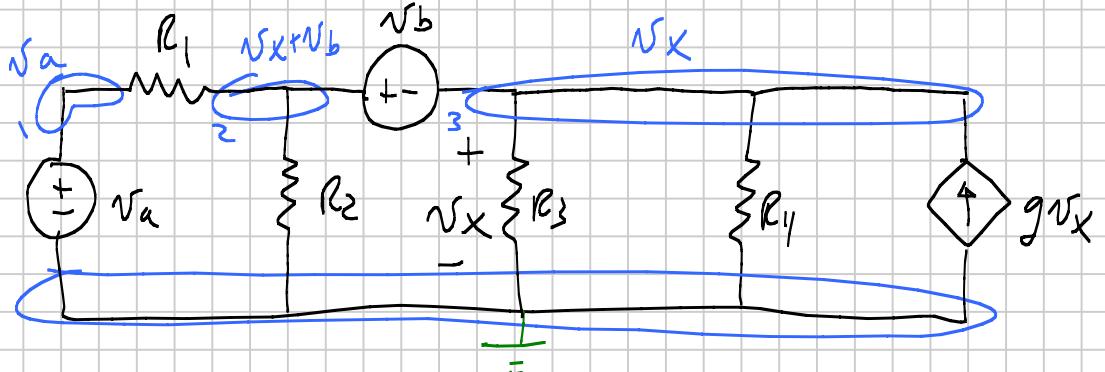


# EGR 119 SPRING 2010 TEST 1

Note Title

## Problem I



4 Meshes w/ no current sources  $\Rightarrow$  4 KVL w/ MCM

4 Nodes w/ 2 voltage sources  $\Rightarrow$  1 KCL w/ NVM

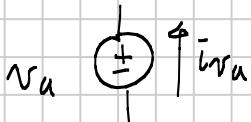
Pick this :

$$KCL_1 \text{ at } 3: \frac{(V_x + V_b) - V_a}{R_1} + \frac{(V_x + V_b) - 0}{R_2} + \frac{V_x - 0}{R_3} + \frac{V_x}{R_4} - gV_x = 0$$

$$V_x \left( \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \frac{1}{R_4} - g \right) = -V_b \left( \frac{1}{R_1} + \frac{1}{R_2} \right) + \frac{V_a}{R_1}$$

$$V_x = \frac{\frac{V_a}{R_1} - V_b \left( \frac{1}{R_1} + \frac{1}{R_2} \right)}{\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \frac{1}{R_4} - g}$$

- $P_{\text{del}, Va}$  needs  $i_{Va}$



$$KCL \text{ at } 1: i_{Va} = \frac{V_a - (V_x + V_b)}{R_1}$$

$$P_{\text{del}, Va} = V_a i_{Va}$$

- $P_{\text{del}, Vb}$  needs  $i_{Vb}$



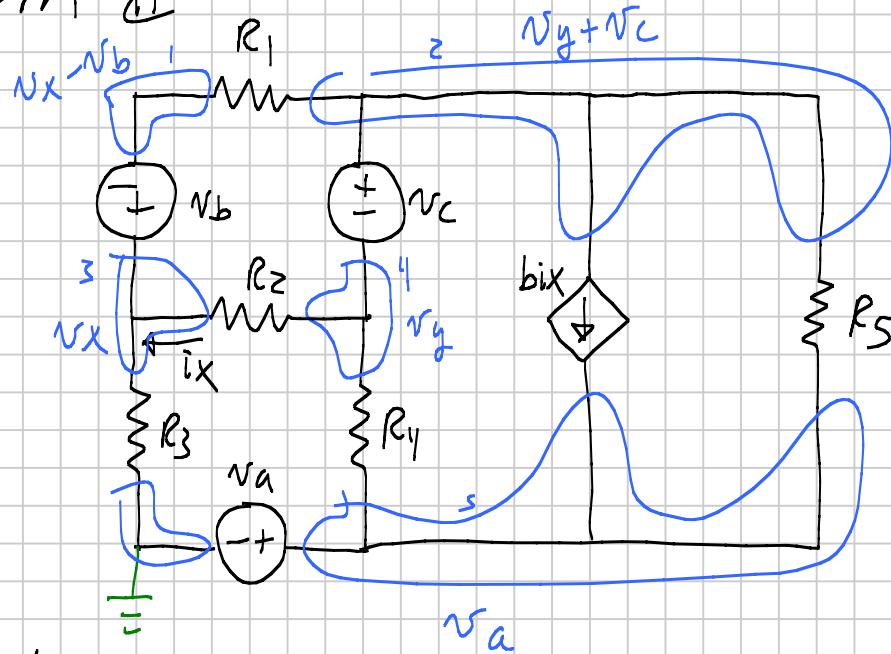
$$KCL \text{ at } 2: i_{Vb} = \frac{V_x + V_b - V_a}{R_1} + \frac{V_x + V_b}{R_2}$$

$$- \frac{0}{R_3} - \frac{0}{R_4} \quad i_{Vb} = -\frac{V_x}{R_3} - \frac{V_x}{R_4} + gV_x$$

$$P_{\text{del}, Vb} = V_b i_{Vb}$$

- $P_{\text{del}, VCCS}} = V_x g V_x$

# Problem 8



(a)

Three unknowns:  $V_x$ ,  $V_y$ ,  $i_x$

$$KCL, sn_{13}: \frac{V_x - 0}{R_3} + \frac{V_x - V_y}{R_2} + \frac{(V_x - V_b) - (V_y + V_c)}{R_1} = 0$$

$$KCL, sn_{24}: \frac{(V_y + V_c) - (V_x - V_b)}{R_1} + \frac{V_y - V_x}{R_2} + b_{ix} + \frac{(V_y + V_c) - V_a}{R_5} = 0$$

CONTROL :  $i_x = \frac{V_y - V_x}{R_2}$

(b)  $P_{del, V_c}$  needs  $i_{rc}$

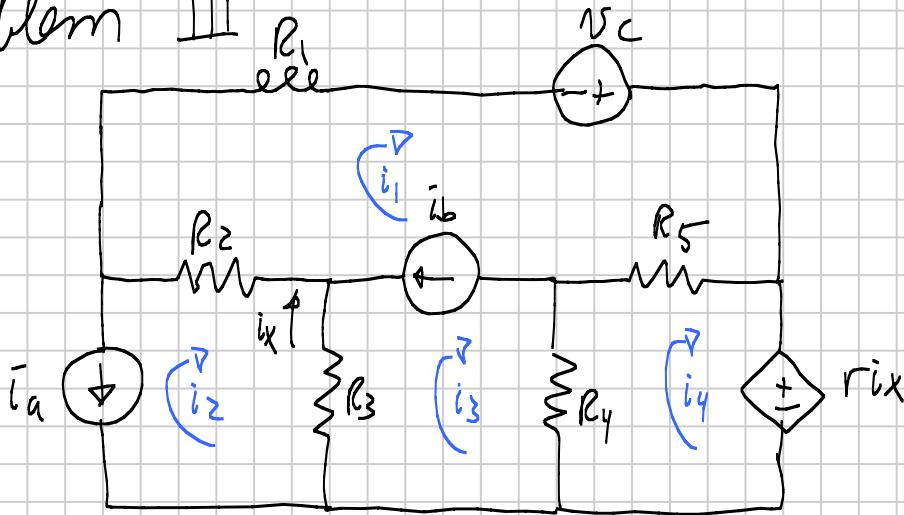
$$i_{rc} \uparrow \oplus V_c$$

$$KCL(2): i_{rc} = \frac{(V_y + V_c) - (V_x - V_a)}{R_1} + b_{ix} + \frac{(V_y + V_c) - V_a}{R_5}$$

$$KCL(4) \quad i_{rc} = \frac{V_x - V_y}{R_2} + \frac{V_a - V_y}{R_4}$$

$$\underline{P_{del, V_c} = i_{rc} V_c}$$

### Problem III



- KVL, Eq 4:  $R_4(i_4 - i_3) + R_5(i_4 - i_1) + r_{ix} = 0$

- KVL, Eq 13:  $R_3(i_3 - i_2) + R_2(i_1 - i_2) + R_1(i_1) - V_C + R_5(i_1 - i_4) + R_4(i_3 - i_4) = 0$

SOURCE a :  $i_a = -i_2$  *Note: could use  $sh_{13y}$  in place of either  $i_y$  or  $sh_{13}$*

SOURCE b :  $i_b = i_1 - i_3$

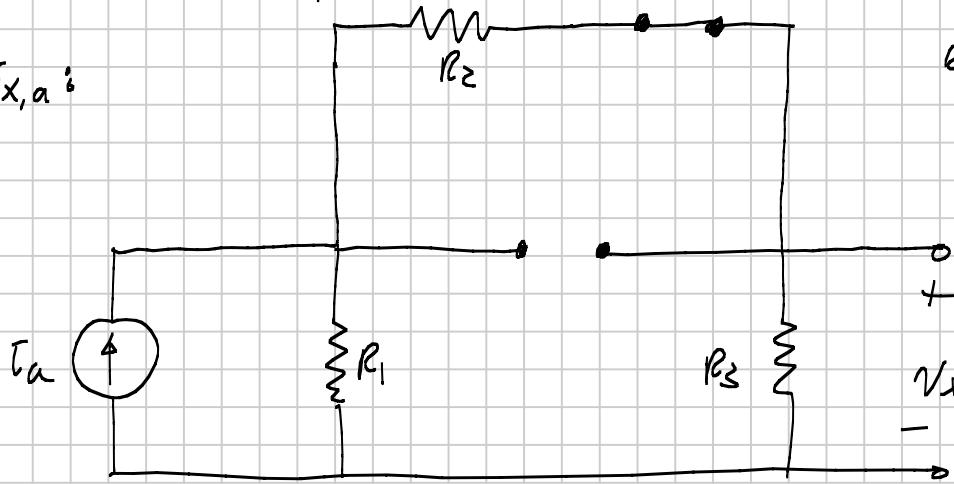
CONTROL :  $i_x = i_3 - i_2$

(b)  $P_{act,ccvs} = -i_4 r_{ix}$  since  $i_4 + r_{ix}$  labeled passive

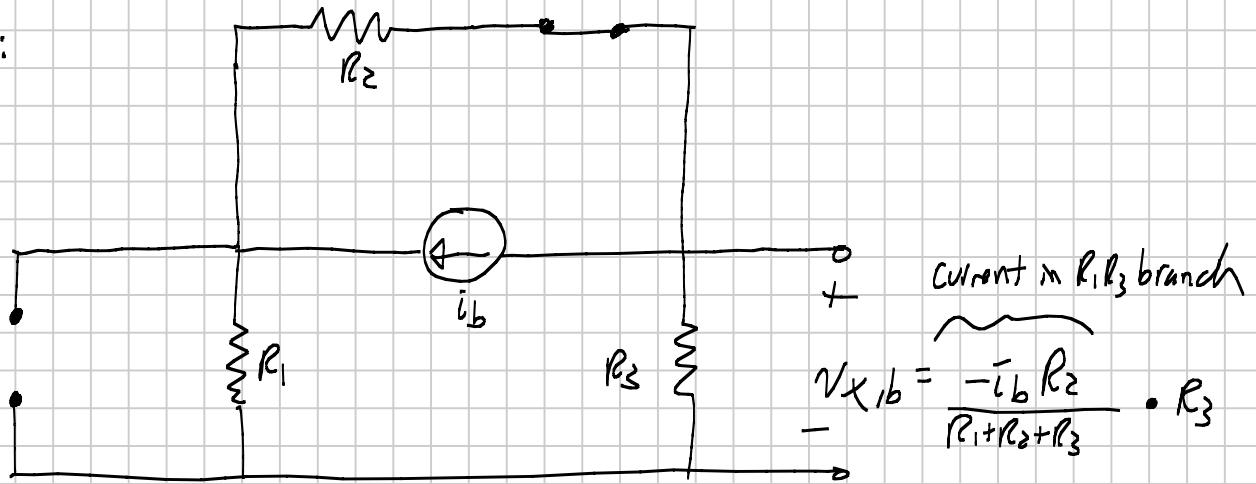
# Problem 4

Note: multiple ways to solve each part ...

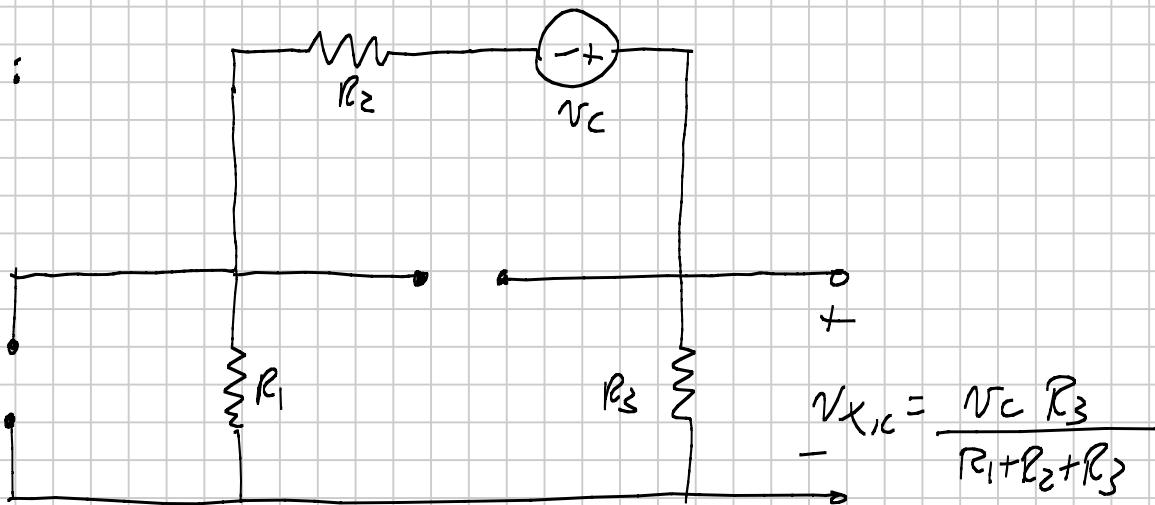
$V_{X,a}:$



$V_{X,b}:$

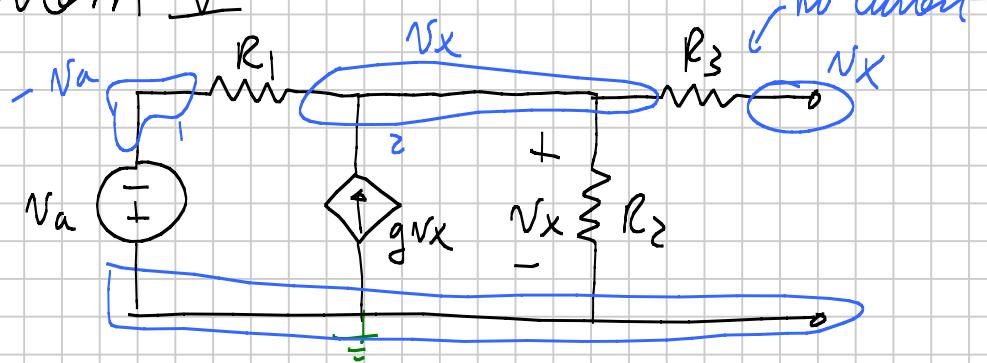


$V_{X,c}:$



$$V_X = V_{X,a} + V_{X,b} + V_{X,c}$$

## Problem V

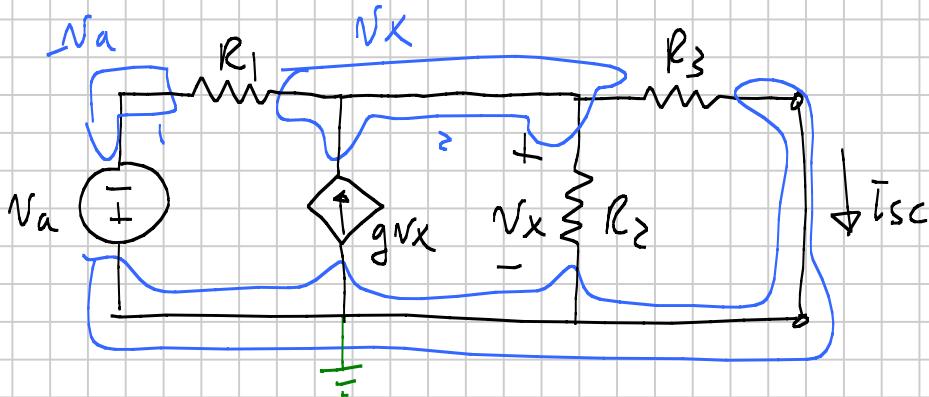


with controlled source, need to find  $V_{oc}$  &  $I_{sc}$ .  $V_{oc}$  above

$$KCL_{in_2}: \frac{V_x - (-V_a)}{R_1} - gV_x + \frac{V_x - 0}{R_2} = 0$$

$$V_x \left( \frac{1}{R_1} + \frac{1}{R_2} - g \right) = -V_a \left( \frac{1}{R_1} \right)$$

$$V_{oc} = V_x \text{ here} = \frac{-V_a \left( \frac{1}{R_1} \right)}{\frac{1}{R_1} + \frac{1}{R_2} - g}$$



$$KCL_{in_2}: \frac{V_x - (-V_a)}{R_1} - gV_x + \frac{V_x - 0}{R_2} + \frac{V_x - 0}{R_3} = 0$$

$$V_x = \frac{-V_a}{\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} - g} \quad \text{here, } I_{sc} = \frac{V_x}{R_3}$$

$$R_{Th} = \frac{V_{oc}}{I_{sc}}$$

