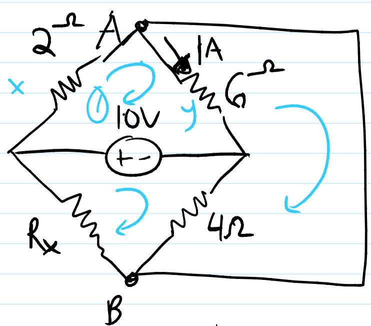
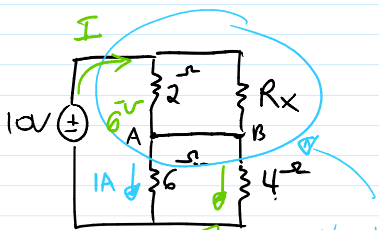
Discussion 1A (Week #1)

Monday, March 29, 2021 3:17 PM

Problem 1



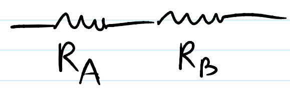
$$10V - I_x 2\Omega - \underset{1A}{I_y}\, 6\Omega = 0$$



$$\frac{6V}{4\Omega} = 1.5A$$

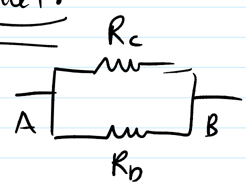
$V_A = V_B$

in series:

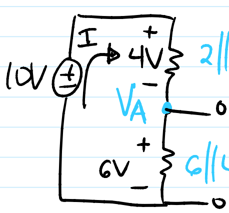


$$= \quad R' = R_A + R_B$$

in parallel:



$$= \quad R' = R_C \| R_D = \frac{R_C R_D}{R_C + R_D}$$



$$2 \| R_x = \frac{2R_x}{2+R_x}\ \Omega$$

$$6 \| 4 = \frac{6\times 4}{6+4} = 2.4\Omega$$

$$V_A = 1A \times 6\Omega = 6V$$

$$4V = I\,(2\|\underset{8}{R_x}) = 1.6\Omega \times 2.5A = 4V$$

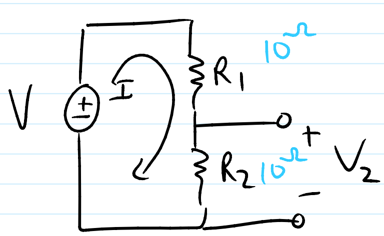
$I = 2.5A$

$$V_A = 6V = \frac{2.4\Omega}{2.4\Omega + 2\|R_x}\, 10V$$

$$\frac{10}{6} \times 2.4 = 2.4 + \frac{2R_x}{2+R_x}$$

$$\rightarrow \boxed{R_x = 8\Omega}$$

∴ Voltage Divider:



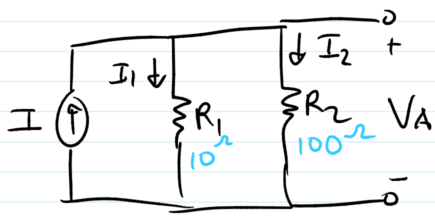
$$V_2 = \frac{R_2}{R_1+R_2} V \longrightarrow V_2 = \frac{10}{10+10} V = \frac{1}{2} V$$

$$V_2 = I R_2 \longrightarrow I = \frac{V_2}{R_2}$$

$$V = I(R_1+R_2) \longrightarrow I = \frac{V}{R_1+R_2}$$

$$\frac{V_2}{R_2} = \frac{V}{R_1+R_2} \longrightarrow \boxed{V_2 = \frac{R_2}{R_1+R_2} V}$$

Current Divider



$$\boxed{\begin{aligned} I_1 &= \frac{R_2}{R_1+R_2} I \\ I_2 &= \frac{R_1}{R_1+R_2} I \end{aligned}}$$

$$V_A = I_1 R_1 = I_2 R_2$$

$$I = I_1 + I_2$$

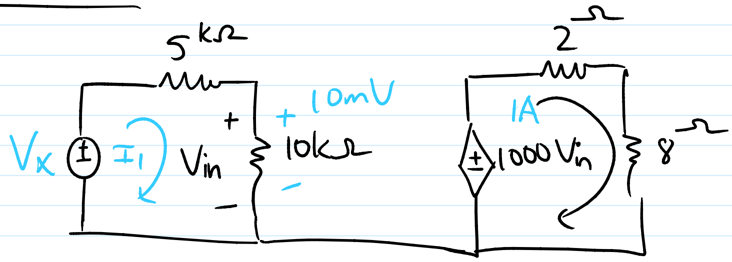
$$I_1 R_1 = I_2 R_2 \longrightarrow I_2 = I_1 \frac{R_1}{R_2}$$

solve for : $I_1 = I - I_2 = I - I_1 \frac{R_1}{R_2}$

$$I_1 \left(1 + \frac{R_1}{R_2}\right) = I$$

$$\longrightarrow \boxed{I_1 = I \left(\frac{R_2}{R_1+R_2}\right)}$$

Problem 2 :



* power delivered to the 8Ω resistor is 8W

$$P = I^2R = IV$$

$$8W = I^2(8\Omega) \rightarrow \boxed{I_2 = 1A}$$

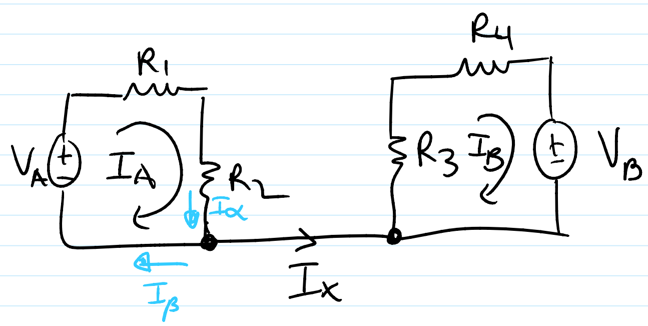
(2) $1000V_{in} - (1A)(2+8) = 0$

$\hookrightarrow V_{in} = \frac{10}{1000} = 10mV$

(1) $V_x = I_1(5^{k\Omega} + 10^{k\Omega})$

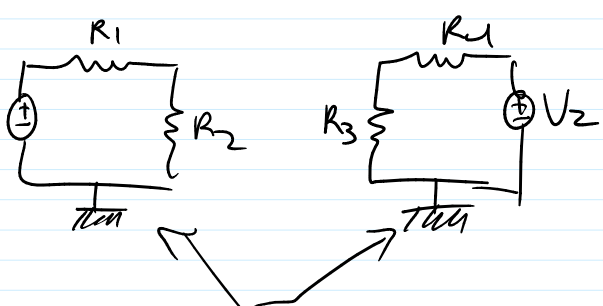
$I_1 = \frac{V_{in}}{10^{k\Omega}} = \frac{10mV}{10^{k\Omega}} = 1\mu A$

$$\boxed{V_x = 1\mu A(15^{k\Omega}) = 15mV}$$



$I_\alpha = I_\beta + I_x$ $I_\alpha = I_\beta$

$\hookrightarrow I_x = 0$



same gnd