Name: Solutions (please print)

Signature: _____

ECE 2201 -- Exam # 3
April 21, 2018

Keep this exam closed until you are told to begin.

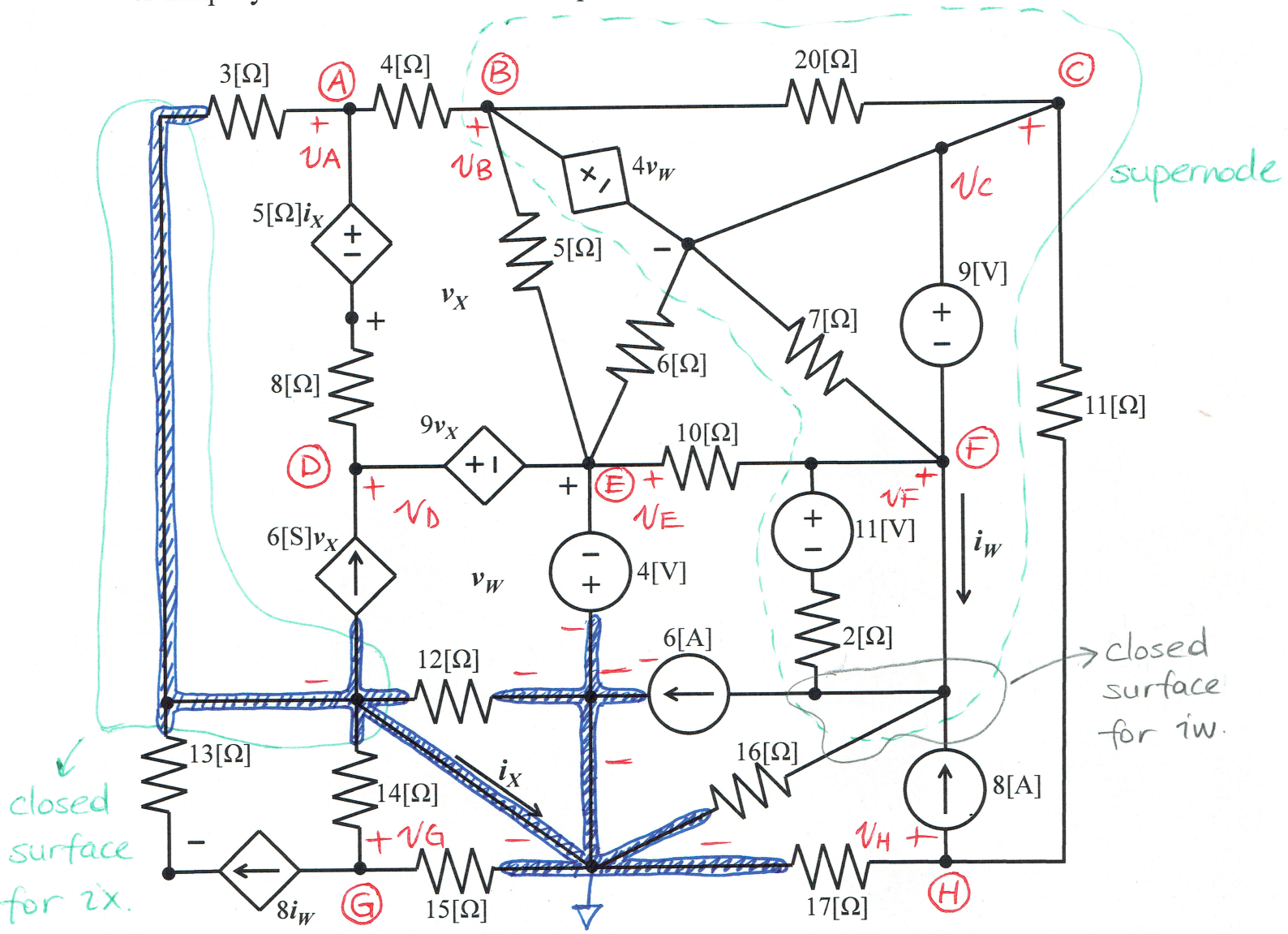
1. This exam is closed book, closed notes. You may use one 8.5" x 11" crib sheet, or its equivalent.
2. Show all work on these pages. Show all work necessary to complete the problem. A solution without the appropriate work shown will receive no credit. A solution that is not given in a reasonable order 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. _____/35
2. _____/35
3. _____/30

Total = 100

Room for extra work

1. {35 Points} Use the Node-Voltage Method to write a complete set of equations that could be used to solve the circuit below. Define all variables. Do not attempt to simplify the circuit. Do not attempt to solve the equations.



8 equations + 4 auxiliary equations = 12 equations.

(A) $\frac{vA}{3[\Omega]} + \frac{vA - vD - 5[\Omega]ix}{8[\Omega]} + \frac{vA - vB}{4[\Omega]} = 0$

(B+C+F) $\frac{vB - vA}{4[\Omega]} + \frac{vB - vE}{5[\Omega]} + \frac{vC - vE}{6[\Omega]} + \frac{vF - vE}{10[\Omega]} + 6[A] + \cdots$

$\cdots + \frac{vF}{16[\Omega]} - 8[A] + \frac{vC - vH}{11[\Omega]} = 0$

Room for extra work

(B+C) $v_B - v_C = 4v_W$

(C+F) $v_C - v_F = 9[V]$

(D+E) $v_D - v_E = 9v_X$

(E) $v_E = -4[V]$

(G) $8iw + \frac{v_G}{14[\Omega]} + \frac{v_G}{15[\Omega]} = 0$

(H) $\frac{v_H}{17[\Omega]} + 8[A] + \frac{v_H - v_C}{11[\Omega]} = 0$

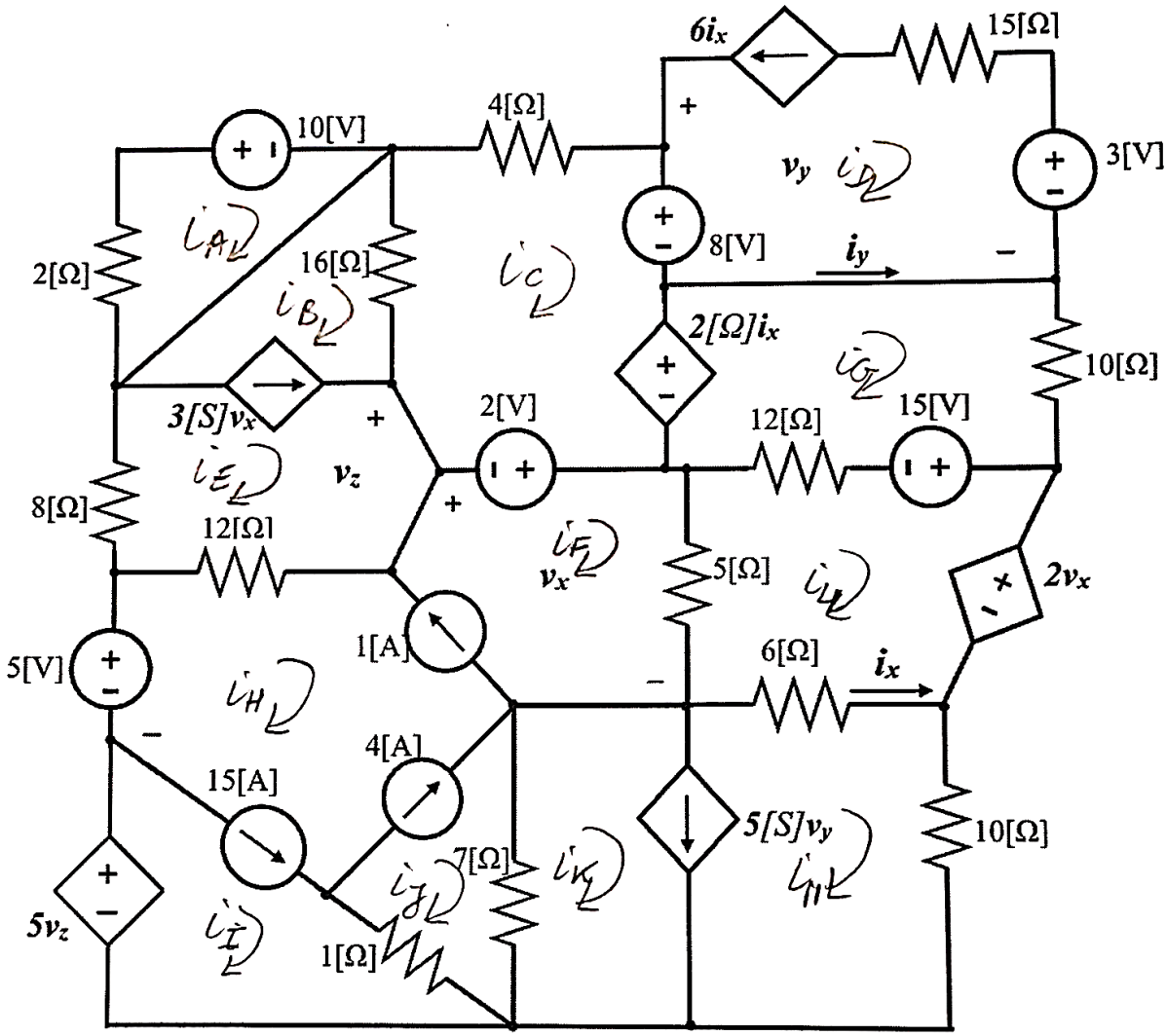
(v_X) $-v_X - 5[\Omega]\,ix + v_A - v_C = 0$

(v_W) $v_W + 13[\Omega] \cdot 8iw - v_E = 0$

(iw) $-iw - 8[A] + \frac{v_F}{16[\Omega]} + 6[A] + \frac{11[V]}{2[\Omega]} = 0$

(ix) $ix - \frac{v_G}{14[\Omega]} - 8iw - \frac{v_A}{3[\Omega]} + 6[S]v_X + \frac{0}{12[\Omega]} = 0$

2. {35 Points} Use the mesh-current method to write a complete set of equations that could be used to solve the circuit below. Define all variables. Do not attempt to simplify the circuit. Do not attempt to solve the equations.



(A) $i_{A2} + 10V = 0$

(B+E) $i_B - i_E = -3v_x$

(B+E) $(i_B - i_C)16\Omega + (i_E - i_H)12\Omega + i_E \cdot 8\Omega = 0$

(C) $8V + 2i_X + 2V + (i_C - i_B)16\Omega + i_C 4\Omega = 0$

(D) $i_D = -6i_X$

(F+H+I+J) $(i_F - i_L)5\Omega + (i_J - i_K)\cdot 7\Omega - 5v_Z - 5V +$
$+ (i_H - i_E)12\Omega - 2V = 0$

Room for extra work

(F+H) $i_F - i_H = 1A$

(H+I) $i_H - i_I = -15A \quad (\equiv i_I - i_H = 15A)$

(H+J) $i_H - i_y = -4A \quad (\equiv i_y - i_H = 4A)$

(G) $i_G \cdot 10\Omega + 15V + (i_G - i_L)12\Omega - 2i_x = 0$

(K+M) $(i_K - i_y)7\Omega + (i_M - i_L)6\Omega + i_M \cdot 10\Omega = 0$

(K+M) $i_K - i_M = 5v_y$

(i_L) $2v_x + (i_L - i_M)6\Omega + (i_L - i_F)\cdot 5\Omega + (i_L - i_G)12 - 15V = 0$

(i_x) $i_x = i_M - i_L$

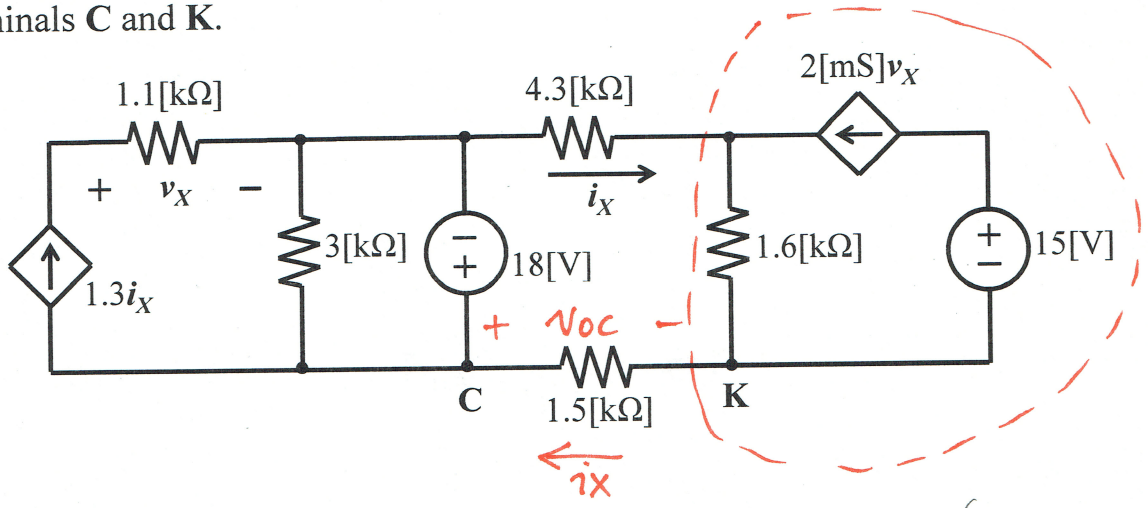
(i_y) $i_y = i_G - i_D$ *not needed - no dependent source with i_y*

(v_x) $v_x = -2V + (i_F - i_L)\cdot 5\Omega$

(v_y) $v_y = 8V$

(v_z) $v_z = (i_E - i_H)\cdot 12\Omega + 5V$

3. {35 Points} For the circuit shown below, find the Thévenin equivalent circuit with respect to terminals **C** and **K**. Draw the Thévenin equivalent circuit showing terminals **C** and **K**.

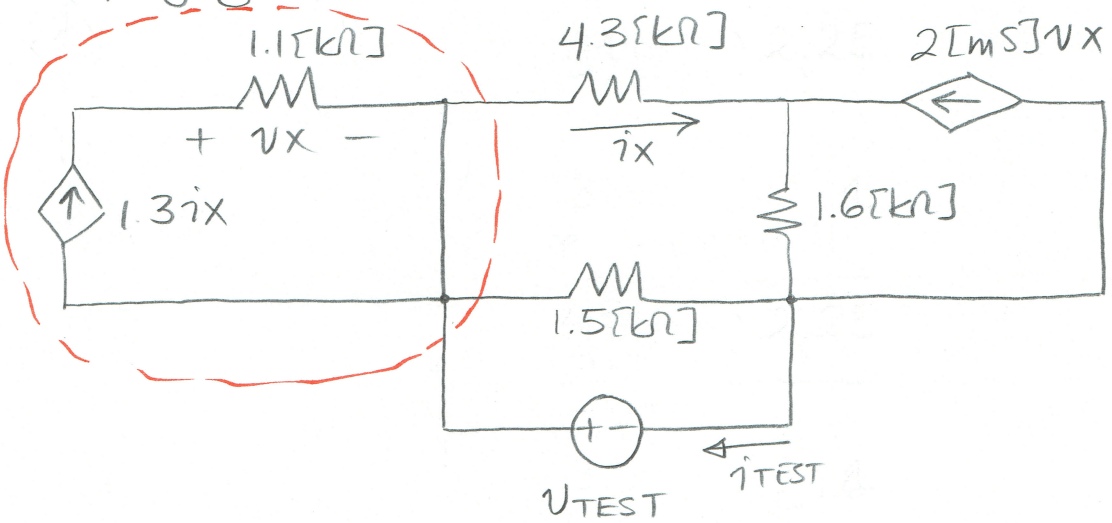


$$18[V] + (4.3[k\Omega] + 1.5[k\Omega])\,ix + 1.6[k\Omega]\,(ix + 2[mS]\,vx) = 0$$

$$vx = 1.1[k\Omega]\,1.3ix \qquad voc = -1.5[k\Omega]\,ix$$

Solving, we get $\boxed{voc = 2.25[V]}$

Applying test source method:



Note that 3[kΩ] resistor is shorted.

Room for extra work

Let $v_{TEST} = 15[V]$

KVL: $-15[V] + 4.3[k\Omega]\, i_x + 1.6[k\Omega](i_x + 2[mS]\, v_x) = 0$

$v_x = 1.1[k\Omega] \cdot 1.3 i_x \quad \Rightarrow \quad i_x = 1.43[mA]$

KCL @ closed surface: $i_x + \dfrac{15[V]}{1.5[k\Omega]} - i_{TEST} = 0$

$i_{TEST} = 11.43[mA]$

$R_{TH} = \dfrac{v_{TEST}}{i_{TEST}} = \boxed{1.31[k\Omega]}$