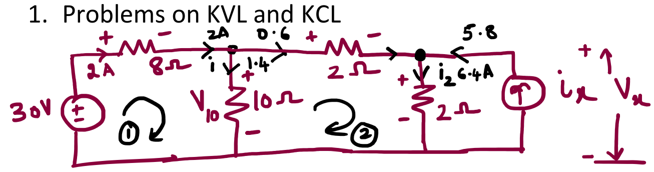
Topics
1. Problems on KVL and KCL
2. Series-Parallel Voltage and Current Sources
3. Voltage and Current Division rule
4. Source Transformation

1. Problems on KVL and KCL



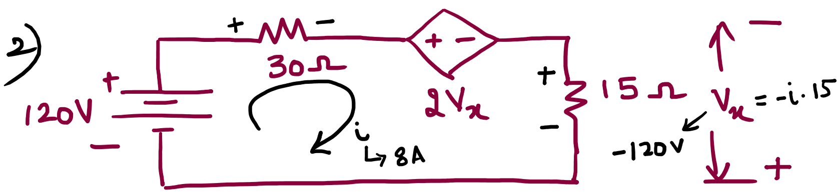
Loop1 $30 - 16 - V_{10} = 0 \Rightarrow V_{10} = 14V$

$i = \frac{V_{10}}{10} = \frac{14}{10} = 1.4\,A$

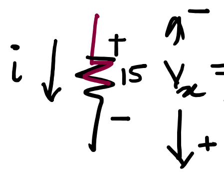
Loop2 $14 - 1.2 - 2i_2 = 0 \Rightarrow i_2 = 6.4\,A$

$i_x = 5.8A$; $V_x = 6.4 \times 2 = 12.8V$

2)



Compute the power absorbed in each element of the ckt shown ; i, V_x



$V_x = -15i$

$120 - 30i - 2V_x + V_x = 0$

$V_x = -15i$

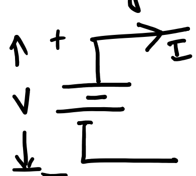
$120 - 30i - V_x = 0 \Rightarrow 120 - 30i + 15i = 0$

$\boxed{i = 8A.}$

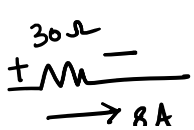
$\boxed{V_x = -15 \times 8 = -120V}$

Power Absorbed

Battery : $P = VI = 120 \times 8 = 960W$

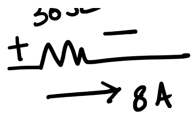
① 

$P_{absorbed} = -960W$

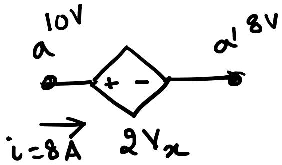
② 

$P_{absorbed} = I^2 R$

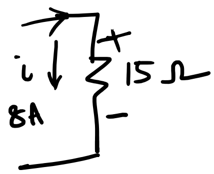
$= 8^2 \times 30 = 1920W$

② 

$P_{absorbed} = I^2 R$
$= 8^2 \times 30 = 1920\,W$

③ 

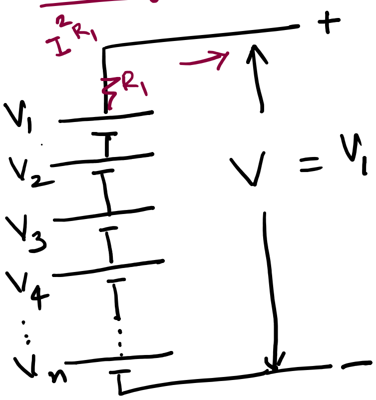
$P_{absorbed} = 2(-120)\,8$
$= -1920\,W$

④ 

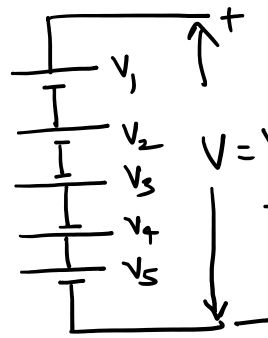
$P_{absorbed} = 8^2 \times 15$
$= \underline{\underline{960\,W}}$

Series-Parallel Source Connections

Voltage source



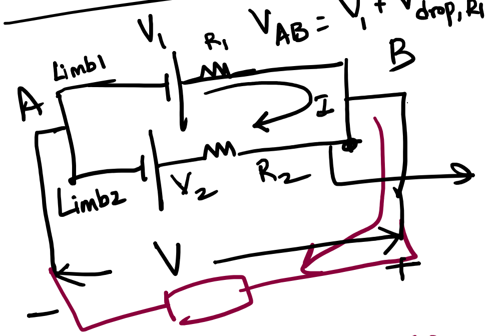
$V = V_1 + V_2 + V_3 + \cdots V_n$



$V = V_1 + V_2 - V_3 - V_4 + V_5$

Parallel Connection.

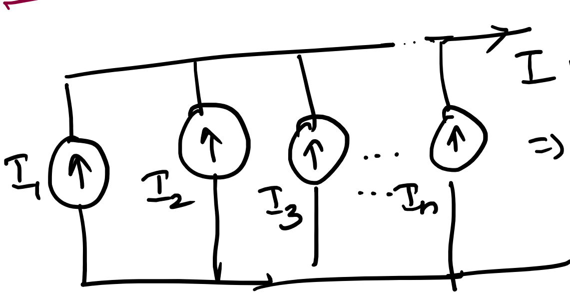
$V_{AB} = V_1 + V_{drop,R_1}$



$I = \dfrac{V_1 - V_2}{(R_1 + R_2)}$

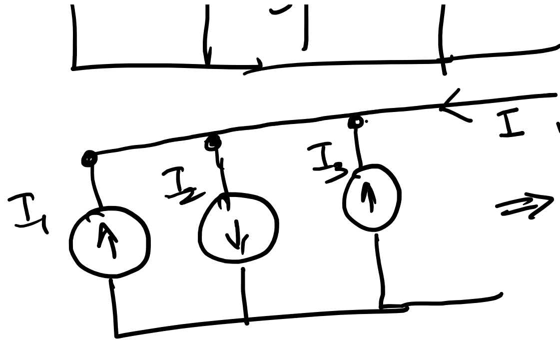
$V_{AB} = V_2 + V_{drop,R_2}$

Current Source



I ✓

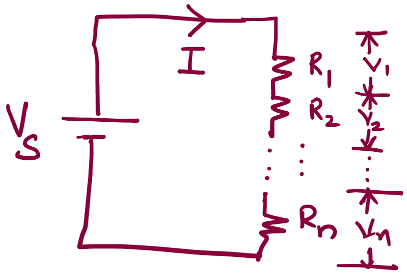
$\Rightarrow I = I_1 + I_2 + \cdots I_n$



$$\Rightarrow \quad I_1 - I_2 + I_3 + I = 0$$

$$\underline{\underline{I}} = I_2 - I_1 - I_3$$

Voltage Division Rule



$$V_S = I\,(R_1 + R_2 + \dots + R_n)$$

$$V_1 = I R_1$$

$$V_2 = I R_2$$

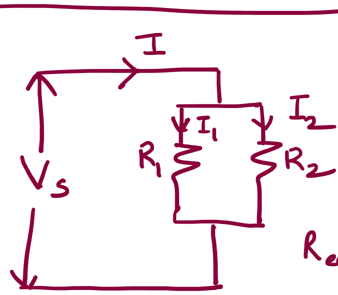
$$\vdots$$

$$V_n = I R_n$$

$$V_1 = I R_1 = \frac{V_S \cdot R_1}{(R_1 + R_2 + \dots R_n)}$$

$$V_2 = I R_2 = \frac{V_S \cdot R_2}{(\Sigma R)}$$

Current Division Rule



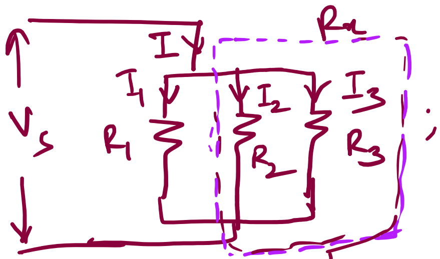
$$V_S = I\left[\frac{R_1 R_2}{R_1 + R_2}\right]$$

$$R_{eq} = \frac{R_1 R_2}{R_1 + R_2}$$

$$I_1 = \frac{V_S}{R_1} = \frac{I}{\cancel{R_1}}\left[\frac{\cancel{R_1} R_2}{R_1 + R_2}\right] =$$

$$I_1 = \frac{I \cdot R_2}{(R_1 + R_2)} \; ; \; I_2 = \frac{I \cdot R_1}{(R_1 + R_2)}.$$

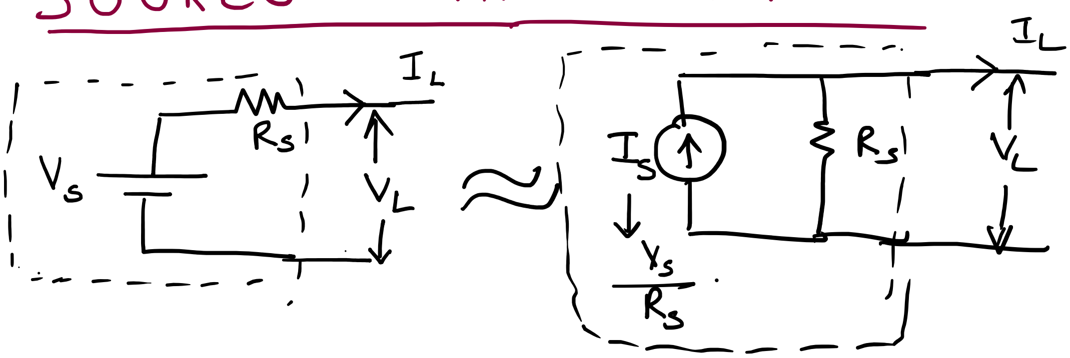
(R_1+R_2) (R_1+R_2)

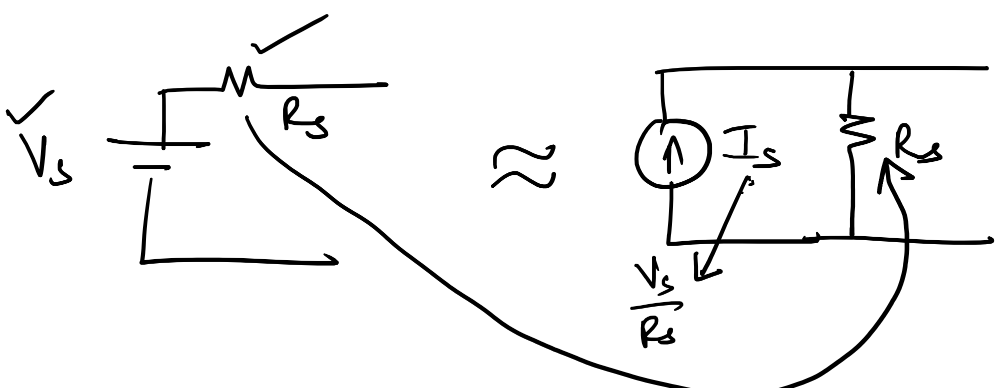


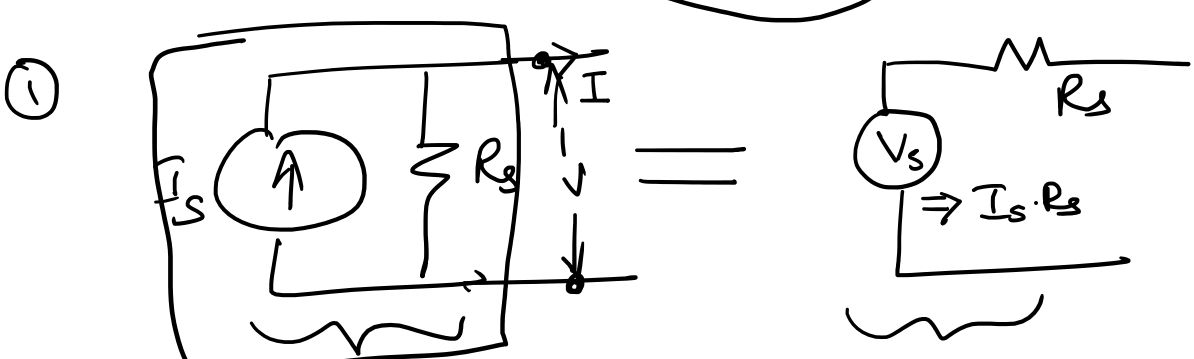
$$I_1 = \frac{I\,R_x}{(R_1+R_x)}$$

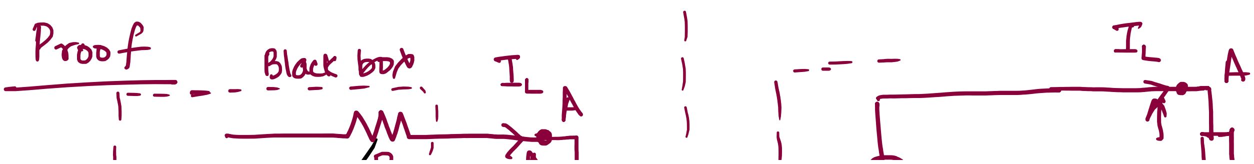
$$\left(\frac{R_2R_3}{R_2+R_3}\right) \Rightarrow R_x$$

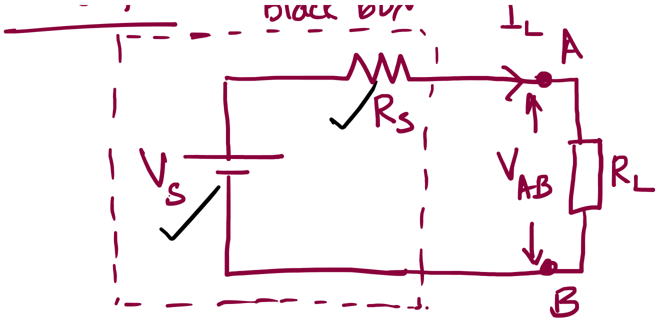
SOURCE TRANSFORMATION.





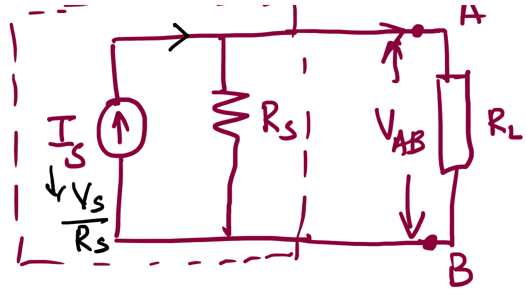






Circuit 1

$\approx$



Circuit 2

$$I_L = \frac{V_s}{(R_s+R_L)} \quad \text{—} \ (1)$$

$$V_{AB} = I_L \cdot R_L = R_L\left[\frac{V_s}{(R_s+R_L)}\right]$$

$$V_{AB} = \frac{V_s \cdot R_L}{(R_s+R_L)} \quad \text{—} \ (2)$$

$$I_L = I_s \cdot \frac{R_s}{(R_s+R_L)} \quad \text{—} \ (1)'$$

$$V_{AB} = R_L I_L = \frac{R_L \cdot I_s R_s}{(R_s+R_L)}$$

$$V_{AB} = \frac{(I_s R_s) R_L}{(R_s+R_L)} \rightarrow (2)'$$

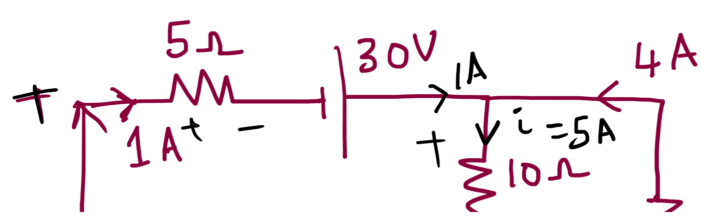
ckt 1 $\approx$ ckt 2

$$I_L^{ck1} = I_L^{ck2} \quad \& \quad V_{AB}^{ck1} = V_{AB}^{ck2}$$

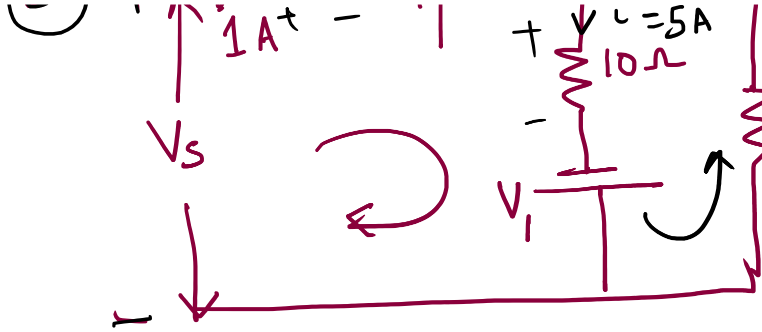
$$\frac{V_s}{(R_s+R_L)} = \frac{I_s R_s}{(R_s+R_L)} \qquad \frac{V_s R_L}{(R_s+R_L)} = \frac{(I_s R_s) R_L}{(R_s+R_L)}$$

$$\boxed{V_s = I_s R_s} \qquad \boxed{V_s = I_s R_s}$$

(3)



Compute V_s & V_l



Compute V_s & V_1

$V_1 = 74V$

$V_s = -49V$

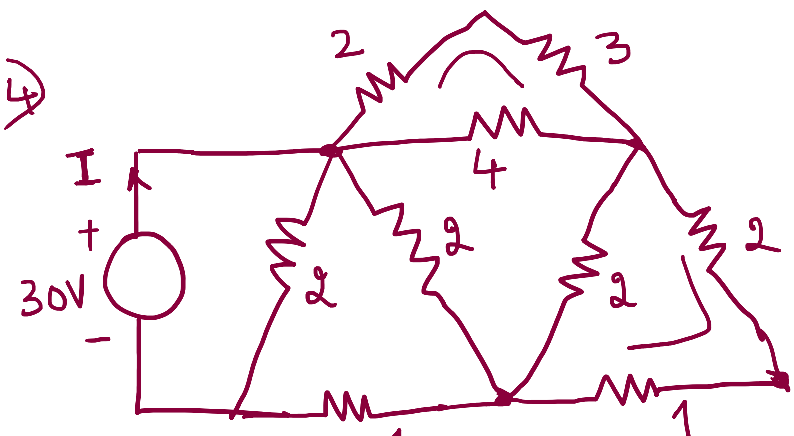
$$V_s - 5 + 30 - 50 + V_1 = 0$$

$$V_s + V_1 = 25$$

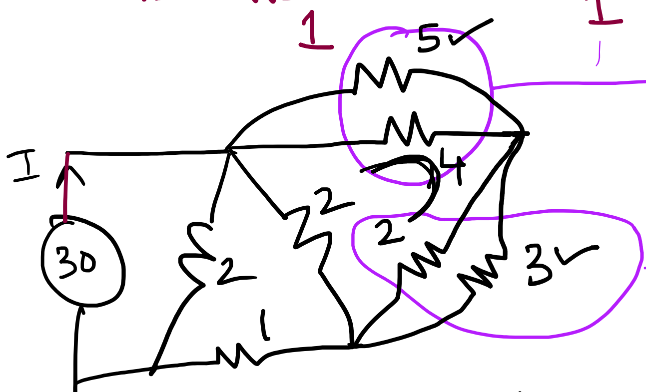
$$V_1 - 24 - 50 = 0 \Rightarrow V_1 = 74V$$

$$V_1 + V_s = 25 \Rightarrow V_s = -49V$$

4)



$I = ??$



$$\frac{5 \times 4}{(5+4)} = \frac{20}{9}$$

$$\frac{2 \times 3}{(2+3)} = \frac{6}{5}$$

$$\Rightarrow \frac{20}{9} + \frac{6}{5} = \frac{100 + 54}{45}$$

$$\Downarrow$$

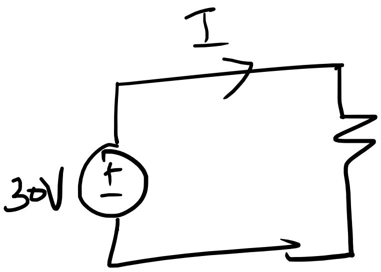
$$= \frac{154}{} =$$

$$\Downarrow$$

$$3.422\,\Omega \qquad = \frac{154}{45} =$$

$$\Rightarrow R_{eq} = (2) \,\|\, (2.2623)$$

$$= \underline{1.0614822\,\Omega}$$



$$1.06\,\Omega\,; \quad I = \frac{30}{1.06} = \underline{\underline{28.26\,A}}$$