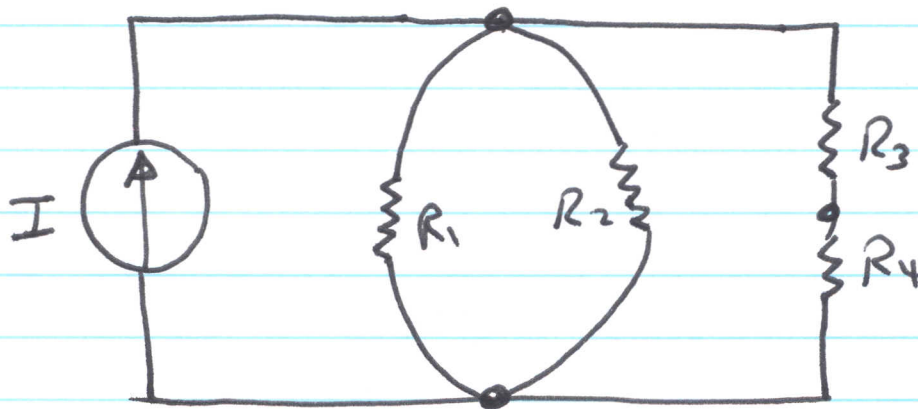
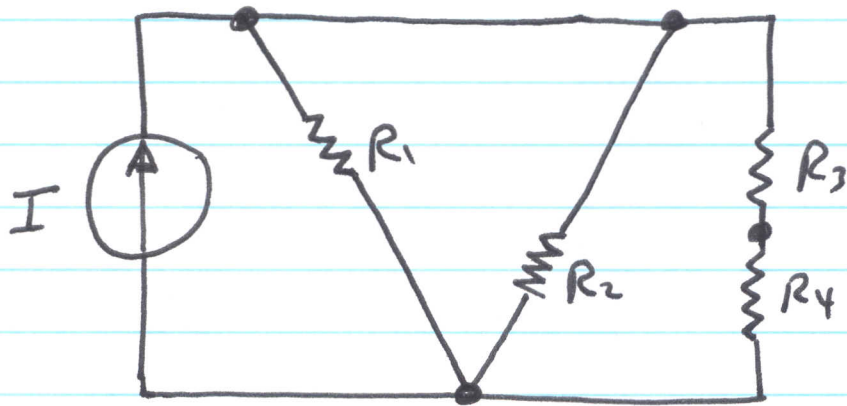
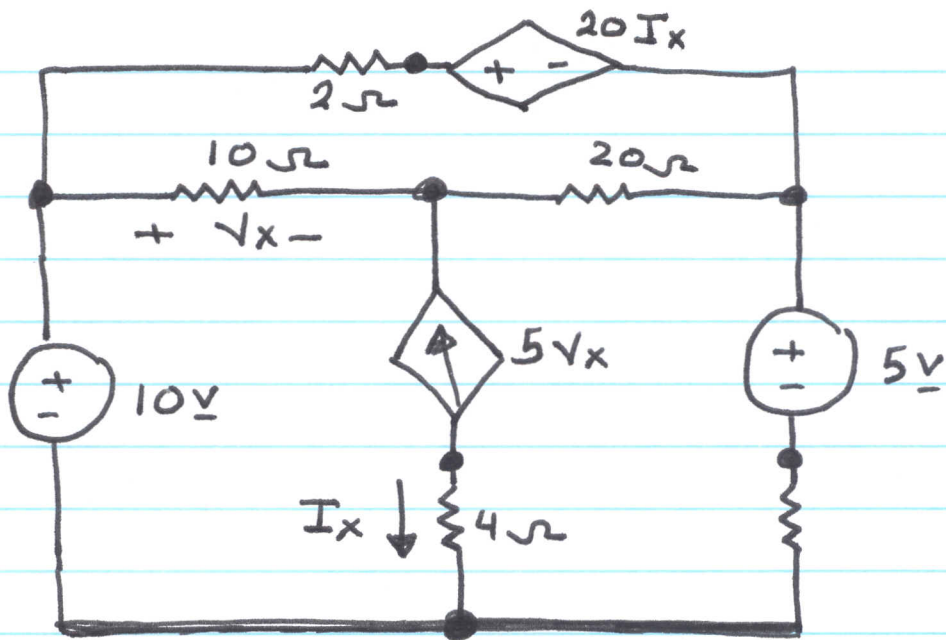


Voltage and Current Laws

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

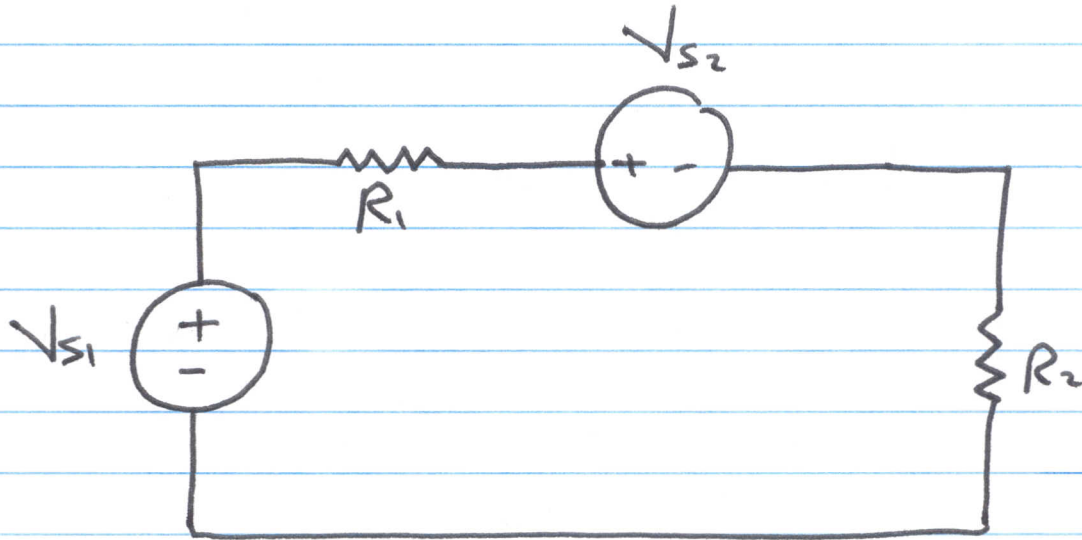
Loop : Any closed path through the Circuit in which no node is crossed more than once

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



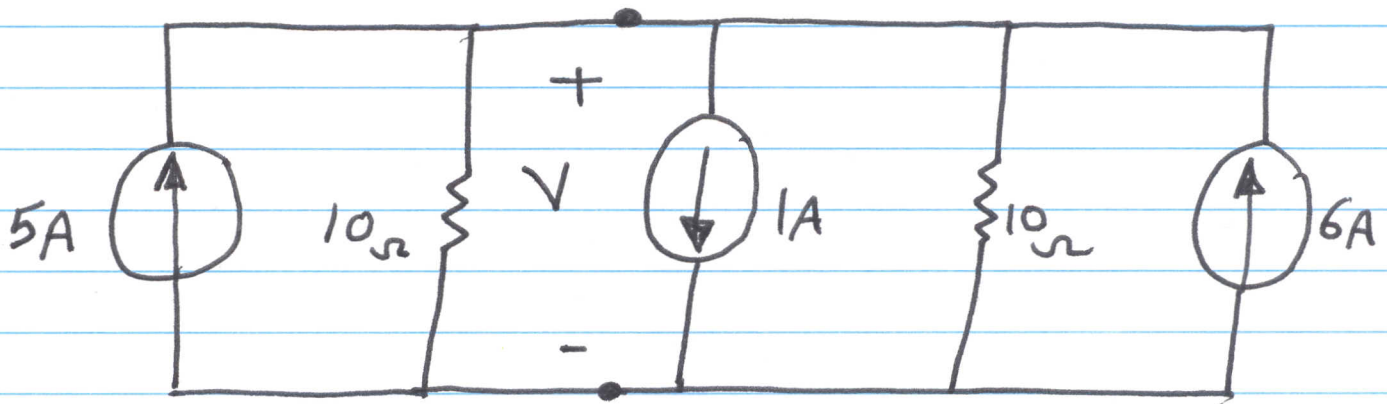
Series Connections

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.

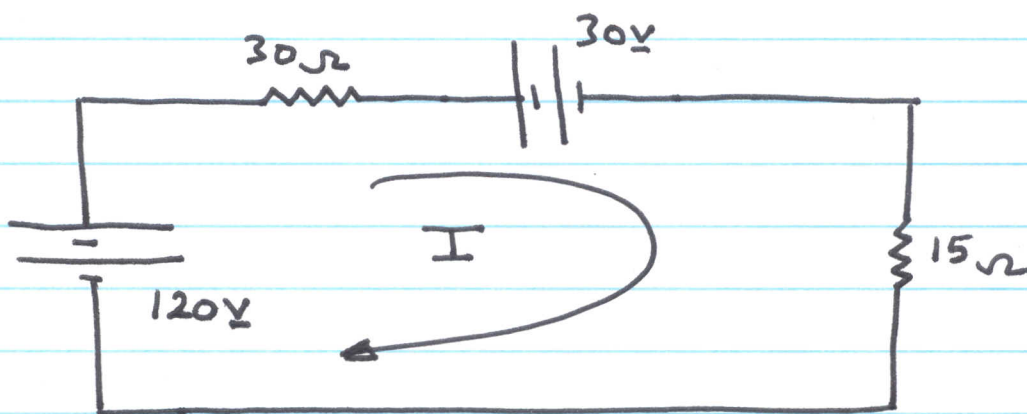


Kirchhoff's Voltage Law : KVL

KVL : The algebraic sum of the voltages around any loop is zero.

Analysis of a single-Loop circuit

Find I



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

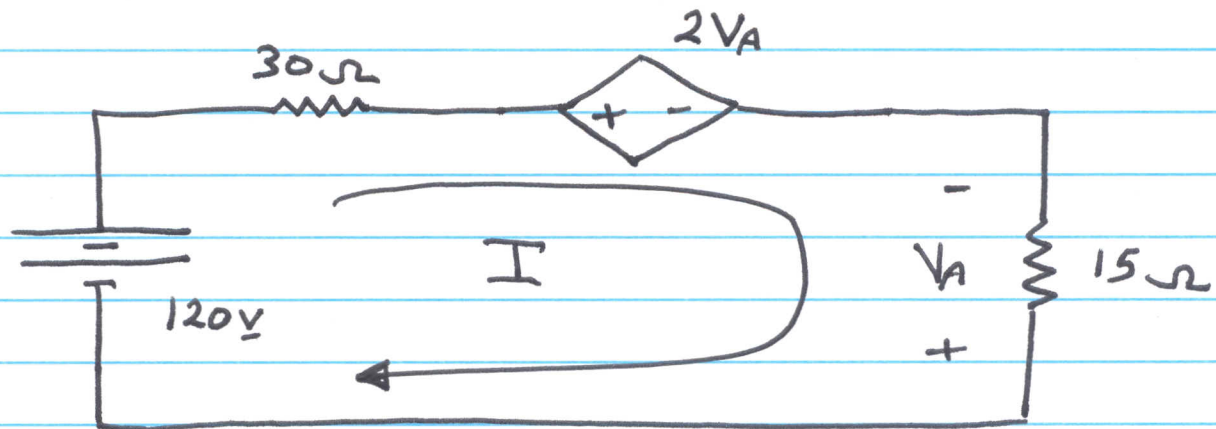
$$\therefore I = 2A$$

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

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

Analysis of a Circuit containing a dependent source

Find I



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

$$V_A = -15I$$

$$\therefore I = 8A$$

$$V_A = -120V$$

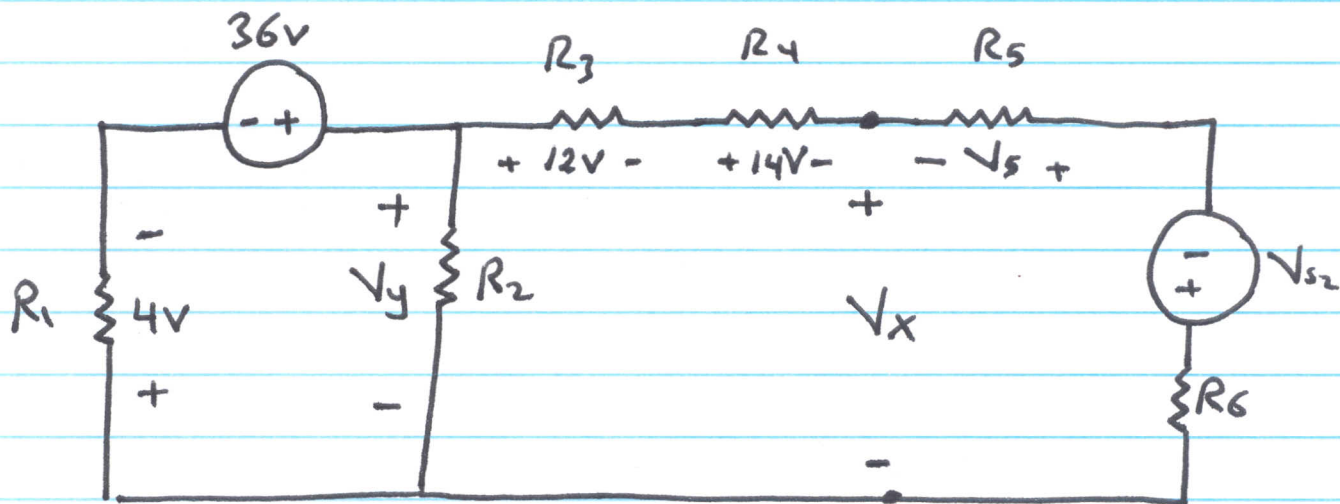
* Calculate the power absorbed by each circuit element

Answers:

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

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

Applying KVL



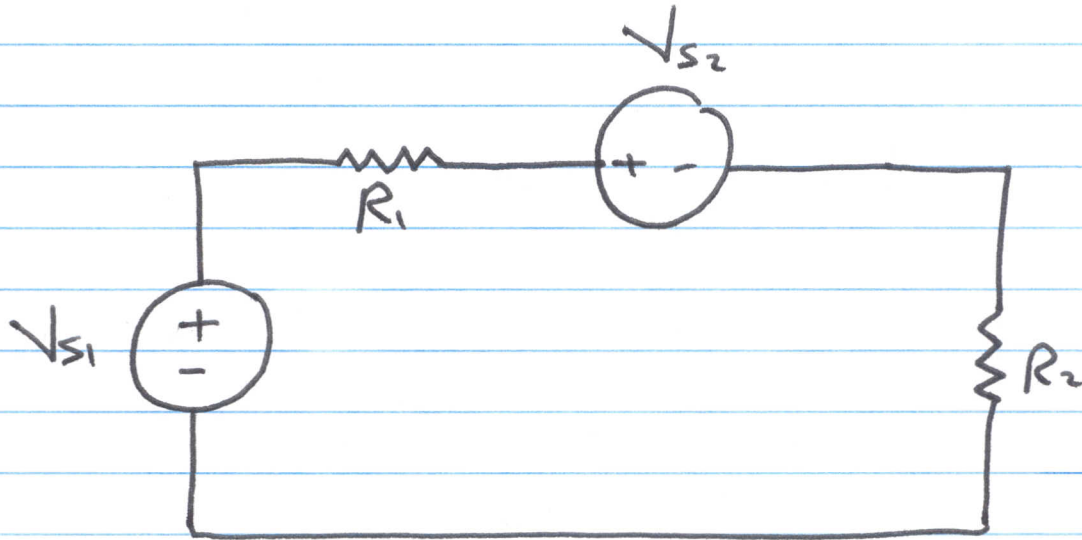
Find V_x and V_y

$$V_y = 36 - 4 = 32 \text{ V}$$

$$V_x = -14 - 12 + 32 = 6 \text{ V}$$

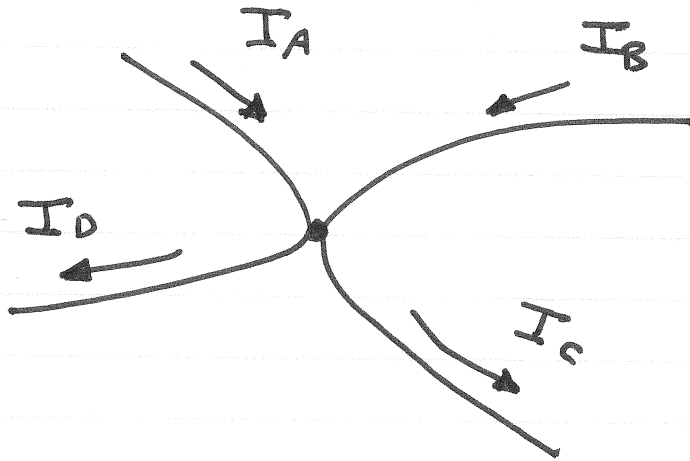
Series Connections

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



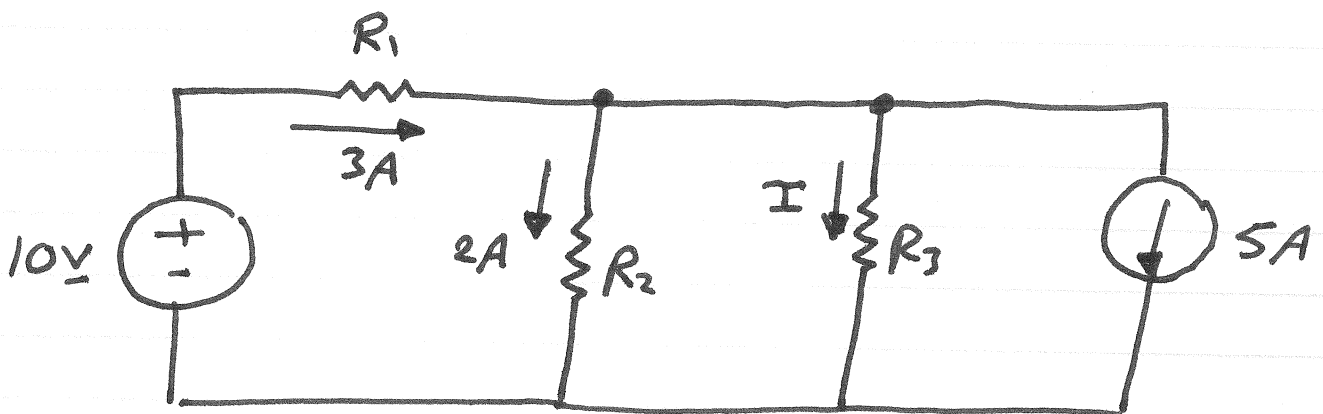
$$I_A + I_B - I_C - I_D = 0$$

KCL : Alternative Form

Current In = Current Out

$$I_A + I_B = I_C + I_D$$

KCL Application



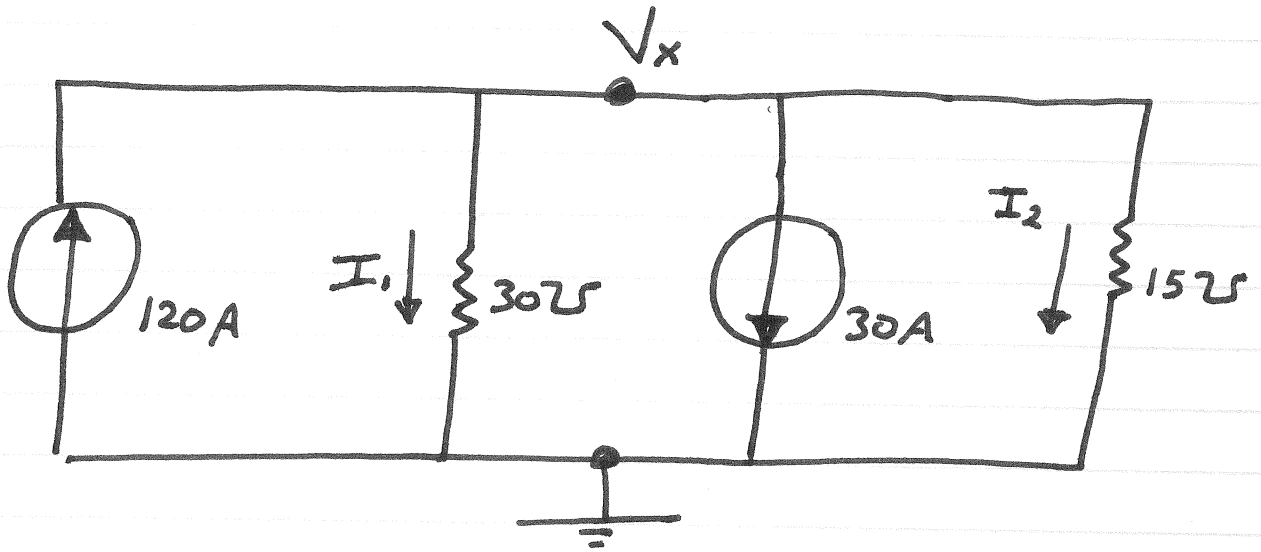
Find I

$$\text{KCL : } 3 = 2 + I + 5$$

$$\therefore I = -4 \text{ A}$$

The single node-pair Circuit

Find V_x



$$I = GV$$

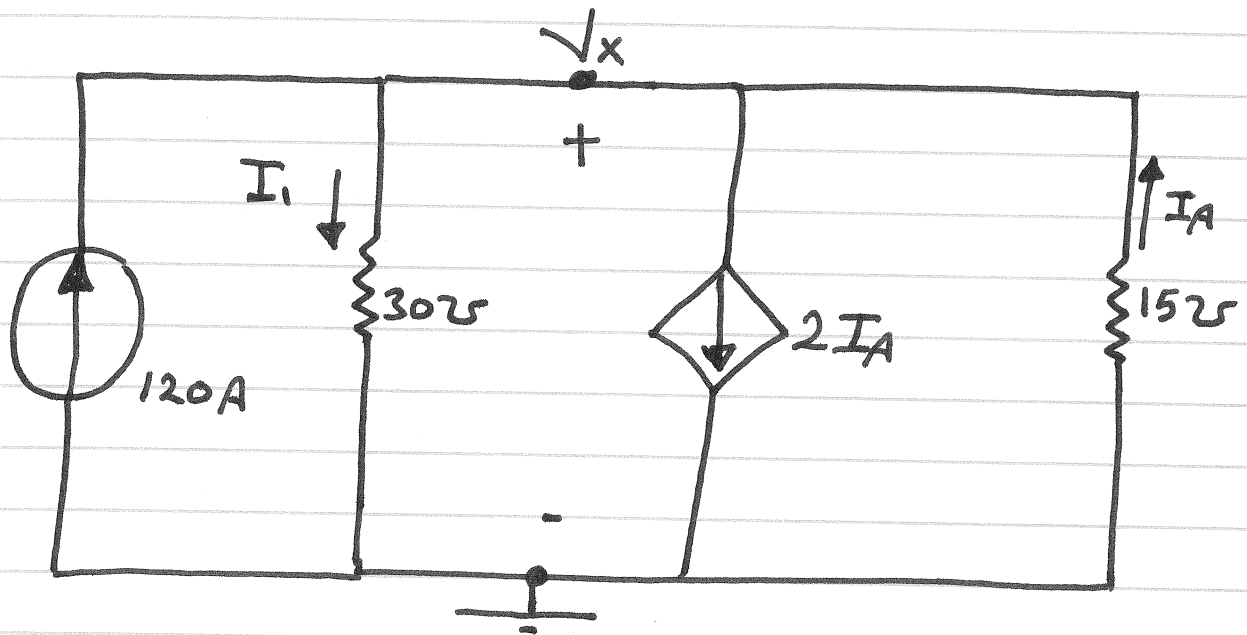
$$\text{KCL : } 120 = 30V_x + 30 + 15V_x$$

$$\therefore V_x = 2V$$

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

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

Analysis of Circuit Containing dependent sources



Find V_x

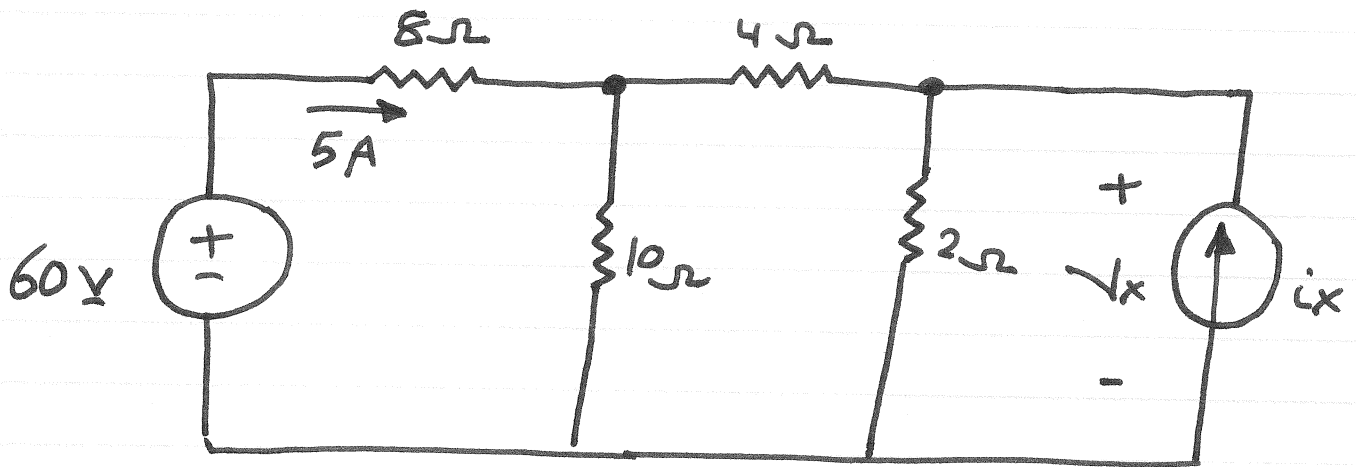
$$\text{KCL : } 120 + I_A = I_1 + 2I_A$$

$$I_A = -15V_x$$

$$I_1 = 30V_x$$

$$\therefore V_x = \underline{8V}$$

Applying KVL and KCL

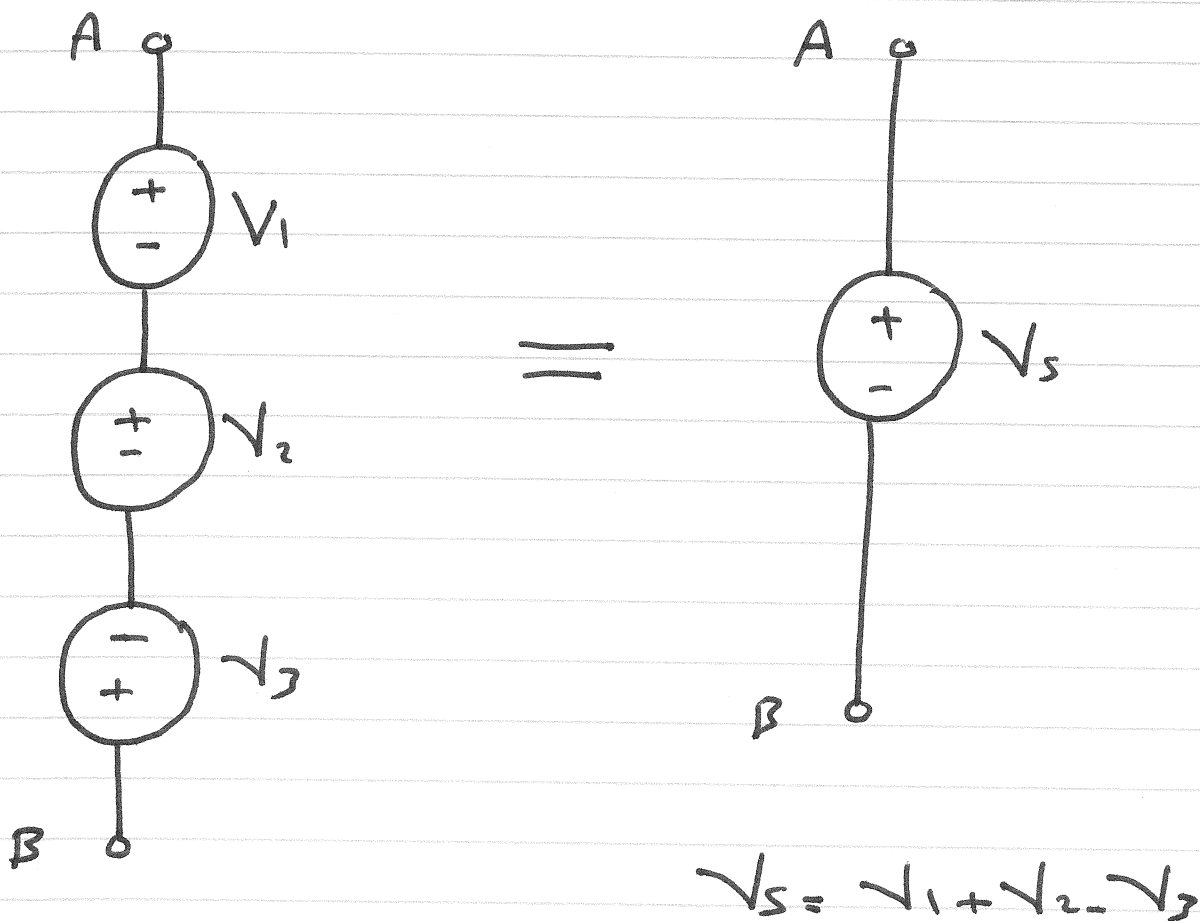


Solve for v_x and i_x

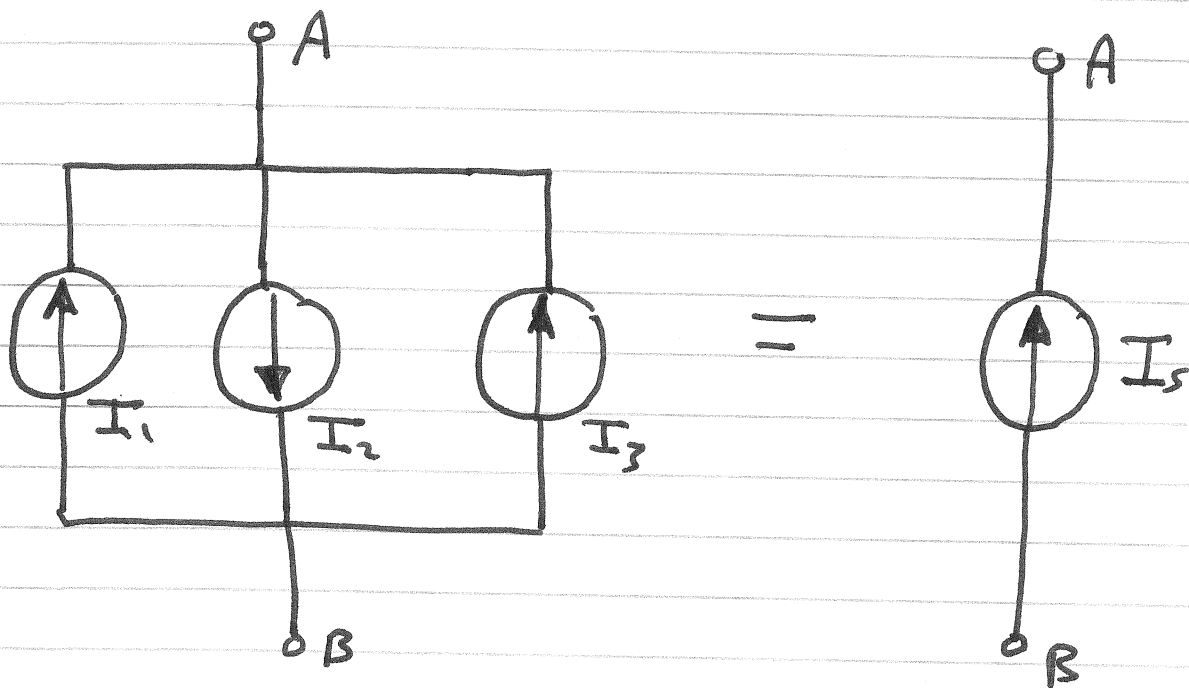
Answer : $v_x = 8\text{V}$ and $i_x = 1\text{A}$

Series and Parallel Sources

Voltage sources connected in series can be combined into an equivalent source:



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



$$I_s = I_1 + I_3 - I_2$$

Impossible Circuits

