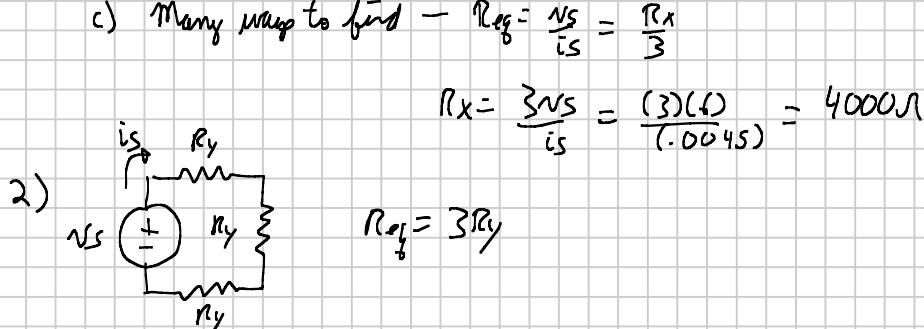
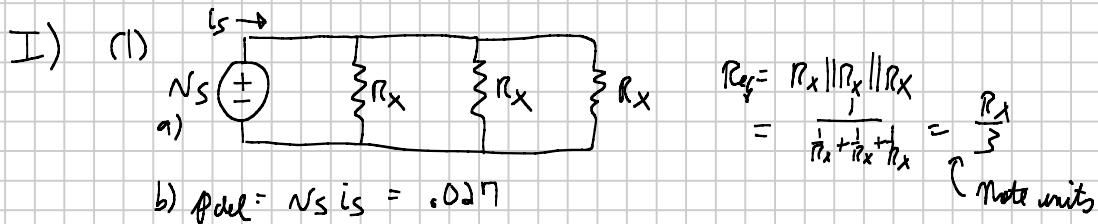


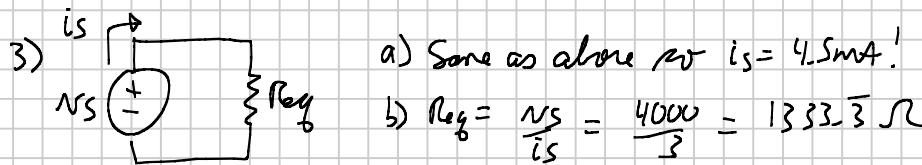
EGR 224 Spring 2018 TEST I

Note Title



b) Same as above, $R_{eq} i_s = 4.5 \text{ mA}$

c) $\frac{Ns}{i_s} = 3R_x \text{ so } R_x = \frac{Ns}{9i_s} = \frac{4000}{9} \Omega = 444.4 \Omega$



so $R \parallel R \parallel R < R_{eq} < R + R + R$

options:

$$R + (R \parallel R) = R + \frac{1}{2}R = \frac{3}{2}R = 3000 \Omega$$

$$R \parallel (2R) = \frac{2}{3}R = \frac{4000}{3} \Omega \quad \checkmark$$

$P_{abs,R_1} = \frac{Ns^2}{R_1} = \frac{36}{2000} = 18 \text{ mW}$

$P_{abs,R_2} = \frac{\left(\frac{Ns}{2}\right)^2}{R_2} = \frac{9}{2000} = 4.5 \text{ mW}$

$P_{abs,R_3} = P_{abs,R_2} = 4.5 \text{ mW}$

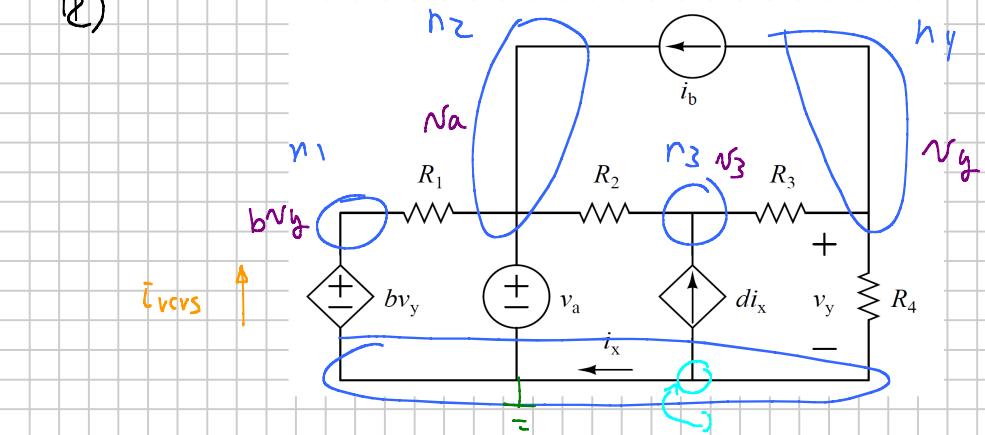
(II) $N_x = N_s \frac{R_2}{R_2 + (R_y \parallel (R_1 + R_3))}$

$$N_w = -N_s \frac{\frac{(R_y \parallel (R_1 + R_3))}{R_2 + (R_y \parallel (R_1 + R_3))}}{\frac{R_1}{R_1 + R_3}}$$

(S) $i_y = i_p \frac{\frac{(R_1 + R_3) \parallel (R_2 + (R_y \parallel R_S))}{R_2 + (R_y \parallel R_S)}}{\frac{(R_1 + R_3)}{(R_1 + R_3) + (R_2 + (R_y \parallel R_S))} i_p}$

$$i_2 = -i_p \frac{\frac{(R_1 + R_3) \parallel (R_2 + (R_y \parallel R_S))}{R_2 + (R_y \parallel R_S)}}{\frac{R_y \parallel R_S}{R_S} \frac{- (R_1 + R_3)}{(R_1 + R_3) + (R_2 + (R_y \parallel R_S))} \frac{R_y}{R_y + R_S} i_p}$$

(2)



$$+KCL = 5 \text{ nodes} - \text{gnd} - 2 \text{ vsrc} = 2 \text{ unk: } v_y, v_3, i_x$$

$$KCL_{n_3}: \frac{v_3 - v_a}{R_2} - di_x + \frac{v_3 - v_y}{R_3} = 0$$

$$KCL_{n_y}: i_b + \frac{v_y - v_3}{R_3} + \frac{v_y}{R_4} = 0$$

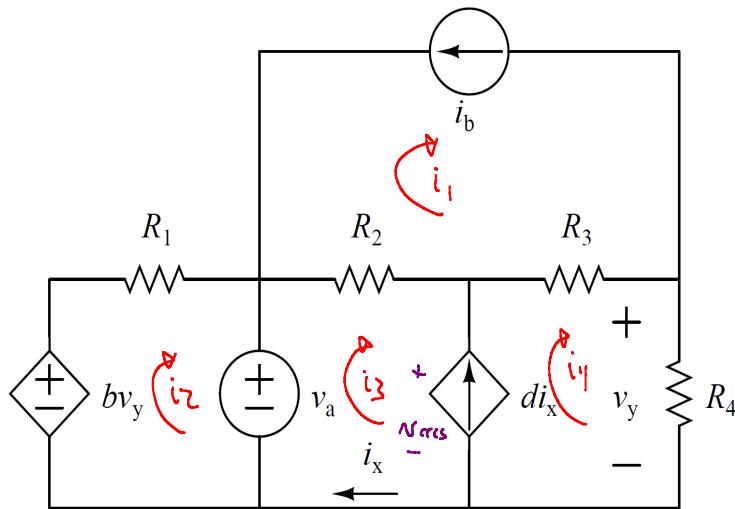
$$\text{MEAS, } i_x: KCL_{ij}: i_x + di_x - \frac{v_y}{R_4} = 0$$

$$(2) P_{abs,n_3} = (v_3 - v_a)^2 / R_3$$

$$(3) P_{diss,ccs} = (v_3)(di_x)$$

$$(4) P_{diss,v_{CVS}} = b v_y i_{VCVS} \quad i_{VCVS} = \frac{b v_y - v_a}{R_1} \text{ from } KCL_{n_1}$$

II) McM



$$KVL = 4 \text{ mesh} - 2 \text{ isrc} = 2$$

Unk: $i_1, i_2, i_3, i_4, i_x, v_y$

$$KVL, l_2: -bV_y + R_1 i_2 + V_a = 0$$

$$KVL, l_3: -V_a + R_2(i_3 - i_1) + R_3(i_4 - i_1) + R_4 i_y = 0$$

$$SRC, i_b: i_b = -i_1$$

$$SRC, di_x: di_x = i_y - i_3$$

$$MEAS, i_x: i_x = i_3$$

$$MEAS, v_y: v_y = R_4 i_y$$

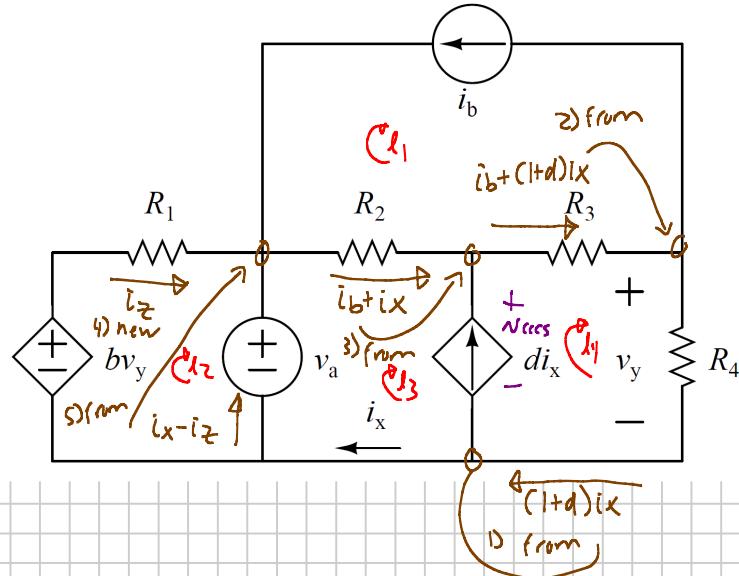
- $P_{abs, R_3} = (i_1 - i_4)^2 R_3$

- $P_{abs, ccs} = i_x (V_{ccs})$ get V_{ccs} from
 $KVL, l_3: -V_a + R_2(i_3 - i_1) + V_{ccs} = 0$

$$KVL, l_4: -V_{ccs} + R_3(i_4 - i_1) + R_4 i_y = 0$$

- $P_{abs, v_{ccs}} = bV_y i_1$

W) BOM



$$KVL_{\Sigma}: -b v_y + R_1 i_z + v_a = 0$$

$$KVL_{sh,y}: -v_a + R_2 (i_a + i_x) + R_3 (i_b + (1+d)i_x) + R_y ((1+d)i_x) = 0$$

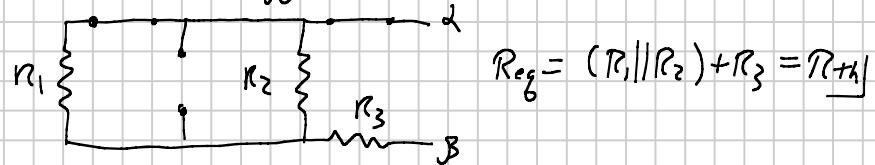
$$MEAS: N_y = R_y ((1+d)i_x)$$

- $P_{abs,R_3} = (i_b + (1+d)i_x)^2 R_3$

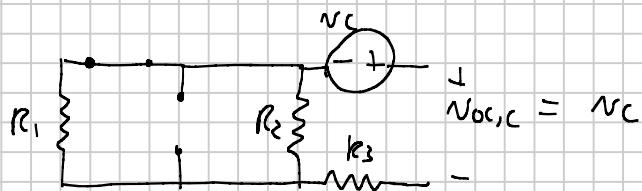
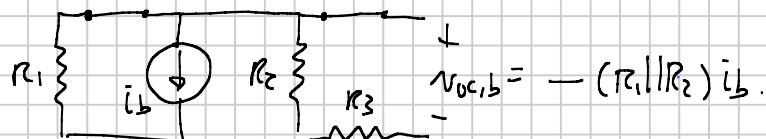
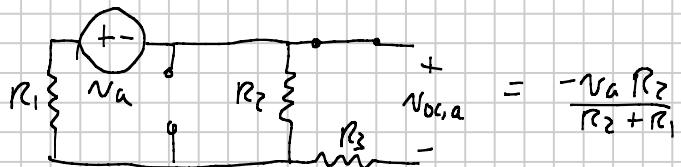
- $P_{abs,cccs} = d i_y N_{cccs}$ where N_{cccs} from $KVL_{sh,y}: -v_{cccs} + R_2 (i_b + i_x) + v_{cccs} = 0$

- $P_{abs,v_{ccs}} = (b v_y)(i_z)$

IV) To get R_{Th} turn sources off:

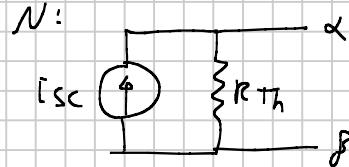
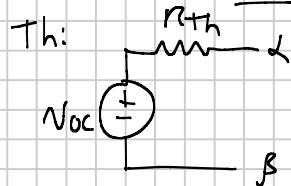


Get N_{oc} - easiest is superposition:

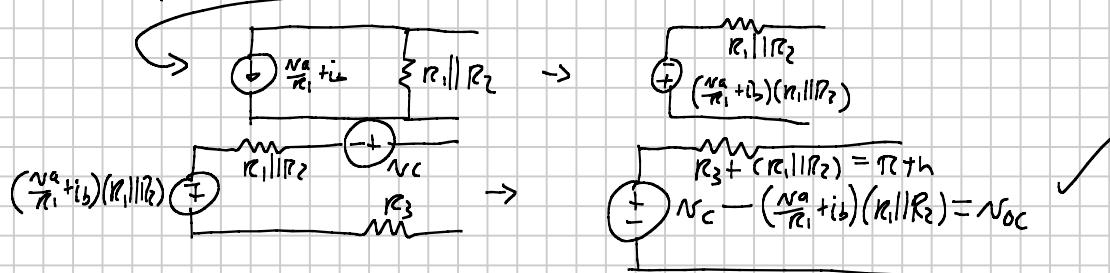
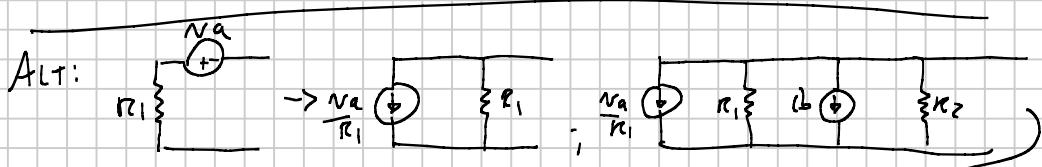


$$N_{oc} = N_{oc,a} + N_{oc,b} + N_{oc,c} = -\frac{V_a R_2}{R_2 + R_1} - (R_1 \parallel R_2) i_b + N_c$$

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

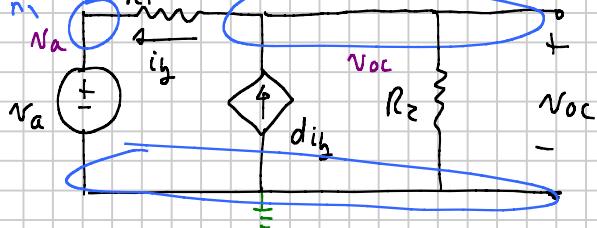


$$(?) R_L = R_{Th} \quad , \quad P_{abs,L} = \frac{N_{oc}^2}{4(R_{Th})}$$



V) (1) | Indep_b | Dep; Find V_{oc} , i_{sc} and $R_{th} = V_{oc}/i_{sc}$

V_{oc} :



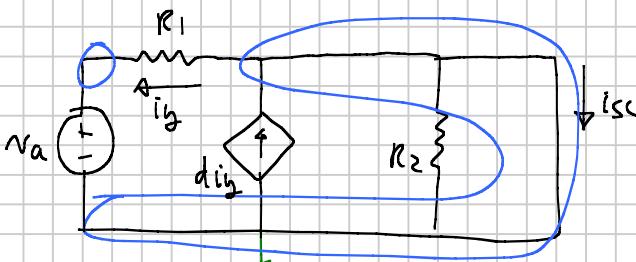
$$i_y = \frac{V_{oc} - V_a}{R_1}$$

$$KCL, n_2: i_y - d_{i_y} + \frac{V_{oc}}{R_2} = 0$$

$$(1-d) \left(\frac{V_{oc} - V_a}{R_1} \right) + \frac{V_{oc}}{R_2} = 0 \quad V_{oc} = \frac{(1-d)V_a}{\frac{(1-d)}{R_1} + \frac{1}{R_2}} \quad \checkmark$$

$$\begin{aligned} &= \frac{R_2(1-d)V_a}{R_2(1-d) + R_1} \\ &= \frac{R_2(1-d)V_a}{R_1 + R_2(1-d)} \end{aligned}$$

i_{sc} :



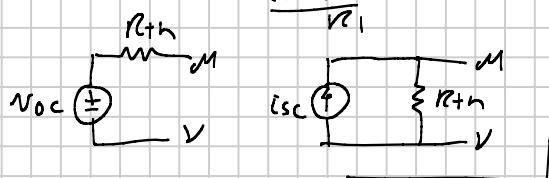
$$i_y = \frac{0 - V_a}{R_1}$$

$$i_{sc} = d_{i_y} - i_y = (d-1) \left(\frac{-V_a}{R_1} \right) = (1-d) \frac{V_a}{R_1}$$

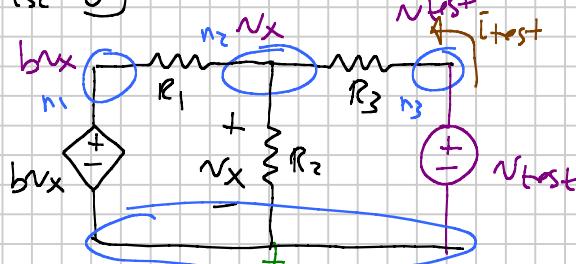
$$R_{th} = \frac{V_{oc}}{i_{sc}}$$

(Can leave like this...)

$$\frac{\frac{(1-d)V_a}{R_1}}{\frac{(1-d)V_a}{R_1} + \frac{1}{R_2}} = \frac{1}{\frac{(1-d)}{R_1} + \frac{1}{R_2}} = \frac{R_1 R_2}{R_1 + R_2(1-d)}$$



2) $V_{oc} = i_{sc} = 0$



$$R_{th} = \frac{V_{test}}{i_{test}}$$

$$R_{th} = \frac{R_1 R_2 + R_1 R_3 + R_2 R_3 (1-b)}{R_1 + R_2 (1-b)}$$

$$KCL, n_2: \frac{V_x - bV_x}{R_1} + \frac{V_x - V_{test}}{R_2} + \frac{V_x - V_{test}}{R_3} = 0$$

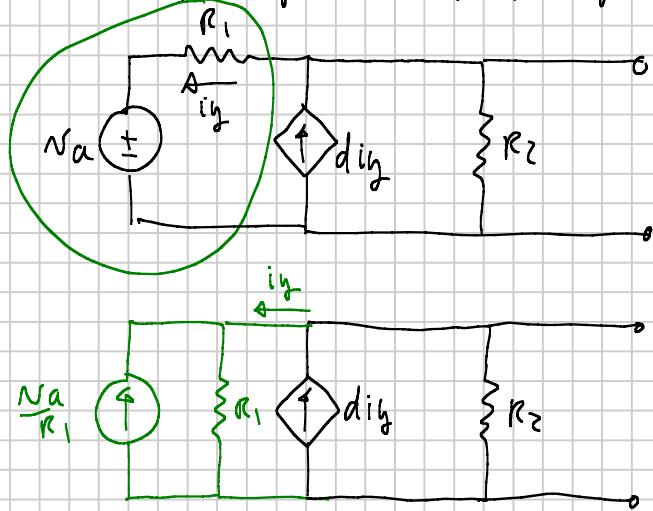
$$V_x = \frac{V_{test}}{\frac{R_1}{1-b} + \frac{1}{R_2} + \frac{1}{R_3}}$$

$$\begin{aligned} i_{test} &= \frac{V_{test} - V_x}{R_3} \\ &= \frac{1}{R_3} \left(V_{test} - \frac{R_1 R_2 V_{test}}{R_1 R_2 + R_1 R_3 + R_2 R_3 (1-b)} \right) \\ &= \frac{(R_1 + R_2 (1-b)) V_{test}}{R_1 R_2 + R_1 R_3 + R_2 R_3 (1-b)} \end{aligned}$$

Must use test voltage or current to simplify.

$$= R_3 + \frac{R_1 R_2}{R_1 + R_2 (1-b)}$$

Note: you have to be very careful trying to use transformations w/ dep. sources:



This is about as far as you can go without losing i_y as a measurement. Also, you cannot combine independent + dependent sources.