Name: Solutions (please print)

Signature: _____

ECE 2201 -- Exam # 2
March 4, 2017

Keep this exam closed until you are told to begin.

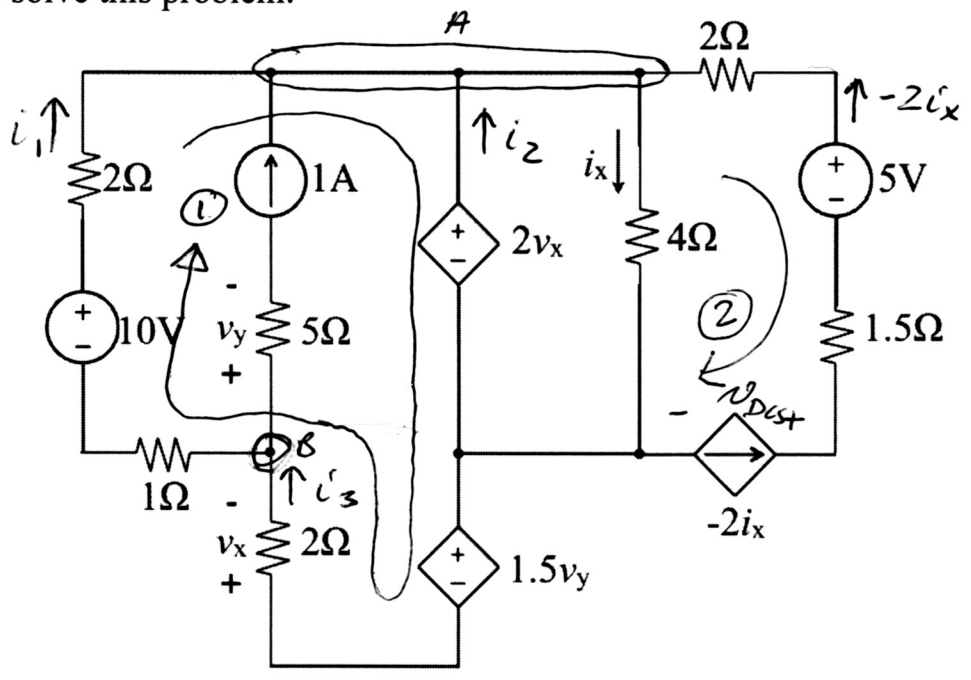
1. This exam is closed book, closed notes. You may use one 8.5" x 11" crib sheet, or its equivalent.
2. Show all work on these pages. Show all work necessary to complete the problem. A solution without the appropriate work shown will receive no credit. A solution that is not given in a reasonable order will lose credit. Clearly indicate your answer (for example by enclosing it in a box).
3. It is assumed that your work will begin on the same page as the problem statement. If you choose to begin your work on another page, you must indicate this on the page with the problem statement, with a clear indication of where the work can be found. **If your work continues on to another page, indicate clearly where your work can be found. Failure to indicate this clearly will result in a loss of credit.**
4. Show all units in solutions, intermediate results, and figures. Units in the exam will be included between square brackets.
5. Do not use red ink. Do not use red pencil.
6. You will have 90 minutes to work on this exam.

1. _____/30
2. _____/35
3. _____/35

Total = 100

Room for extra work

1. {30 Points} Use the circuit shown below to determine if the dependent current source delivers or absorbs the power. Calculate its value. Do not use NVM or MCM to solve this problem.



KCL in A $\quad -i_1 - 1A - i_2 + i_x - (-2i_x) = 0 \qquad (1)$

$v_y = 1A \cdot 5\Omega = 5V$

$v_x = i_3 \cdot 2\Omega$

KVL in A① $\quad 2v_x + 1.5v_y + v_x + i_1 \cdot 1\Omega - 10V + i_1 \cdot 2\Omega = 0$

$3i_1 + 3v_x = 10 - 7.5 = 2.5 \rightarrow 3i_1 + 6i_x = 2.5 \qquad (2)$

$i_x = \frac{2v_x}{4} \rightarrow v_x = 2i_x$

KCL in B $\quad i_1 + 1A - i_3 = 0 \rightarrow i_1 - \frac{v_x}{2} = -1$

$i_1 - i_x = -1 \qquad (3)$

group (1)-(3) $\quad \begin{cases} -i_1 - i_2 + 3i_x = 1 \\ 3i_1 + 6i_x = 2.5 \\ i_1 - i_x = -1 \end{cases}$

$i_1 = -0.39\ A$

$i_2 = 1.22A$

$i_x = 0.611A$

Room for extra work

For power calculation: Find v_{DCS} from KVL in (2)

$$5V + V_{DCS} + 2i_x \cdot 1.5\Omega - i_x \cdot 4\Omega + 2i_x \cdot 2\Omega = 0$$

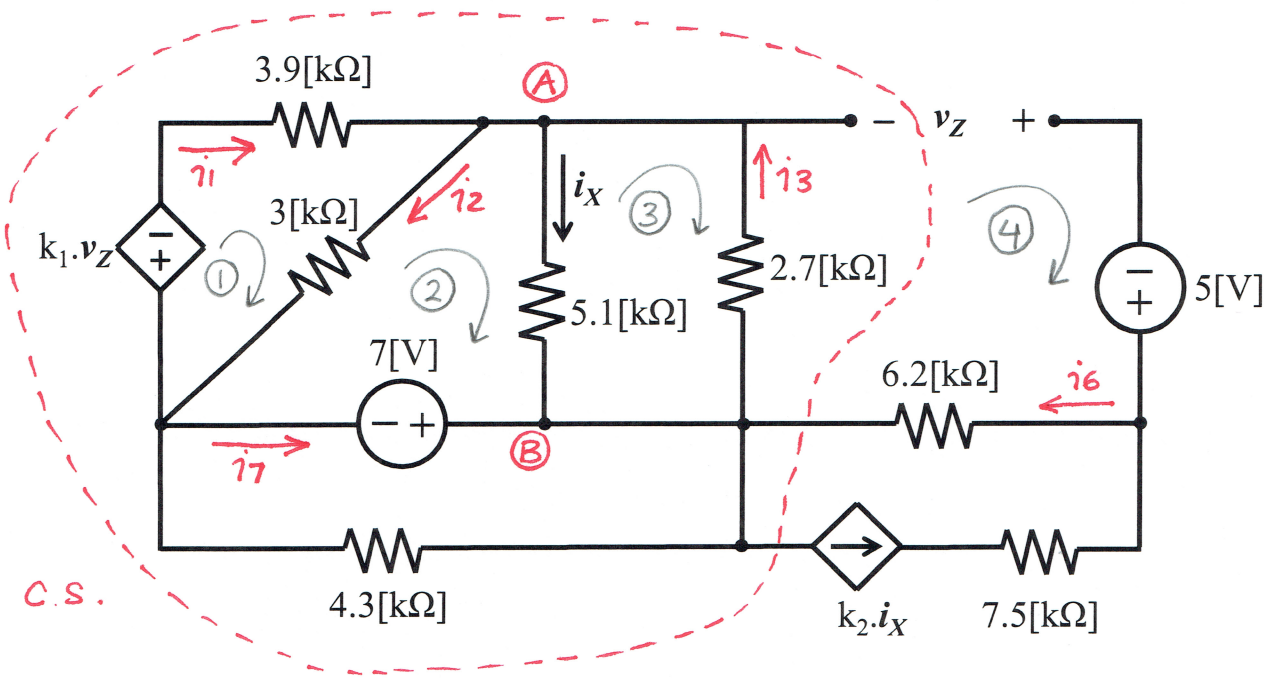
$$V_{DCS} = -6.83\ V$$

$$P_{del,DCS} = V_{DCS} \cdot (-2i_x) = 8.33\ W$$

Power is delivered by the source.

2. {35 Points} In the circuit given below, v_Z = -3.5[V] and the power delivered by the 7[V] voltage source is 11.9[mW].

a) Find $\mathbf{k_1}$ and $\mathbf{k_2}$. Do not use NVM or MCM to solve this problem.
b) What is the power absorbed by the dependent voltage source?



$P_{DEL,7[V]} = 11.9[mV] = 7[V]\, i_7 \Rightarrow i_7 = 1.7[mA]$

KCL @ c.s : $i_6 = k.i_X$ $\quad v_Z = -3.5[V]$

KVL ① : $k_1.(-3.5[V]) + i_1.3.9[k\Omega] + i_2.3[k\Omega] = 0$ (1)

KVL ② : $-i_2.3[k\Omega] + i_X.5.1[k\Omega] + 7[V] = 0$ (2)

KVL ③ : $-i_X.5.1[k\Omega] - i_3.2.7[k\Omega] = 0$ (3)

KVL ④ : $i_3.2.7[k\Omega] + 3.5[V] - 5[V] + k_2.i_X.6.2[k\Omega] = 0$ (4)

KCL @ A : $-i_1 + i_2 + i_X - i_3 = 0$ (5)

KCL @ B : $-i_X + i_3 - 1.7[mA] + \dfrac{7[V]}{4.3[k\Omega]} = 0$ (6)

6 equations, 6 unknowns ($k_1, k_2, i_1, i_2, i_3, i_X$)

Solving, we get : $\boxed{k_1 = 4.436}$ $\quad \boxed{k_2 = -8.872}$

Room for extra work

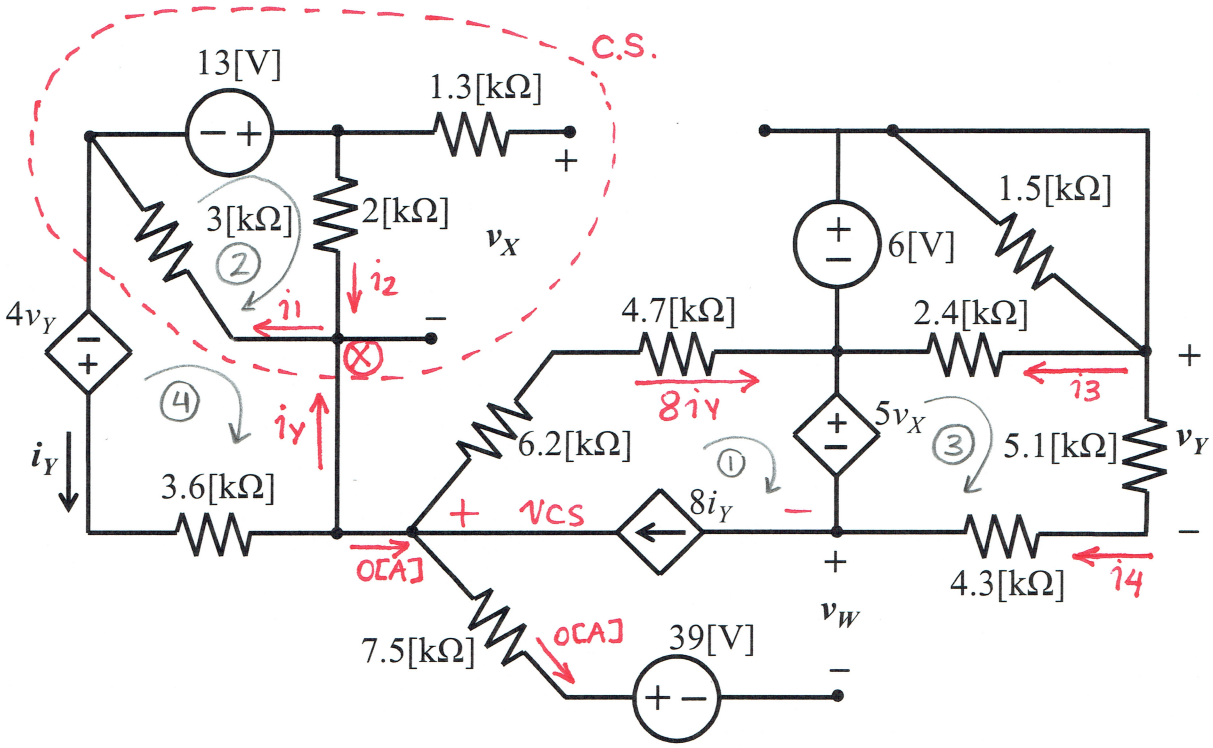
b) From part a), we also get $i_1 = 2.218\ [mA]$

$$p_{ABS,DVS} = k_1 . v_Z . i_1$$

$$\boxed{p_{ABS,DVS} = -34.43\ [mW]}$$

3. {35 Points} Use the following figure to solve this problem. Do not use NVM or MCM to solve this problem.

a) What is the power delivered by the dependent current source?
b) Find v_W.
c) What is the power delivered by the 2.4[kΩ] resistor?



a) $p_{DEL,DCS} = v_{CS}\, 8i_Y$. So we need to find v_{CS} and i_Y.

KVL ①: $8i_Y(6.2+4.7)[k\Omega] + 5v_X - v_{CS} = 0$ (1)

There's no current through 1.3[kΩ]. So $v_X = i_2 \cdot 2[k\Omega]$ (2)

KCL @ X: $i_1 - i_2 - i_Y = 0$ (3)

KVL ②: $i_1 \cdot 3[k\Omega] - 13[V] + i_2 \cdot 2[k\Omega] = 0$ (4)

KVL ③: $-5v_X - i_3 \cdot 2.4[k\Omega] + v_Y + i_4 \cdot 4.3[k\Omega] = 0$ (5)

KVL ④: $4v_Y - i_1 \cdot 3[k\Omega] - i_Y \cdot 3.6[k\Omega] = 0$ (6)

$i_3 = 6[V] / 2.4[k\Omega]$ (7) $\quad i_4 = v_Y / 5.1[k\Omega]$ (8)

8 equations, 8 unknowns (i_Y, v_X, v_{CS}, v_Y, i_1, i_2, i_3, i_4)

Room for extra work

Solving, we get $v_{cs} = 306.88\,[V]$ $i_y = 3.459\,[mA]$

$$p_{DEL,DCS} = v_{cs}\, 8 i_y = \boxed{8.49\,[W]}$$

b) KVL gives us $v_w - 39[V] + v_{cs} = 0$

$$\boxed{v_w = -267.88\,[V]}$$

c) $$p_{DEL,2.4[k\Omega]} = -p_{ABS,2.4[k\Omega]} = \frac{-(6[V])^2}{2.4[k\Omega]} = \boxed{-15\,[mW]}$$