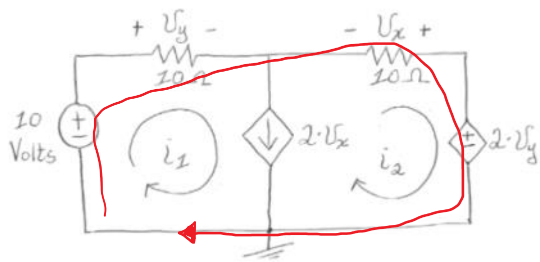
Quiz 2

Monday, November 2, 2020 9:18 AM

"I pledge my honor I have abided by the Stevens Honor system."

-Alex Haskins

Problem One: Consider the circuit shown below.



Determine the numerical values of i_1 and i_2. Please use mesh analysis. **(20 points each; 40 points total)**

Super mesh

$$-10 + V_y - V_x + 2V_y = 0$$

$$3V_y = 10 + V_x$$

$$V_y = \frac{10}{3} + \frac{V_x}{3}$$

$$I_1 - I_2 = 2V_x$$

$$10(I_1 - I_2) + 2V_y - 10 = 0$$

$$10(2V_x) + 2\left(\frac{10}{3} + \frac{V_x}{3}\right) - 10 = 0$$

$$20V_x + \frac{20}{3} + \frac{2}{3}V_x = 10$$

$$\frac{62}{3}V_x = \frac{10}{3}$$

$$\boxed{V_x = \frac{5}{31}\ \text{V.}}$$

$$V_y = 10(I_1)$$

$$I_1 = \frac{315}{930}$$

$$I_1 = \frac{63}{\ }\ \text{A.}$$

$$V_y = \frac{10}{3} + \left(\frac{5}{31}\right)\left(\frac{1}{3}\right)$$

$$V_y = \frac{315}{\ }\ \text{V.}$$

$$\boxed{I_1 = \frac{63}{186}\ A.}$$

$$\boxed{V_y = \frac{315}{93}\ V.}$$

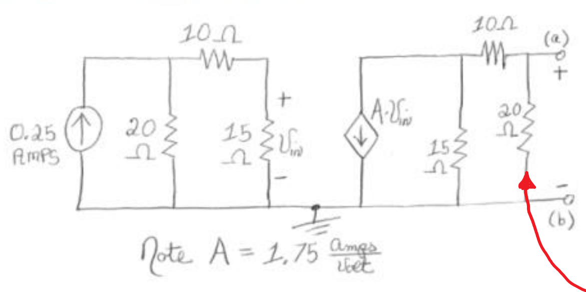
$V_x = -10\,(I_2)$

$I_2 = -\frac{V_x}{10}$

$I_2 = -\frac{5}{310}$

$$\boxed{I_2 = -\frac{1}{62}\ A.}$$

Problem Two: Consider the circuit shown below.



$R_{eq} = 10\,\Omega$

$i_r = \frac{15}{45}\left(-1.75\left(\frac{15}{9}\right)\right) = -.972\ A$

Note;

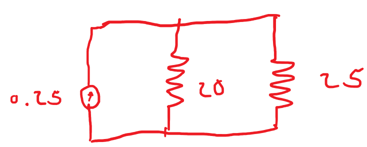
- The parameter "A" = 1.75 Amps/Volt

$V_{oc} = 20\,(-.972)$

$V_{oc} = -19.44\ V.$

Part (a); A load resistance is placed between terminals "a" and "b". We want to select the value of the load resistance which will result in the maximum power being delivered to this load resistance. Determine the value of this load resistance for maximum power transfer. **(30 points)**

$i_{sc} = \frac{15}{25}\left(-A V_{in}\right)$



$R_{eq} = \frac{25\,(20)}{45} = 11.11\ \Omega$

$i_{sc} = -1.75\,V.$

$V = 11.11\,(.25)$

$V = 2.78$

$i_{v_{in}} = \frac{20}{45}\,(.25)$

$i_{v_{in}} = \frac{1}{9}\ A.$

$$V_{in} = 15\left(\frac{1}{9}\right)$$

$$V_{in} = \frac{15}{9}\ V.$$

$$R_T = \frac{V_{oc}}{i_{sc}}$$

$$R_T = \frac{-19.44}{-1.75}$$

$$R_T = 11.11\,\Omega$$

For max power $R_T = R_L$

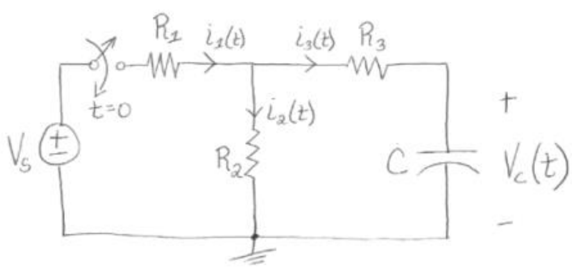
$$R_L = 11.11\,\Omega$$

Part (b): Determine the maximum power that can be delivered to a resistive load for the given circuit. **(10 points)**

$$P = \frac{\left(\frac{V_{oc}}{2}\right)^2}{R} = \frac{\left(\frac{-19.44}{2}\right)^2}{11.11}$$

$$P = 8.50 \text{ Watts}$$

Problem Three: Consider the circuit shown below.



Note;

- Vs is a constant dc voltage source

For $t \to \infty$:

a) Determine an expression for the current $i_1(t)$ at t approaches infinity. **(5 points)**

$V_c \rightarrow$ Fully charged and $i_c = 0$

$i_1 = i_2$ (in series and $i_c = i_3$)

$$i_1(t) = \frac{V_s}{R_1 + R_1}$$

b) Determine an expression for the current $i_2(t)$ at t approaches infinity. **(5 points)**

$i_1 = i_2$

$$i_2(t) = \frac{V_s}{R_1 + R_2}$$

c) Determine an expression for the current $i_3(t)$ at t approaches infinity. **(5 points)**

$i_c \rightarrow 0$

$i_c = i_3$

$i_3(t) = 0$

d) Determine an expression for the voltage $V_c(t)$ at t approaches infinity. **(5 points)**

$$V_c(t) = \frac{R_2}{R_1 + R_2}(V_s)$$