23W-EC ENGR-10-LEC-1 HW2

SANJIT SARDA

TOTAL POINTS

95.5 / 97

QUESTION 1

12 pts

1.1 a **3 / 3**

✓ **- 0 pts** *Correct*

1.2 b **5 / 5**

✓ **- 0 pts** *Correct*

1.3 c **4 / 4**

✓ **- 0 pts** *Correct*

QUESTION 2

25 pts

2.1 **6 / 6**

✓ **- 0 pts** *Correct*

2.2 **12 / 12**

✓ **- 0 pts** *Correct*

2.3 **3 / 3**

✓ **- 0 pts** *Correct*

2.4 **3.5 / 4**

✓ **- 0.5 pts** *partially wrong answer*

QUESTION 3

3 **15 / 15**

✓ **- 0 pts** *Correct*

QUESTION 4

4 **10 / 10**

✓ **- 0 pts** *Correct*

QUESTION 5

20 pts

5.1 **10 / 10**

✓ **- 0 pts** *Correct*

5.2 **10 / 10**

✓ **- 0 pts** *Correct*

QUESTION 6

15 pts

6.1 **5 / 5**

✓ **- 0 pts** *Correct*

6.2 **4 / 5**

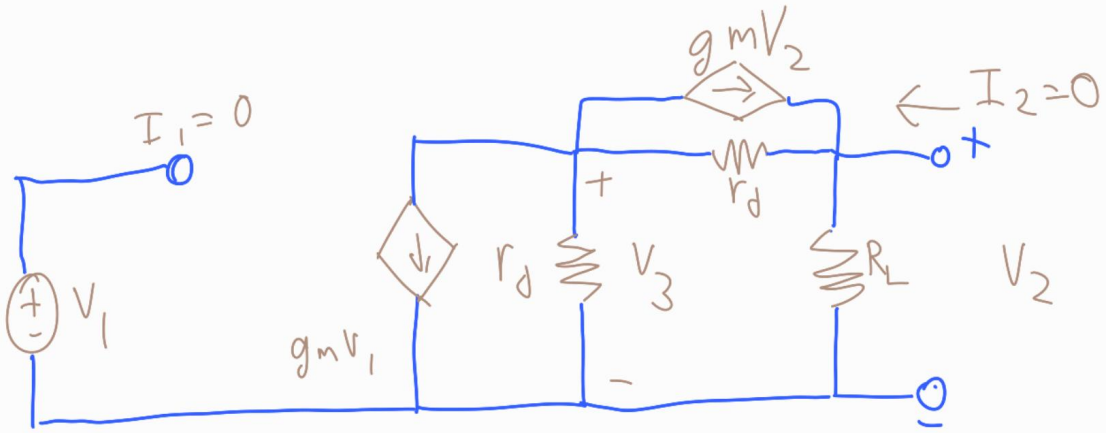
✓ **- 1 pts** *wrong R*

6.3 **5 / 5**

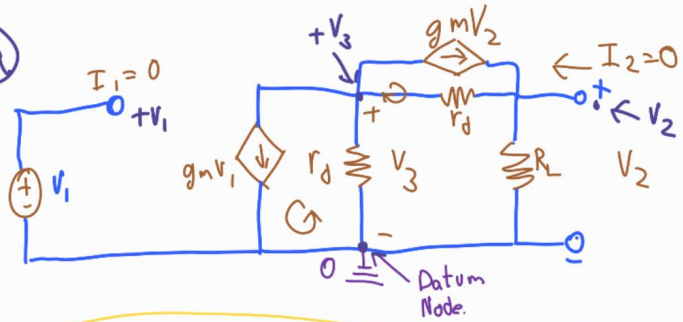
✓ **- 0 pts** *Correct*

ECE 10 HW#2

1)

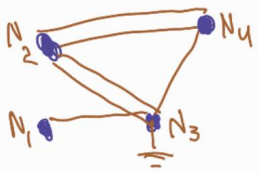


a)

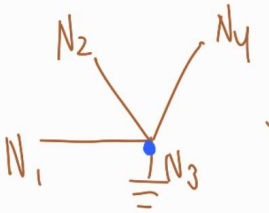


b) Tree:

$n=4, b=6, p=1$



Spanning tree



$I = \frac{V}{R}$

KCL @ each Node:

@ N_1: $V_1 = V_1$

@ N_2: $-g_m V_1 + V_3/r_d - g_m V_2 + \frac{(V_{N_4} - V_{N_2})}{r_d} = 0$ ($V_2 - V_3$)

$g_m(V_1+V_2) = \frac{V_3 + V_2 - V_3}{r_d} \rightarrow \therefore V_2 = r_d g_m V_1 + r_d g_m V_2$

$\therefore (1 - r_d g_m) V_2 - r_d g_m V_1 = 0$

@ N_4: $g_m V_2 + \frac{V_2}{R_L} - \frac{V_2 - V_3}{r_d} = 0 \therefore g_m V_2 + \frac{V_2}{r_L} - \frac{V_2}{r_d} - \frac{V_3}{r_d} = 0$

$\therefore r_L r_d g_m V_2 + r_d V_2 - r_L V_2 - r_L V_3 = 0$

$\therefore (r_L r_d g_m + r_d - r_L) V_2 - r_L V_3 = 0$

c) $\therefore$ In Matrix form:

$$\begin{bmatrix} 1 & 0 & 0 \\ -r_d g_m & 1 - r_d g_m & 0 \\ 0 & r_L r_d g_m + r_d - r_L & -r_L \end{bmatrix} \begin{bmatrix} V_1 \\ V_2 \\ V_3 \end{bmatrix} = \begin{bmatrix} V_1 \\ 0 \\ 0 \end{bmatrix}$$

$V_{N_2} - V_{N_3} = V_3$

$V_{N_1} - V_{N_3} = V_1$

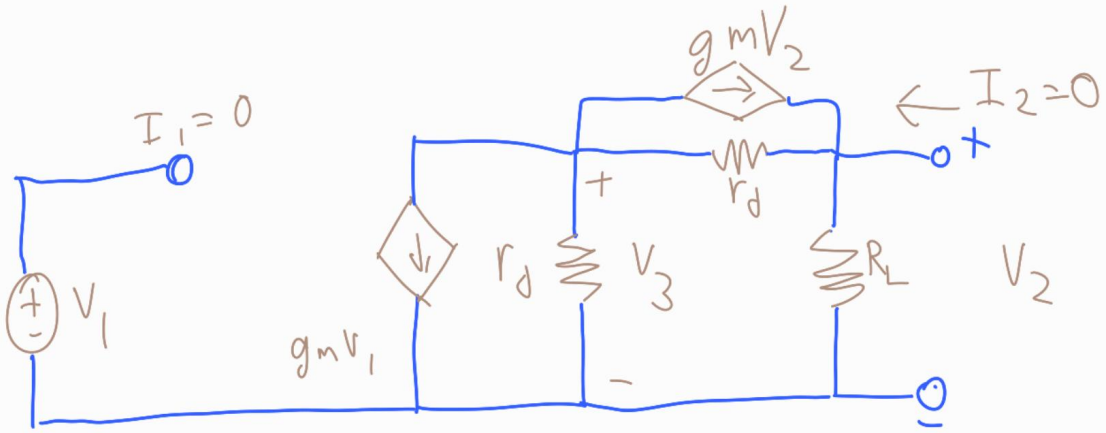
$V_{N_4} - V_{N_3} = V_2$

1.1 a **3 / 3**

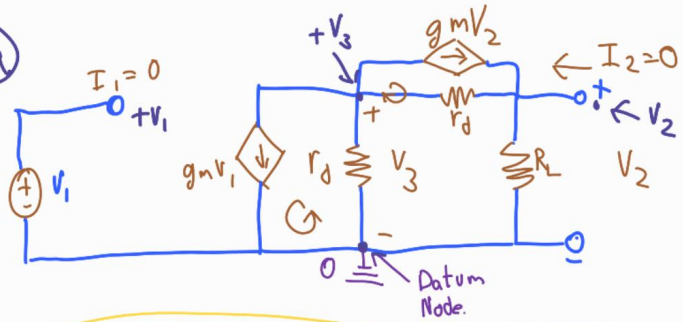
✓ **- 0 pts** *Correct*

ECE 10 HW#2

1)

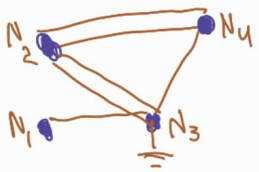


a)



b) Tree:

$n=4, b=6, p=1$



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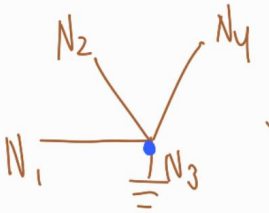


$I = \frac{V}{R}$

KCL @ each Node:

@ N_1: $V_1 = V_1$

@ N_2: $-g_m V_1 + V_3/r_d - g_m V_2 + \frac{(V_{N_4} - V_{N_2})}{r_d} = 0$ ($V_2 - V_3$)

$g_m(V_1+V_2) = \frac{V_3 + V_2 - V_3}{r_d} \rightarrow \therefore V_2 = r_d g_m V_1 + r_d g_m V_2$

$\therefore (1 - r_d g_m) V_2 - r_d g_m V_1 = 0$

@ N_4: $g_m V_2 + \frac{V_2}{R_L} - \frac{V_2 - V_3}{r_d} = 0 \therefore g_m V_2 + \frac{V_2}{r_L} - \frac{V_2}{r_d} - \frac{V_3}{r_d} = 0$

$\therefore r_L r_d g_m V_2 + r_d V_2 - r_L V_2 - r_L V_3 = 0$

$\therefore (r_L r_d g_m + r_d - r_L) V_2 - r_L V_3 = 0$

c) $\therefore$ In Matrix form:

$$\begin{bmatrix} 1 & 0 & 0 \\ -r_d g_m & 1 - r_d g_m & 0 \\ 0 & r_L r_d g_m + r_d - r_L & -r_L \end{bmatrix} \begin{bmatrix} V_1 \\ V_2 \\ V_3 \end{bmatrix} = \begin{bmatrix} V_1 \\ 0 \\ 0 \end{bmatrix}$$

$V_{N_2} - V_{N_3} = V_3$

$V_{N_1} - V_{N_3} = V_1$

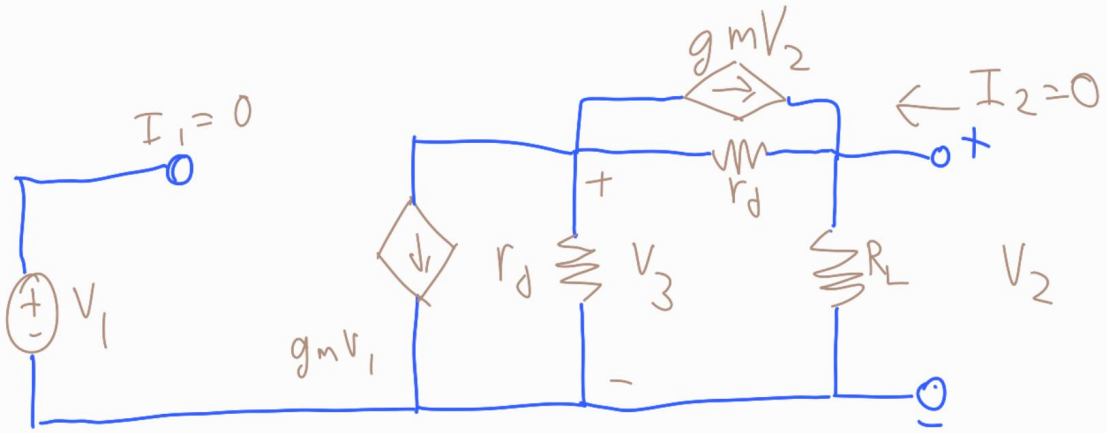
$V_{N_4} - V_{N_3} = V_2$

1.2 b **5 / 5**

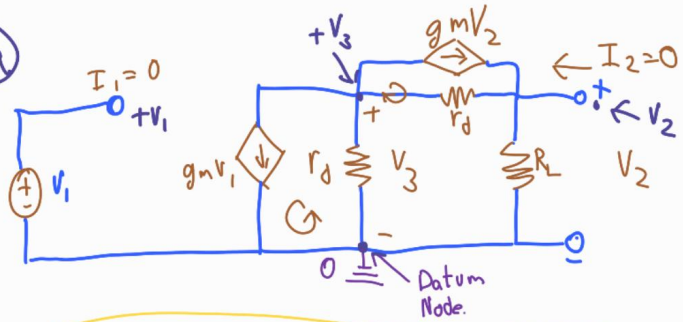
✓ **- 0 pts** *Correct*

ECE 10 HW#2

1)

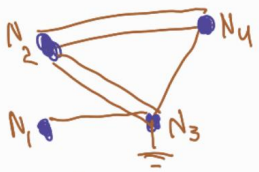


a)

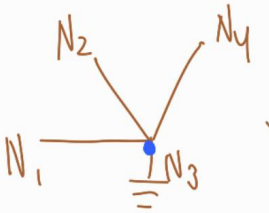


b) Tree:

$n=4, b=6, p=1$



Spanning tree



$I = \frac{V}{R}$

KCL @ each Node:

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@ N_2: $-g_m V_1 + V_3/r_d - g_m V_2 + \frac{(V_{N_4} - V_{N_2})}{r_d} = 0$ ($V_2 - V_3$)

$g_m(V_1+V_2) = \frac{V_3 + V_2 - V_3}{r_d} \rightarrow \therefore V_2 = r_d g_m V_1 + r_d g_m V_2$

$\therefore (1 - r_d g_m) V_2 - r_d g_m V_1 = 0$

@ N_4: $g_m V_2 + \frac{V_2}{R_L} - \frac{V_2 - V_3}{r_d} = 0 \therefore g_m V_2 + \frac{V_2}{r_L} - \frac{V_2}{r_d} - \frac{V_3}{r_d} = 0$

$\therefore r_L r_d g_m V_2 + r_d V_2 - r_L V_2 - r_L V_3 = 0$

$\therefore (r_L r_d g_m + r_d - r_L) V_2 - r_L V_3 = 0$

c) $\therefore$ In Matrix form:

$$\begin{bmatrix} 1 & 0 & 0 \\ -r_d g_m & 1 - r_d g_m & 0 \\ 0 & r_L r_d g_m + r_d - r_L & -r_L \end{bmatrix} \begin{bmatrix} V_1 \\ V_2 \\ V_3 \end{bmatrix} = \begin{bmatrix} V_1 \\ 0 \\ 0 \end{bmatrix}$$

$V_{N_2} - V_{N_3} = V_3$

$V_{N_1} - V_{N_3} = V_1$

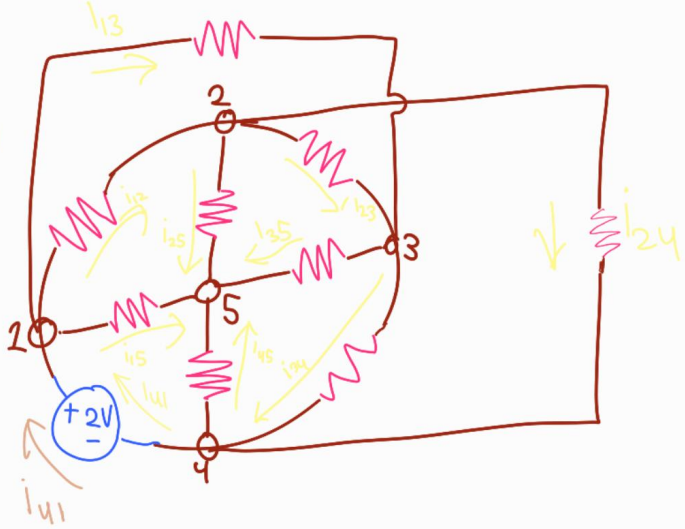
$V_{N_4} - V_{N_3} = V_2$

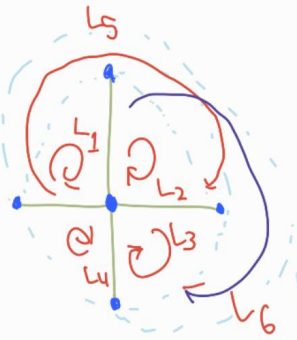
1.3 C **4 / 4**

✓ **- 0 pts** *Correct*

2)

a)





Nodes = 5
Branches: 10
P = 1

Edges = N − P = 4
Chords = B − (N − P)
= 6

Using Loop Current Analysis

@5 $I_{35} + I_{25} + I_{15} + I_{45} = 0$

@1 $I_{15} + I_{12} + I_{13} = I_{41}$

@2 $I_{25} + I_{23} + I_{24} = I_{12}$

@3 $I_{35} + I_{34} = I_{13} + I_{23}$

@4 $I_{45} + I_{41} = I_{34} + I_{24}$

b) KVL

@L_1 $\sum(V_{12} + I_{13} - I_{41} + 3I_{12} - I_{23} - I_{24}) = 0$

@L_2 $\sum(I_{23} + I_{24} - I_{12} + 3I_{23} + I_{13} - I_{34}) = 0$

@L_3 $\sum(I_{34} - I_{13} - I_{23} + 3I_{34} + I_{24} - I_{41}) = 0$

@L_4 $\sum(I_{41} - I_{34} - I_{24} + 2I_{41} - I_{12} - I_{13}) = 1$

@L_5 $\sum(I_{13} + I_{13} + I_{23} - I_{34} + I_{12} + 3I_{13} - I_{41}) = 0$

@L_6 $\sum(I_{24} + I_{34} + I_{24} - I_{41} + I_{23} + 3I_{24} - I_{12}) = 0$

L_1: $-2i_{15} + 2i_{12} + 2i_{25} = 0$	L_1: $-i_{15} + i_{12} + i_{25} = 0$
L_2: $-2i_{25} + 2i_{23} + 2i_{35} = 0$	L_2: $-i_{25} + i_{23} + i_{35} = 0$
L_3: $-2i_{35} + 2i_{34} + 2i_{45} = 0$	L_3: $-i_{35} + i_{34} + i_{45} = 0$
L_4: $-2i_{45} - 2 + 2i_{15} = 0$	L_4: $-i_{45} + 0 + i_{15} = 1$
L_5: $2i_{13} + 2i_{35} - 2i_{15} = 0$	L_5: $i_{13} + i_{35} - i_{15} = 0$
L_6: $2i_{24} + 2i_{45} - 2i_{25} = 0$	L_6: $i_{24} + i_{45} - i_{25} = 0$

c)

$$\begin{bmatrix} 3 & -1 & 0 & -1 & 1 & -1 \\ -1 & 3 & -1 & 0 & 1 & 1 \\ 0 & -1 & 3 & -1 & -1 & 1 \\ -1 & -1 & -1 & 2 & 0 & -1 \\ 1 & 1 & -1 & -1 & 3 & 0 \\ -1 & 1 & 1 & -1 & 0 & 3 \end{bmatrix} \begin{bmatrix} I_{12} \\ I_{23} \\ I_{34} \\ I_{41} \\ I_{13} \\ I_{24} \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \\ 1 \\ 0 \\ 0 \end{bmatrix}$$

d)

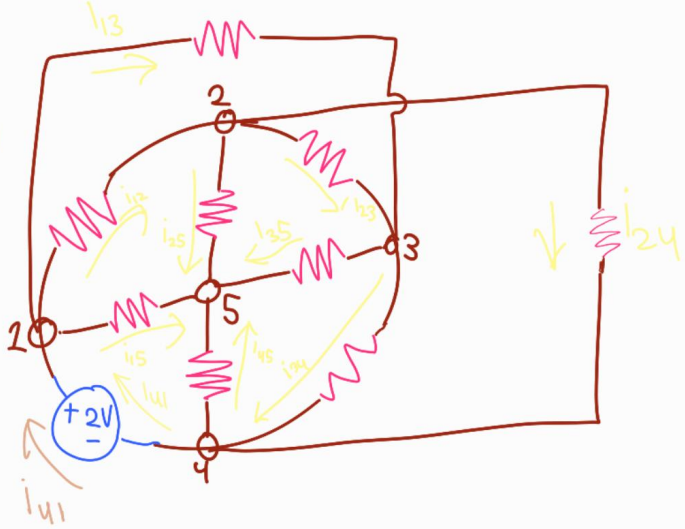
$\therefore$ $I_{12} = I_{13}$
$I_{23} = 0$
$I_{34} = 1/3$
$I_{41} = 2$
$I_{13} = 1/3$
$I_{24} = 1/3$

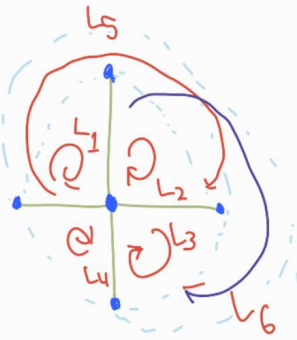
2.1 **6 / 6**

✓ **- 0 pts** *Correct*

2)

a)





Nodes = 5
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= 6

Using Loop Current Analysis

@5 $I_{35} + I_{25} + I_{15} + I_{45} = 0$

@1 $I_{15} + I_{12} + I_{13} = I_{41}$

@2 $I_{25} + I_{23} + I_{24} = I_{12}$

@3 $I_{35} + I_{34} = I_{13} + I_{23}$

@4 $I_{45} + I_{41} = I_{34} + I_{24}$

b) KVL

@L_1 $\sum(V_{12} + I_{13} - I_{41} + 3I_{12} - I_{23} - I_{24}) = 0$

@L_2 $\sum(I_{23} + I_{24} - I_{12} + 3I_{23} + I_{13} - I_{34}) = 0$

@L_3 $\sum(I_{34} - I_{13} - I_{23} + 3I_{34} + I_{24} - I_{41}) = 0$

@L_4 $\sum(I_{41} - I_{34} - I_{24} + 2I_{41} - I_{12} - I_{13}) = 1$

@L_5 $\sum(I_{13} + I_{13} + I_{23} - I_{34} + I_{12} + 3I_{13} - I_{41}) = 0$

@L_6 $\sum(I_{24} + I_{34} + I_{24} - I_{41} + I_{23} + 3I_{24} - I_{12}) = 0$

L_1: $-2i_{15} + 2i_{12} + 2i_{25} = 0$	L_1: $-i_{15} + i_{12} + i_{25} = 0$
L_2: $-2i_{25} + 2i_{23} + 2i_{35} = 0$	L_2: $-i_{25} + i_{23} + i_{35} = 0$
L_3: $-2i_{35} + 2i_{34} + 2i_{45} = 0$	L_3: $-i_{35} + i_{34} + i_{45} = 0$
L_4: $-2i_{45} - 2 + 2i_{15} = 0$	L_4: $-i_{45} + 0 + i_{15} = 1$
L_5: $2i_{13} + 2i_{35} - 2i_{15} = 0$	L_5: $i_{13} + i_{35} - i_{15} = 0$
L_6: $2i_{24} + 2i_{45} - 2i_{25} = 0$	L_6: $i_{24} + i_{45} - i_{25} = 0$

c)

$$\begin{bmatrix} 3 & -1 & 0 & -1 & 1 & -1 \\ -1 & 3 & -1 & 0 & 1 & 1 \\ 0 & -1 & 3 & -1 & -1 & 1 \\ -1 & -1 & -1 & 2 & 0 & -1 \\ 1 & 1 & -1 & -1 & 3 & 0 \\ -1 & 1 & 1 & -1 & 0 & 3 \end{bmatrix} \begin{bmatrix} I_{12} \\ I_{23} \\ I_{34} \\ I_{41} \\ I_{13} \\ I_{24} \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \\ 1 \\ 0 \\ 0 \end{bmatrix}$$

d)

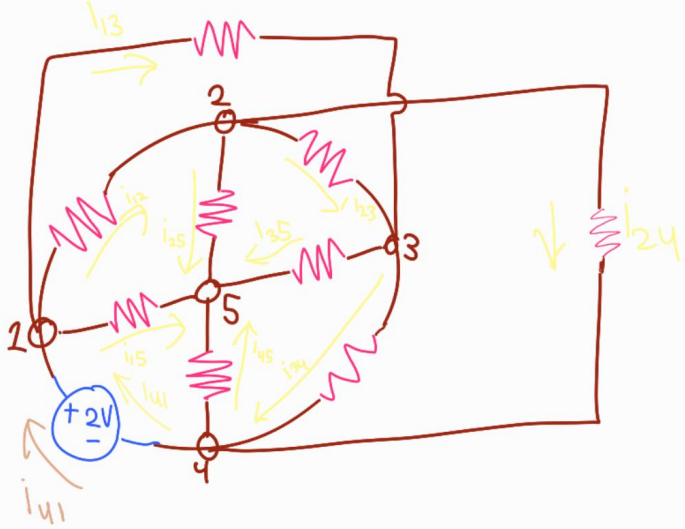
$\therefore$ $I_{12} = I_{13}$
$I_{23} = 0$
$I_{34} = 1/3$
$I_{41} = 2$
$I_{13} = 1/3$
$I_{24} = 1/3$

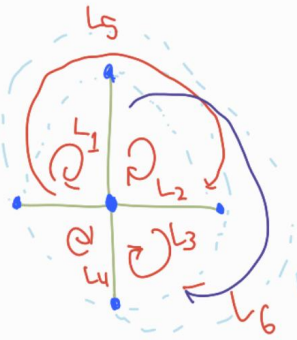
2.2 **12 / 12**

✓ **- 0 pts** *Correct*

2)

a)





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Using Loop Current Analysis

@5 $I_{35} + I_{25} + I_{15} + I_{45} = 0$

@1 $I_{15} + I_{12} + I_{13} = I_{41}$

@2 $I_{25} + I_{23} + I_{24} = I_{12}$

@3 $I_{35} + I_{34} = I_{13} + I_{23}$

@4 $I_{45} + I_{41} = I_{34} + I_{24}$

b) KVL

@L_1 $\sum(V_{12} + I_{13} - I_{41} + 3I_{12} - I_{23} - I_{24}) = 0$

@L_2 $\sum(I_{23} + I_{24} - I_{12} + 3I_{23} + I_{13} - I_{34}) = 0$

@L_3 $\sum(I_{34} - I_{13} - I_{23} + 3I_{34} + I_{24} - I_{41}) = 0$

@L_4 $\sum(I_{41} - I_{34} - I_{24} + 2I_{41} - I_{12} - I_{13}) = 1$

@L_5 $\sum(I_{13} + I_{13} + I_{23} - I_{34} + I_{12} + 3I_{13} - I_{41}) = 0$

@L_6 $\sum(I_{24} + I_{34} + I_{24} - I_{41} + I_{23} + 3I_{24} - I_{12}) = 0$

L_1: $-2i_{15} + 2i_{12} + 2i_{25} = 0$	L_1: $-i_{15} + i_{12} + i_{25} = 0$
L_2: $-2i_{25} + 2i_{23} + 2i_{35} = 0$	L_2: $-i_{25} + i_{23} + i_{35} = 0$
L_3: $-2i_{35} + 2i_{34} + 2i_{45} = 0$	L_3: $-i_{35} + i_{34} + i_{45} = 0$
L_4: $-2i_{45} - 2 + 2i_{15} = 0$	L_4: $-i_{45} + 0 + i_{15} = 1$
L_5: $2i_{13} + 2i_{35} - 2i_{15} = 0$	L_5: $i_{13} + i_{35} - i_{15} = 0$
L_6: $2i_{24} + 2i_{45} - 2i_{25} = 0$	L_6: $i_{24} + i_{45} - i_{25} = 0$

c)

$$\begin{bmatrix} 3 & -1 & 0 & -1 & 1 & -1 \\ -1 & 3 & -1 & 0 & 1 & 1 \\ 0 & -1 & 3 & -1 & -1 & 1 \\ -1 & -1 & -1 & 2 & 0 & -1 \\ 1 & 1 & -1 & -1 & 3 & 0 \\ -1 & 1 & 1 & -1 & 0 & 3 \end{bmatrix} \begin{bmatrix} I_{12} \\ I_{23} \\ I_{34} \\ I_{41} \\ I_{13} \\ I_{24} \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \\ 1 \\ 0 \\ 0 \end{bmatrix}$$

d)

$\therefore$ $I_{12} = I_{13}$
$I_{23} = 0$
$I_{34} = 1/3$
$I_{41} = 2$
$I_{13} = 1/3$
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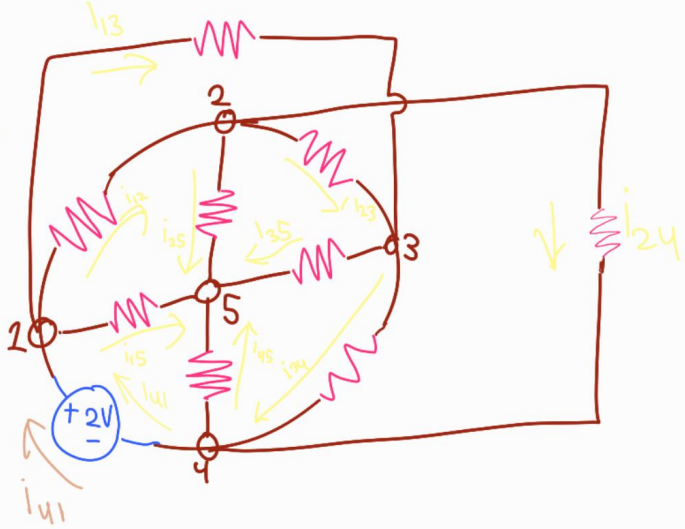
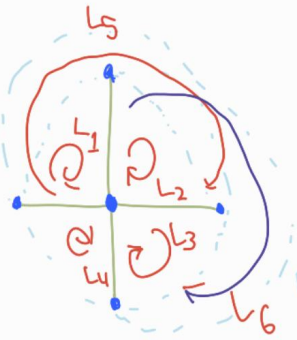
2.3 **3 / 3**

✓ **- 0 pts** *Correct*

2)

a)





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@3 $I_{35} + I_{34} = I_{13} + I_{23}$

@4 $I_{45} + I_{41} = I_{34} + I_{24}$

b) KVL

@L_1 $\sum(V_{12} + I_{13} - I_{41} + 3I_{12} - I_{23} - I_{24}) = 0$

@L_2 $\sum(I_{23} + I_{24} - I_{12} + 3I_{23} + I_{13} - I_{34}) = 0$

@L_3 $\sum(I_{34} - I_{13} - I_{23} + 3I_{34} + I_{24} - I_{41}) = 0$

@L_4 $\sum(I_{41} - I_{34} - I_{24} + 2I_{41} - I_{12} - I_{13}) = 1$

@L_5 $\sum(I_{13} + I_{13} + I_{23} - I_{34} + I_{12} + 3I_{13} - I_{41}) = 0$

@L_6 $\sum(I_{24} + I_{34} + I_{24} - I_{41} + I_{23} + 3I_{24} - I_{12}) = 0$

L_1: $-2i_{15} + 2i_{12} + 2i_{25} = 0$	L_1: $-i_{15} + i_{12} + i_{25} = 0$
L_2: $-2i_{25} + 2i_{23} + 2i_{35} = 0$	L_2: $-i_{25} + i_{23} + i_{35} = 0$
L_3: $-2i_{35} + 2i_{34} + 2i_{45} = 0$	L_3: $-i_{35} + i_{34} + i_{45} = 0$
L_4: $-2i_{45} - 2 + 2i_{15} = 0$	L_4: $-i_{45} + 0 + i_{15} = 1$
L_5: $2i_{13} + 2i_{35} - 2i_{15} = 0$	L_5: $i_{13} + i_{35} - i_{15} = 0$
L_6: $2i_{24} + 2i_{45} - 2i_{25} = 0$	L_6: $i_{24} + i_{45} - i_{25} = 0$

c)

$$\begin{bmatrix} 3 & -1 & 0 & -1 & 1 & -1 \\ -1 & 3 & -1 & 0 & 1 & 1 \\ 0 & -1 & 3 & -1 & -1 & 1 \\ -1 & -1 & -1 & 2 & 0 & -1 \\ 1 & 1 & -1 & -1 & 3 & 0 \\ -1 & 1 & 1 & -1 & 0 & 3 \end{bmatrix} \begin{bmatrix} I_{12} \\ I_{23} \\ I_{34} \\ I_{41} \\ I_{13} \\ I_{24} \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \\ 1 \\ 0 \\ 0 \end{bmatrix}$$

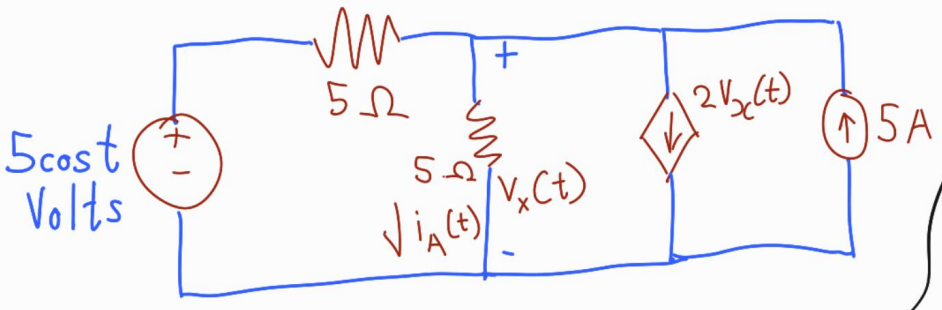
d)

$\therefore$ $I_{12} = I_{13}$
$I_{23} = 0$
$I_{34} = 1/3$
$I_{41} = 2$
$I_{13} = 1/3$
$I_{24} = 1/3$

2.4 **3.5 / 4**

✓ **- 0.5 pts** *partially wrong answer*

③ Superposition



Using Superposition:

$5-2x = I_b = I_c + I_a$
N_1 N_2

@L_1 : $-5I_c + 5I_a = 0$

@N_2 : $I_c = I_a = \frac{I_b}{2}$

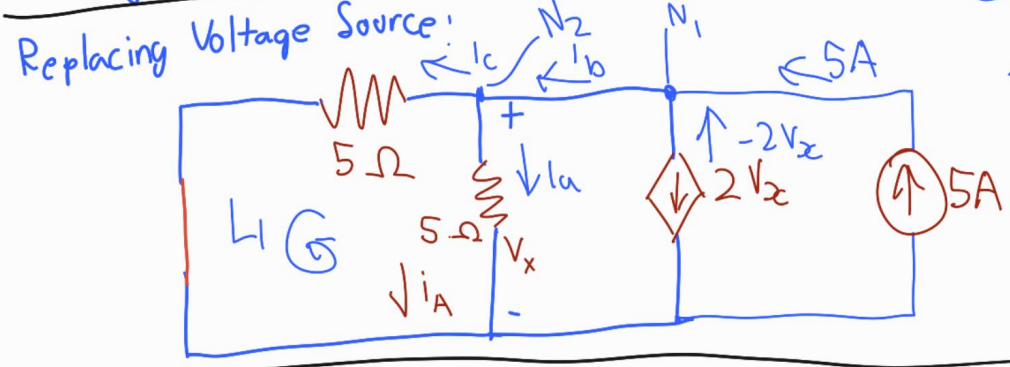
@L_1 $V_x = 5I_a = 5I_b/2$

$\therefore 5 - 2V_x = \frac{2}{5}V_x$

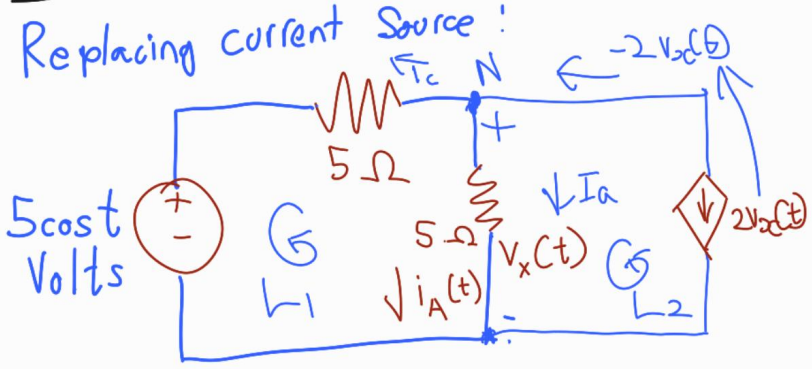
$\therefore 25 = 10V_x + 2V_x = 12V_x$

$V_x = \frac{25}{12} \therefore I_a = \frac{V_x}{5} = \frac{5}{12}$ A

Replacing Voltage Source:



Replacing current Source:



@L_1: $-5\cos(t) + 5I_a(t) - 5I_c(t) = 0$

@N : $-2V_x(t) = I_a(t) + I_c(t)$

@L_2: $V_x(t) = 5I_a(t)$

$\therefore I_c(t) = -2V_x(t) - I_a(t)$

$\therefore -5\cos(t) + 5I_a(t) + 10V_x(t) + 5I_a(t) = 0$

$\therefore 5\cos(t) = 12V_x(t)$

$\therefore V_x(t) = \frac{5}{12}\cos(t)$

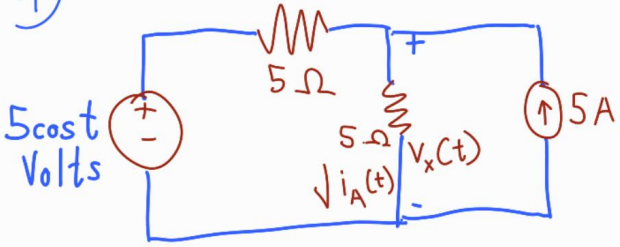
Summing up,

$$V_x(t) = \boxed{\frac{5\cos(t) + 25}{12}}$$

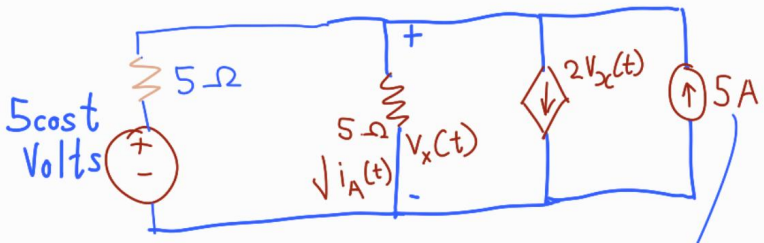
3 **15 / 15**

✓ **- 0 pts** *Correct*

4)



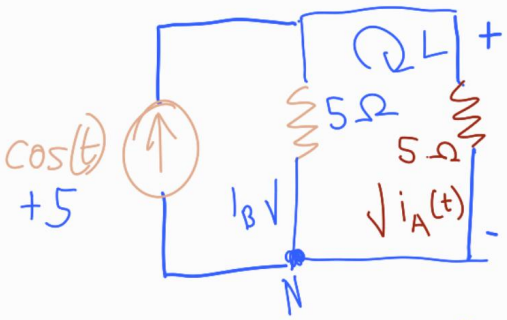
=



$$I = \frac{V}{R} = \frac{5\cos t}{5} = \cos t$$

$$\therefore I_s = I + 5$$

$$= \cos t + 5$$



@N KCL: $\cos t + 5 = I_a + I_b$

@LKVL: $5I_a = 5I_b$

$$\therefore \cos t + 5 = 2I_a$$

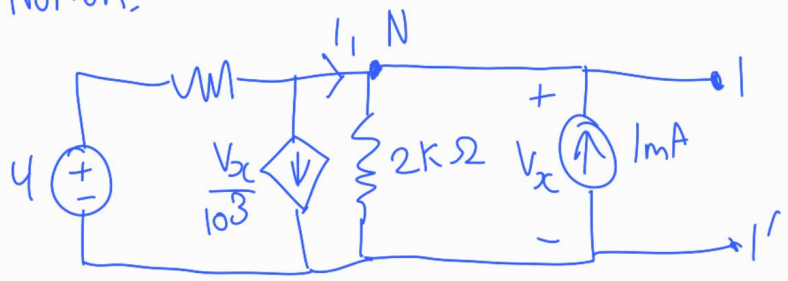
$$\therefore I_a = \frac{\cos t + 5}{2}$$

Current divider also works out

4 **10 / 10**

✓ **- 0 pts** *Correct*

5) Norton:



a)

Open Circuit

$$i_1 = \frac{4 - V_x}{2000} - \frac{V_x}{1000} = \frac{4 - 3V_x}{2000}$$

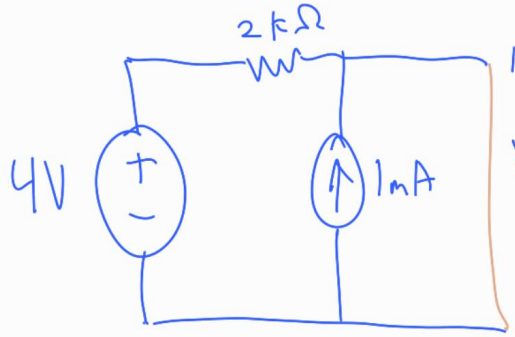
$$i_1 = \frac{V_x}{2000} - \frac{1}{1000} = \frac{V_x - 2}{2000}$$

$$\therefore V_x - 2 = 4 - 3V_x$$

$$\therefore 4V_x = 6 \quad \therefore V_x = \frac{3}{2}$$

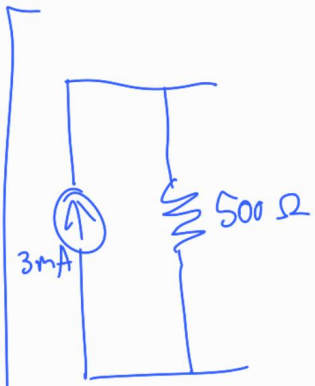
$$\therefore R = \frac{V}{I} = \frac{3}{2} \cdot \frac{1000}{\not 3} = 500\,\Omega$$

Short Circuit:



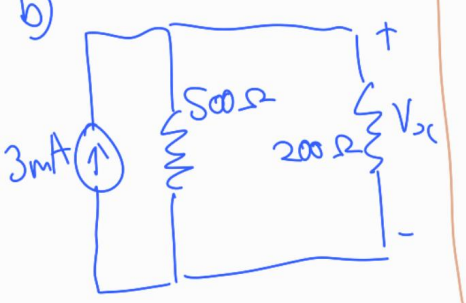
$$\therefore I_n = \frac{4}{2000} + \frac{1}{1000} = 3mA$$

$\therefore$ Norton Eq:



a

b)



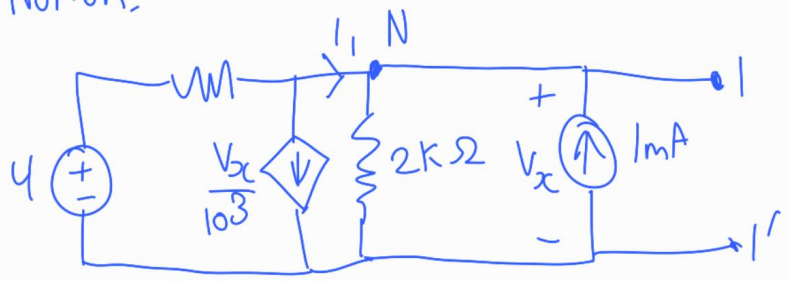
$$R_{eq} = \frac{200 \cdot 500}{200 + 500} = 1000/7\ \Omega$$

$$\therefore V_x = \frac{1000}{7} \cdot 3 = \frac{3000}{7} V$$

5.1 **10 / 10**

✓ **- 0 pts** *Correct*

5) Norton:



a)

Open Circuit

$$i_1 = \frac{4 - V_x}{2000} - \frac{V_x}{1000} = \frac{4 - 3V_x}{2000}$$

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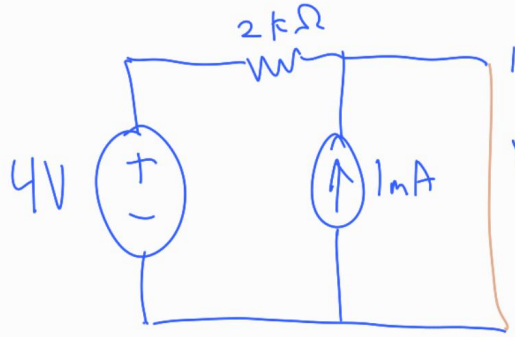
$$\therefore V_x - 2 = 4 - 3V_x$$

$$\therefore 4V_x = 6 \quad \therefore V_x = \frac{3}{2}$$

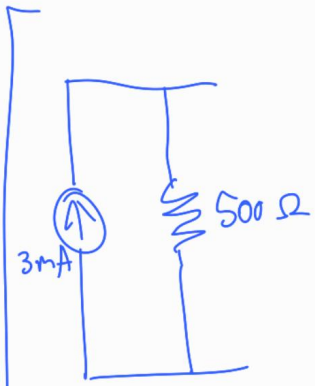
$$\therefore R = \frac{V}{I} = \frac{3}{2} \cdot \frac{1000}{\not 3} = 500\,\Omega$$

Short Circuit:



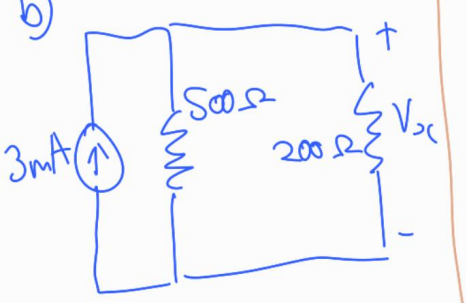
$$\therefore I_n = \frac{4}{2000} + \frac{1}{1000} = 3mA$$

$\therefore$ Norton Eq:



a

b)



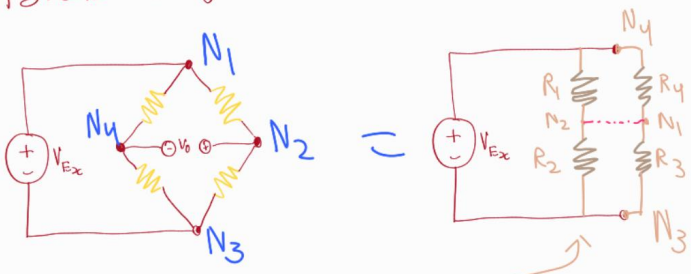
$$R_{eq} = \frac{200 \cdot 500}{200 + 500} = 1000/7\ \Omega$$

$$\therefore V_x = \frac{1000}{7} \cdot 3 = \frac{3000}{7} V$$

5.2 **10 / 10**

✓ **- 0 pts** *Correct*

6) Wheatstone Bridge

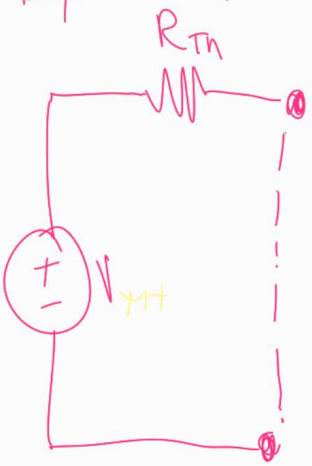


Short Circuit: $R_{Th} = \frac{R_1 R_4}{R_1+R_4} + \frac{R_2 R_3}{R_2+R_3} = \frac{R_1R_4(R_2+R_3)+R_2R_3(R_1+R_4)}{(R_1+R_4)(R_2+R_3)}$

Open Circuit:

$V_{Th} = V_o = V_{N_1} - V_{N_2} = V_{ex}\frac{R_3}{R_3+R_4} - V_{ex}\frac{R_2}{R_1+R_2}$

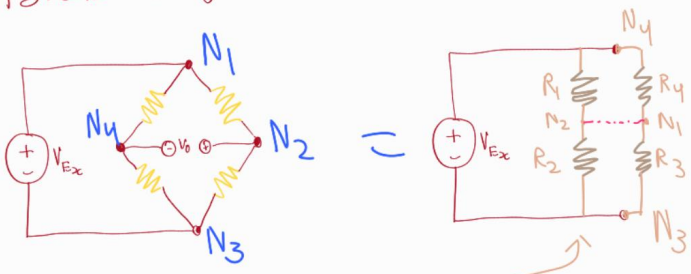
Thevenin Eq:



6.1 **5 / 5**

✓ **- 0 pts** *Correct*

6) Wheatstone Bridge

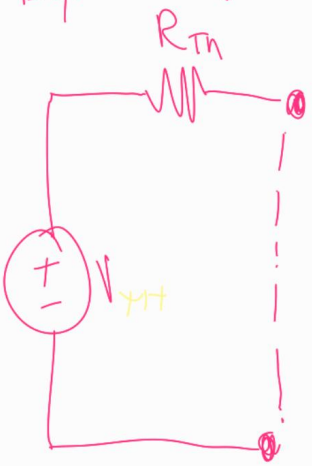


Short Circuit: $R_{Th} = \frac{R_1 R_4}{R_1+R_4} + \frac{R_2 R_3}{R_2+R_3} = \frac{R_1R_4(R_2+R_3)+R_2R_3(R_1+R_4)}{(R_1+R_4)(R_2+R_3)}$

Open Circuit:

$V_{Th} = V_o = V_{N_1} - V_{N_2} = V_{ex}\frac{R_3}{R_3+R_4} - V_{ex}\frac{R_2}{R_1+R_2}$

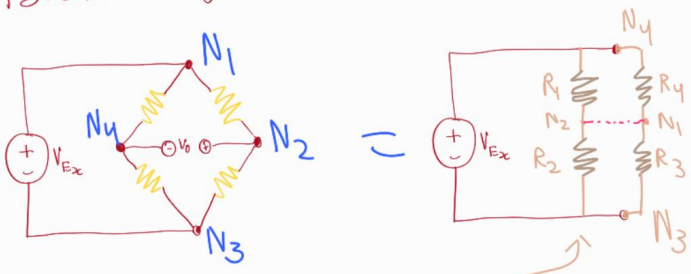
Thevenin Eq:



6.2 **4 / 5**

✓ **- 1 pts** *wrong R*

6) Wheatstone Bridge

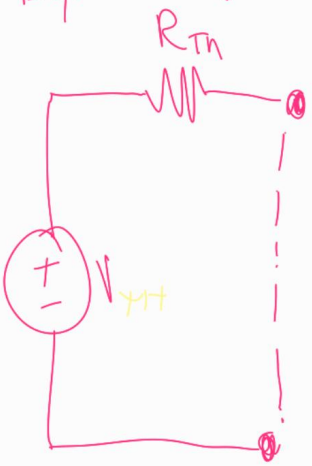


Short Circuit: $R_{Th} = \frac{R_1 R_4}{R_1+R_4} + \frac{R_2 R_3}{R_2+R_3} = \frac{R_1R_4(R_2+R_3)+R_2R_3(R_1+R_4)}{(R_1+R_4)(R_2+R_3)}$

Open Circuit:

$V_{Th} = V_o = V_{N_1} - V_{N_2} = V_{ex}\frac{R_3}{R_3+R_4} - V_{ex}\frac{R_2}{R_1+R_2}$

Thevenin Eq:



6.3 **5 / 5**

✓ **- 0 pts** *Correct*