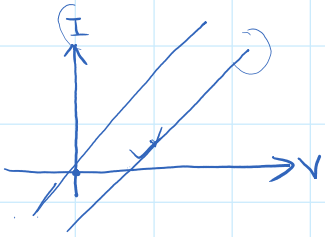
Network Theorems

Friday, November 5, 2021 10:40 AM



$y = mx + c$

$y = 0$ c non linear

* Linear → Superposition principle

→ homogenity principle

$V_1(t) \longrightarrow V_o'(t)$

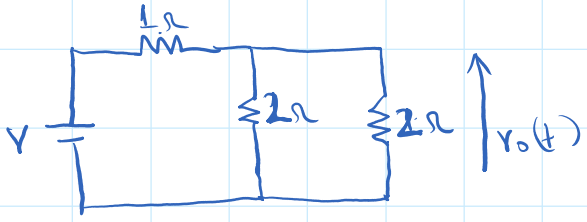
$V_2(t) \longrightarrow V_o''(t)$

$V_1(t) + V_2(t) \longrightarrow V_o'(t) + V_o''(t)$ → superposition

$C V_1(t) \longrightarrow C V_o'(t)$ → homogenity

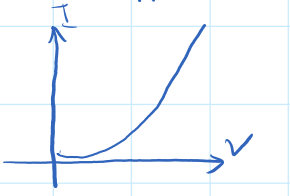
$$C_1 V_1(t) + C_2 V_2(t) \longrightarrow C_1 V_o'(t) + C_2 V_o''(t)$$

Linear



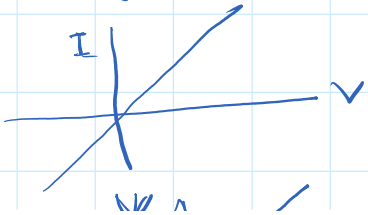
$V = 10 \rightarrow V_o(t) = 5V$ ✓

$V = 50 \rightarrow V_o(t) = 25V$



→ non linear element

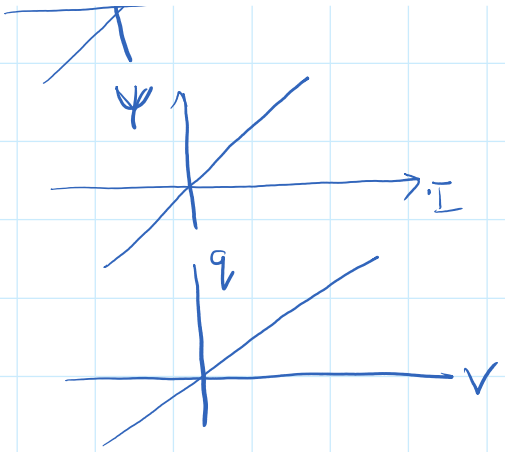
$V = iR$.



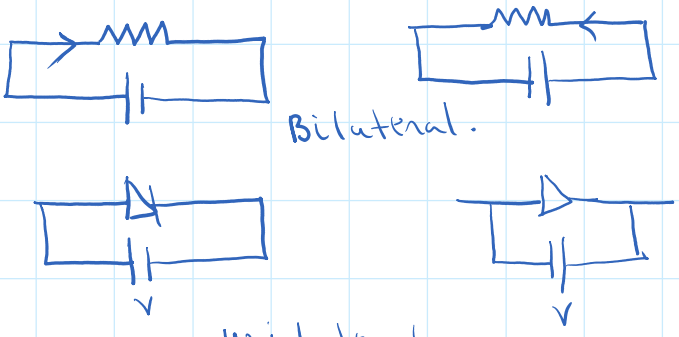
$$V = L\frac{di}{dt}$$

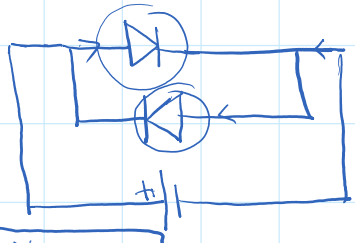
$$\psi = iL \quad \checkmark$$

$$q = CV \quad \checkmark$$

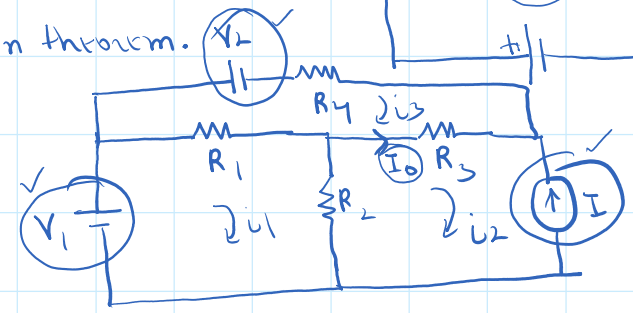


Bi-lateral element





Superposition theorem.



$i_2 = -I$ ×

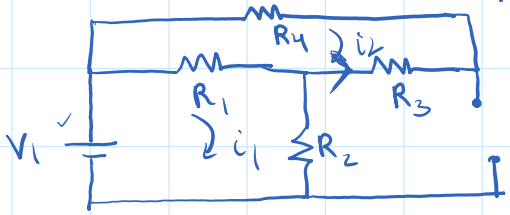
$R_3 \rightarrow i_2 - i_3$

$I_0 = I_{0V_1} + I_{0I} + I_{0V_2}$

Voltage source → Short CKt

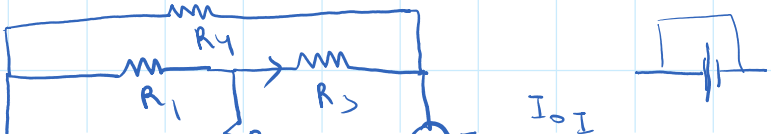
current source → open CKt

①



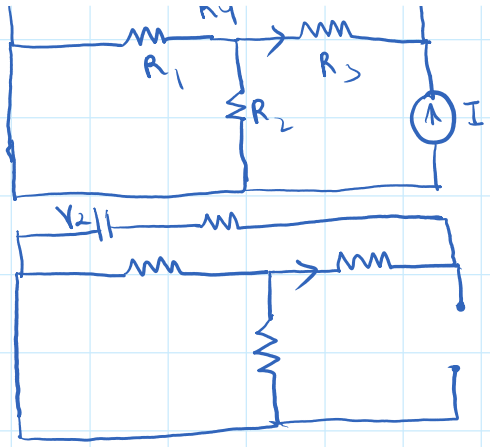
I_{0V_1}

②

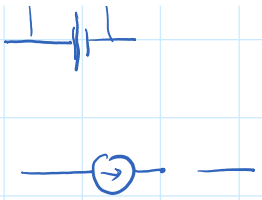


I_{0I}

(2)



$I_0 I$

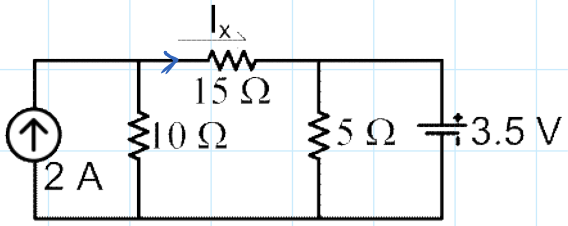


$I_0 V_2$

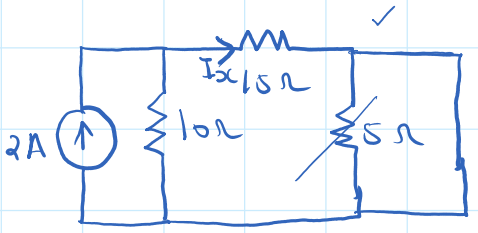
Illustration 1

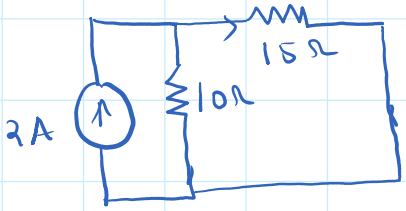
Friday, November 5, 2021 10:40 AM

Find the current I_x using Superposition theorem ✓

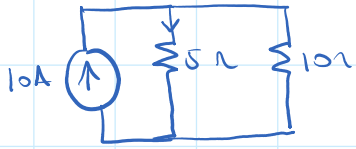


2A Source



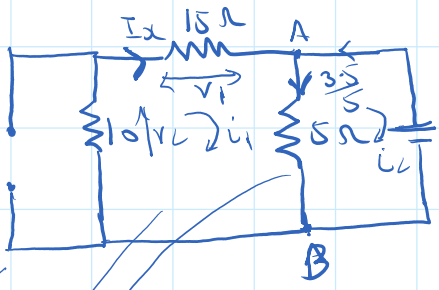


$$I_5 = \frac{I_x \times 0}{5+0} = 0$$



$$I_{5A} = \frac{2 \times 10}{15+10} = \frac{20}{25} = 0.8A \quad \checkmark$$

$$I = 10 \times \frac{10}{15}$$



$$V_1 = \frac{3.5 \times 15}{25}$$

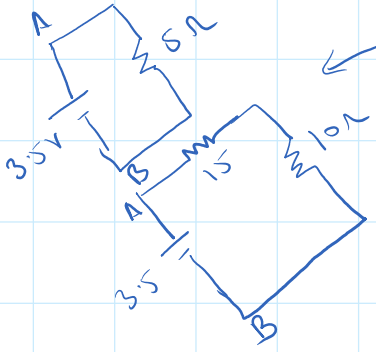
$$I_{x_{3.5V}} = -\frac{3.5}{15+10}$$

$$I_{x_{3.5V}} = -0.14\,A$$

$$I_x = I_{x1A} + I_{x3.5V}$$

$$= 0.8A - 0.14A$$

$$\boxed{I_x = 0.66A}$$

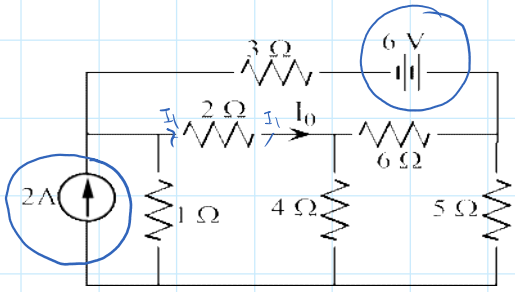


$\frac{V}{R}$

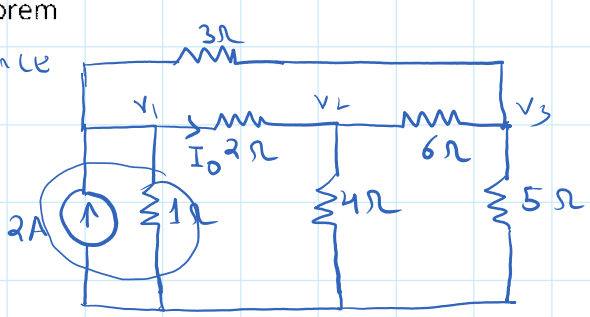
Illustration 2

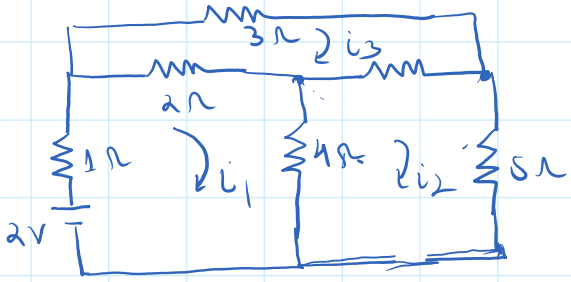
Tuesday, November 16, 2021 3:39 PM

Find the current I_0 using Superposition theorem



2A source





$2 - i_1 - 2(i_1 - i_3) - 4(i_1 - i_2) = 0$

$7i_1 - 4i_2 - 2i_3 = 2 \quad -①$

$-4i_1 + 15i_2 - 6i_3 = 0$

$-2i_1 - 6i_2 + 11i_3 = 0$

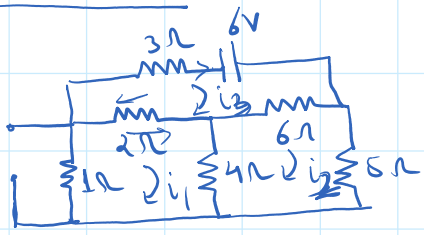
$i_1 = 0.451$

$i_2 = 0.196$

$i_3 = 0.189$

$I_{2\,2A} = i_1 - i_3 = 0.451 - 0.189 = 0.262$

6V source.



$7i_1 - 4i_2 - 2i_3 = 0$

$-4i_1 + 15i_2 - 6i_3 = 0$

$-2i_1 - 6i_2 + 11i_3 = 6$

$i_1 = 0.567$

$i_2 = 0.525$

$i_3 = 0.935$

$I_{2\,6V} = i_1 - i_3$

$= 0.567 - 0.935$

$= -0.368A$

$I_2 = I_{2\,2A} + I_{2\,6V}$

$= 0.262 + (-0.368)$

$\boxed{I_2 = -0.106\,A}$

* Fundamental of Electrical Engineering

Leonard S. Bobrow.