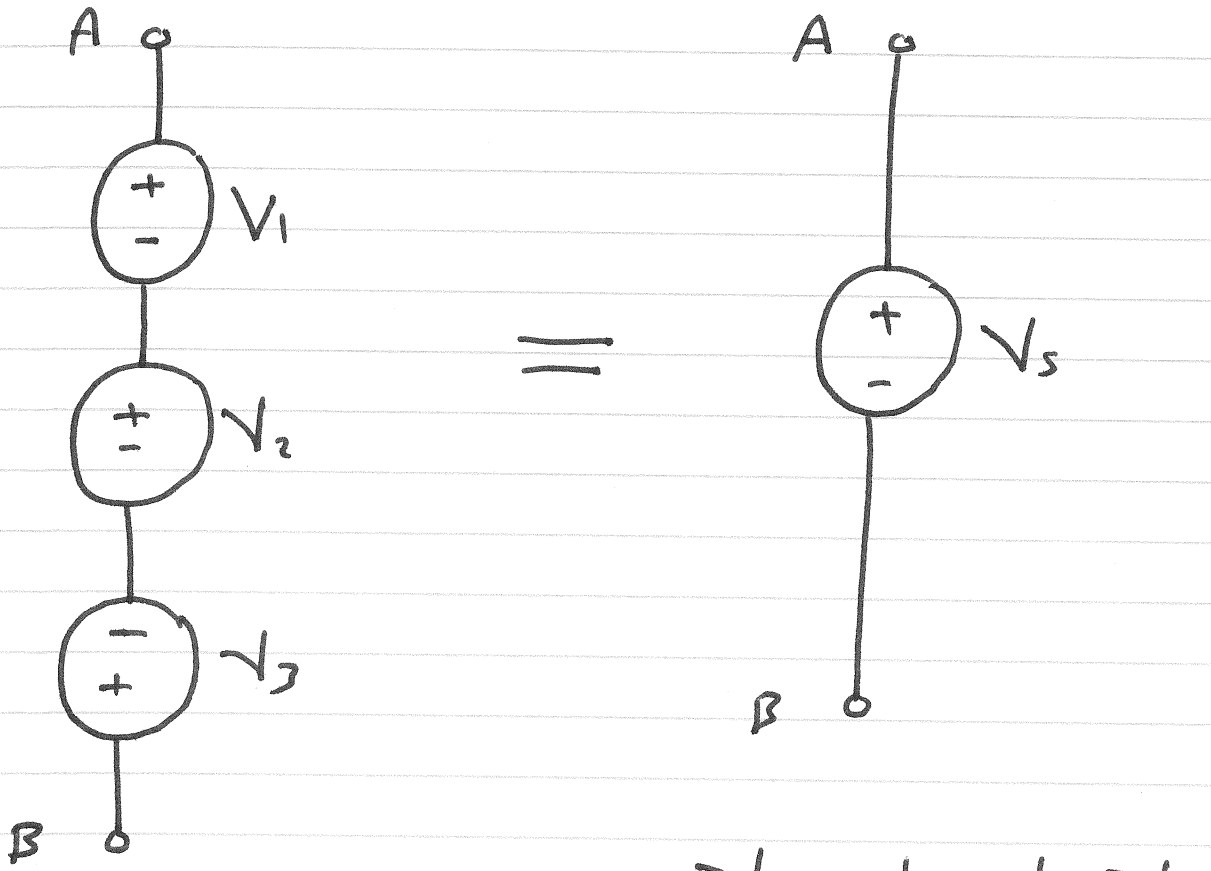


Solve for V_x and i_x

Answer : $V_x = 8V$ and $i_x = 1A$

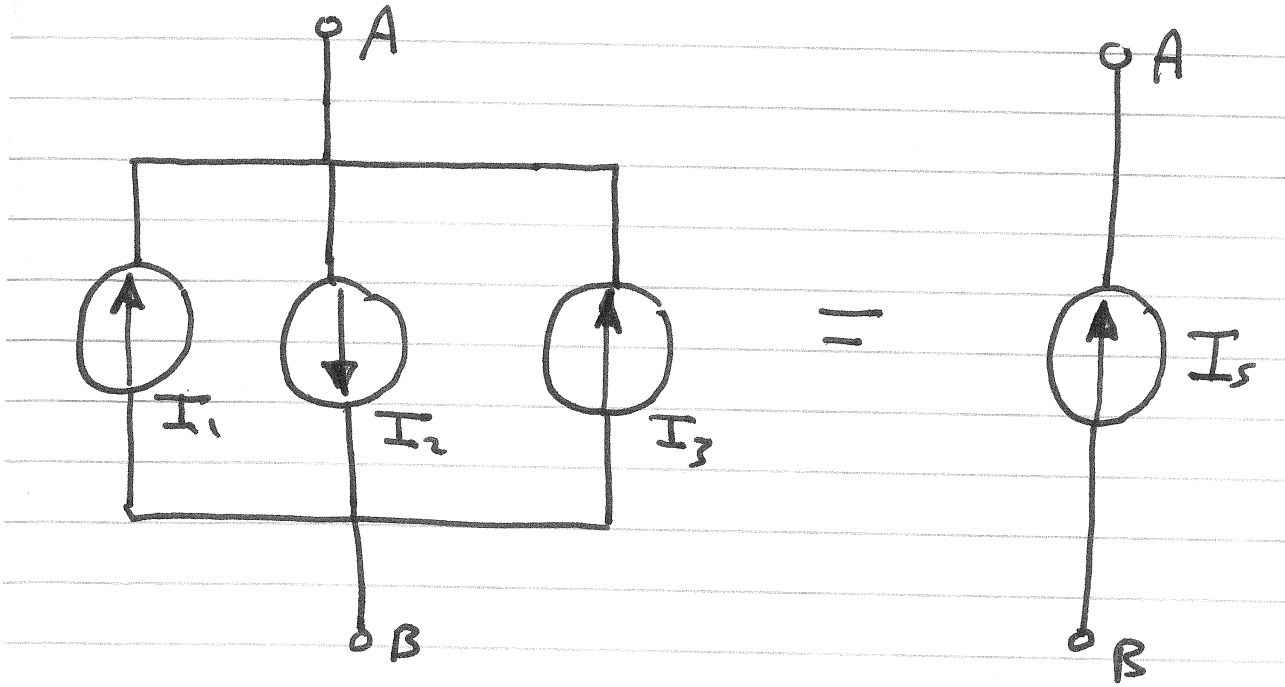
Sevier and Parallel Sources

Voltage Sources Connected in sevier can be Combined into an equivalent Source :



$$V_S = V_1 + V_2 - V_3$$

Current sources connected in parallel can be combined into an equivalent current source :



$$I_5 = I_1 + I_3 - I_2$$

Impossible Circuits