Name: _____ (please print)

Signature: _____

# ECE 2201 – Exam 2
# November 9, 2021

# Keep this exam closed and face up until you are told to begin.

1. This exam is closed book, closed notes. You may have a crib sheet in the form of one 8 ½ x 11" piece of paper written on both sides.
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 which is not given in a reasonable order will lose credit.
3. Show all units in solutions, intermediate results, and figures. Units in the exam will be included between square brackets.
4. If the grader has difficulty following your work because it is messy or disorganized, you will lose credit.
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) A device can be modeled by a voltage source in series with a resistor. When a 2 [V] source is connected to the device output, 1 [A] current is measured, as shown in Fig. 1. When parallel resistors 12[Ω] and 4[Ω] are connected to the output, a current of 2.5 [A] is measured in the 4[Ω] resistor, as shown in Figure 2.

a) Find the voltage source and series resistor that model the device, and draw your model, showing terminals A and B.
b) Two identical devices are connected to a circuit, as shown in Figure 3. *Note the configuration of A and B terminals for each device.*
c) Find the power delivered by the dependent current source $10[S]v_x$.

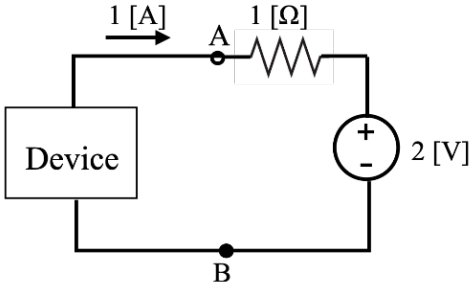



Figure 1.

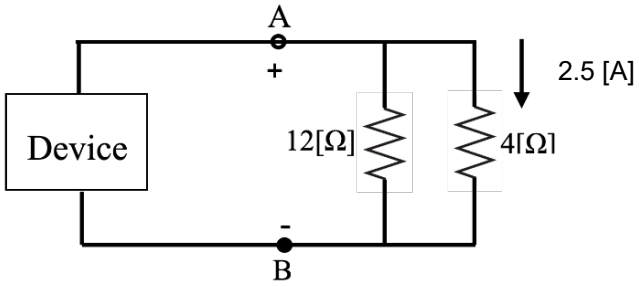



Figure 2.

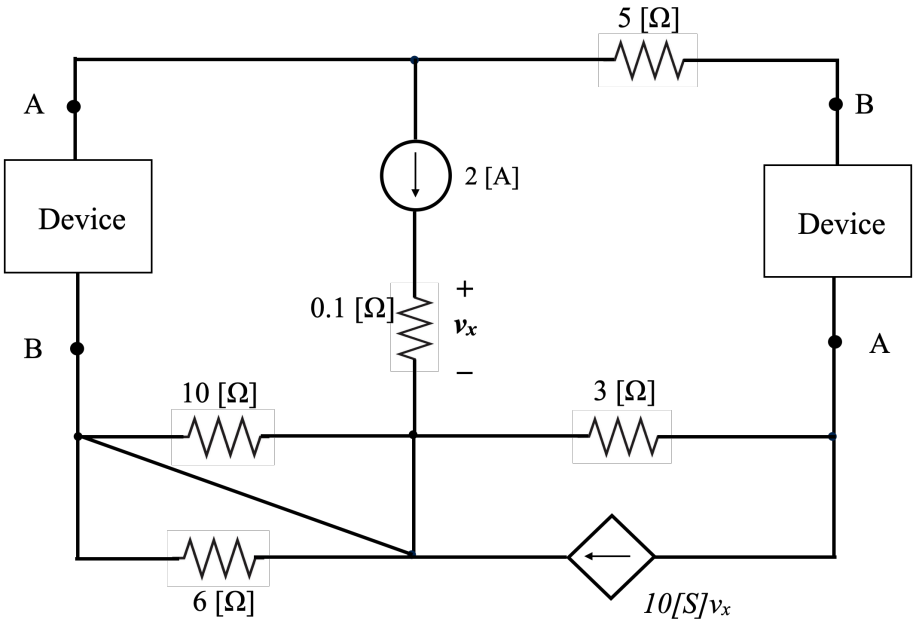
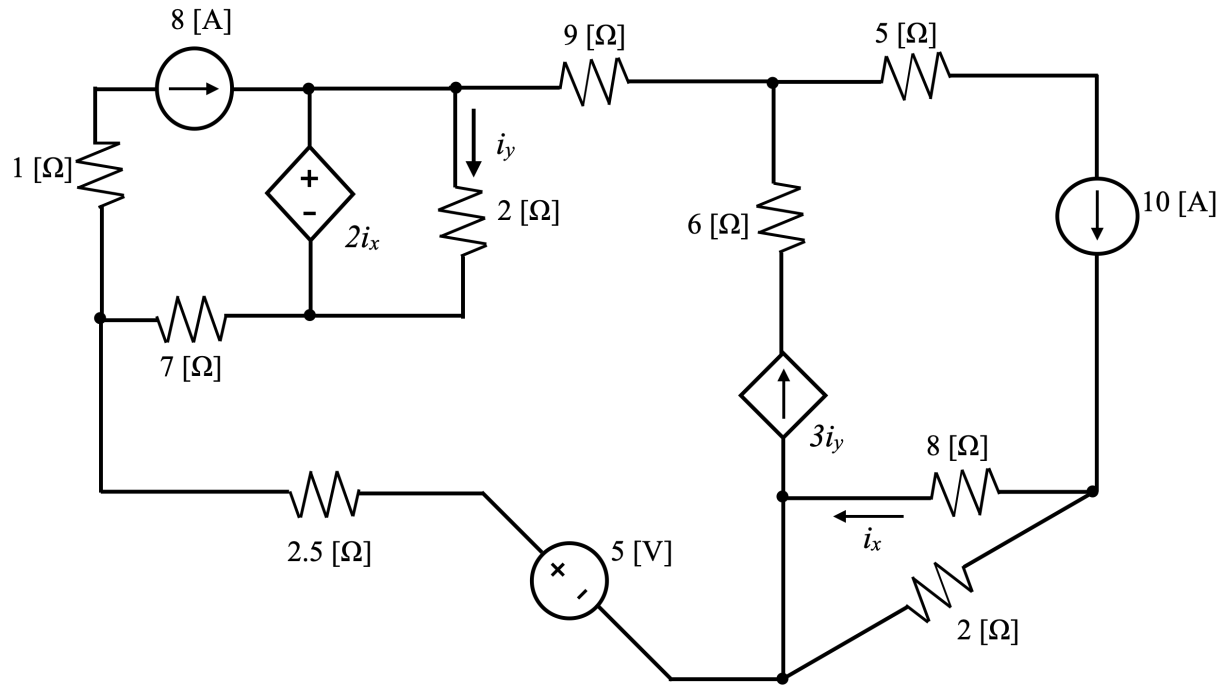



Figure 3.

Room for Extra Work

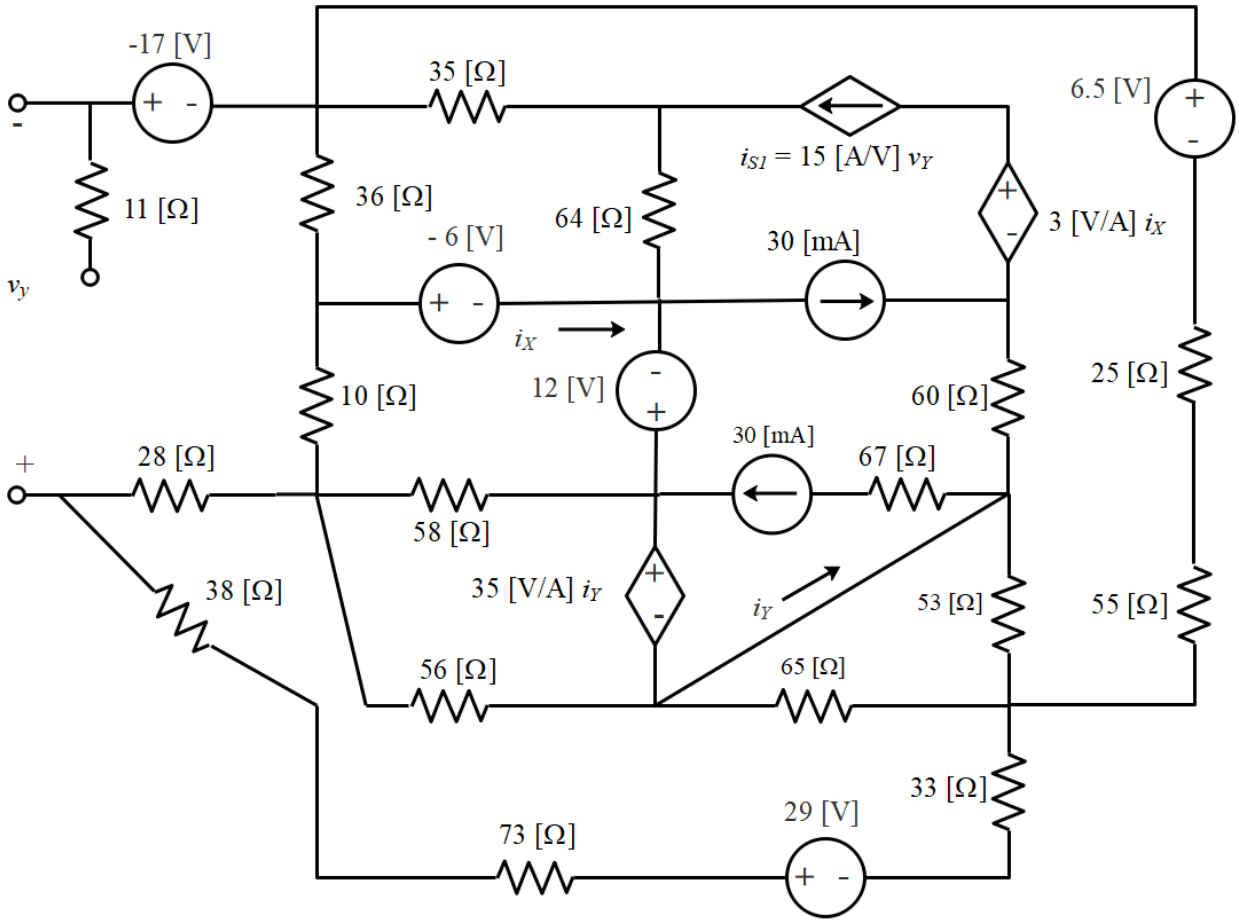
2. (35 points) For the circuit below, do the following.

a) Find the power delivered by the dependent current source 3iy.
b) Find the power delivered by the independent current source 8 [A].



Room For Extra Work

3. (35 points) Use the node voltage method to write a set of equations that could be used to solve the circuit below. Do not simplify the circuit. Do not solve the equations. Be sure to label all node voltages.



Room For Extra Work

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1. (30 points) A device can be modeled by a voltage source in series with a resistor. When a 2 [V] source is connected to the device output, 1 [A] current is measured, as shown in Fig. 1. When parallel resistors 12[Ω] and 4[Ω] are connected to the output, a current of 2.5[A] is measured in the 4[Ω] resistor, as shown in Figure 2.

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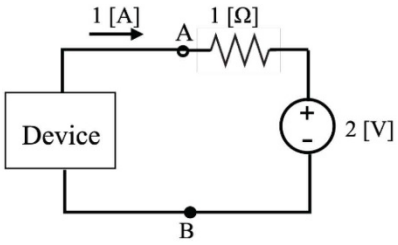


Figure 1.

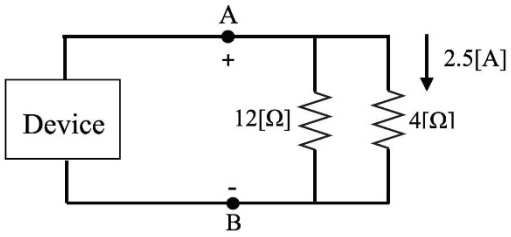


Figure 2.

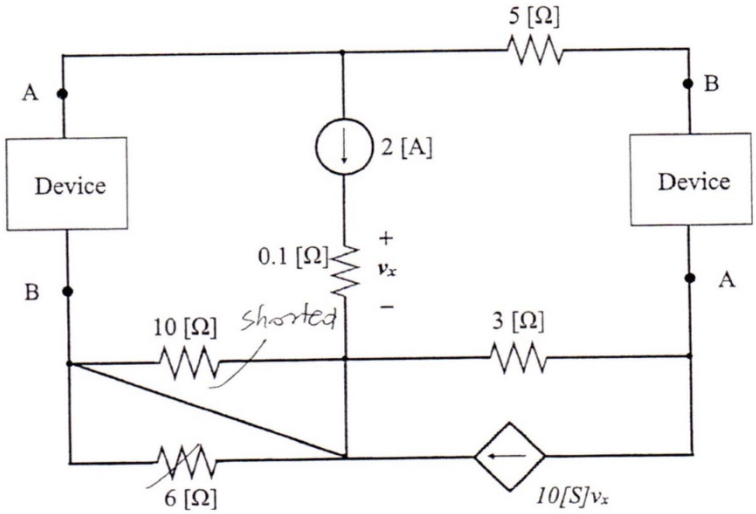


Figure 3.

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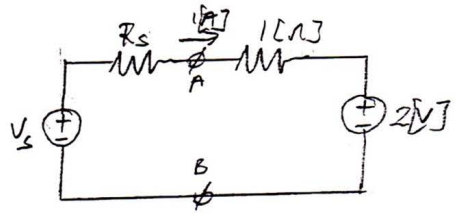
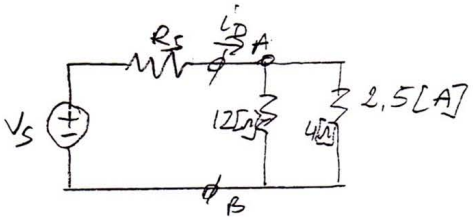
We start with the device model.




$$-V_S + i[A]\cdot R_S + 1[V] + 2[V] = 0$$

$$-v_S + i_D\cdot(R_S + 3[\Omega]) = 0$$

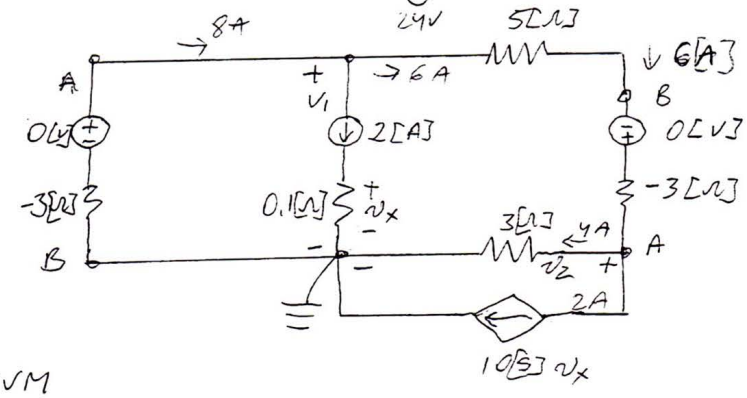



$$i_D = 2.5[A] + \frac{2.5[A]\cdot 4[\Omega]}{12[\Omega]} = 3.33[A]$$

$$-v_S + i_D\cdot R_S + i_D\cdot 12[\Omega] \parallel 4[\Omega] = 0$$

Solving (1) & (2) $v_S = 0$ $R_S = -3[\Omega]$

Negative resistance represents a device that has the ability of delivering power.




NVM

$$\frac{v_1}{-3[\Omega]} + 2[A] + \frac{v_1 - v_2}{5[\Omega] - 3[\Omega]} = 0$$

$$\frac{v_2}{3[\Omega]} + 10\,v_x + \frac{v_2 - v_1}{5[\Omega] - 3[\Omega]} = 0$$

$$v_x = 2[A]\cdot 0.1[\Omega] = 0.2[V]$$

Solve

$v_1 = 24[V]$

$v_2 = 12[V]$

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Room For Extra Work

$P_{del\ by\ 10[s]v_x} = v_2 \cdot 10[s] v_x = -24[W]$

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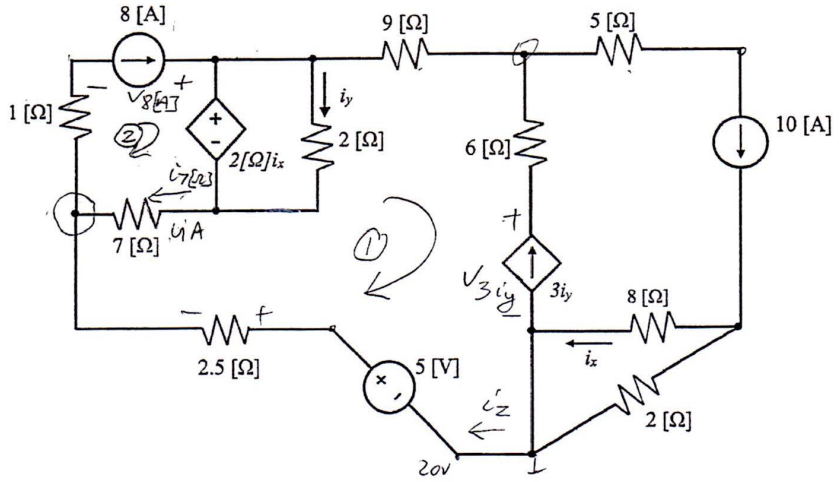
2. (35 points) For the circuit below, do the following.

a) Find the power delivered by the dependent current source 3iy.
b) Find the power delivered by the independent current source 8 [A].




We start with finding $i_x$ from CDR.

$$i_x = 10[A] \cdot \frac{2[\Omega]}{(8+2)[\Omega]} = 2[A]$$

To find power delivered by $3i_y$ use the following steps

$$i_y = \frac{2[\Omega]\, i_x}{2[\Omega]} = \frac{4[V]}{2[\Omega]} = 2[A]$$

$3i_y = 6[A]$ → then go to KVL ①

Need: $i_z = -3i_y + 10[A] = 4[A]$

$i_z + i_{7[\Omega]} = 8[A]$ → $i_{7[\Omega]} = 4[A]$

KVL ① $-5[V] + i_z \cdot 2.5[\Omega] - i_{7[\Omega]} \cdot 7[\Omega] - i_y \cdot 2[\Omega] + i_z\, 9[\Omega]$
$-3i_y \cdot 6[\Omega] + v_{3i_y} = 0$

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Room For Extra Work

$V_{3iy} = 27[V]$

$P_{del\ by\ 3iy} = 27[V] \cdot 6[A] = 162[W]$

(6) KVL ② for $P_{del\ by\ 8[A]}$

$2[\Omega] i_x + i_7 \cdot 7[\Omega] + 8[A] \cdot 1[\Omega] - V_{8[A]} = 0$

$V_{8[A]} = 40[V]$

$P_{del\ by\ 8[A]} = V_{8[A]} \cdot 8[A] = 320[W]$

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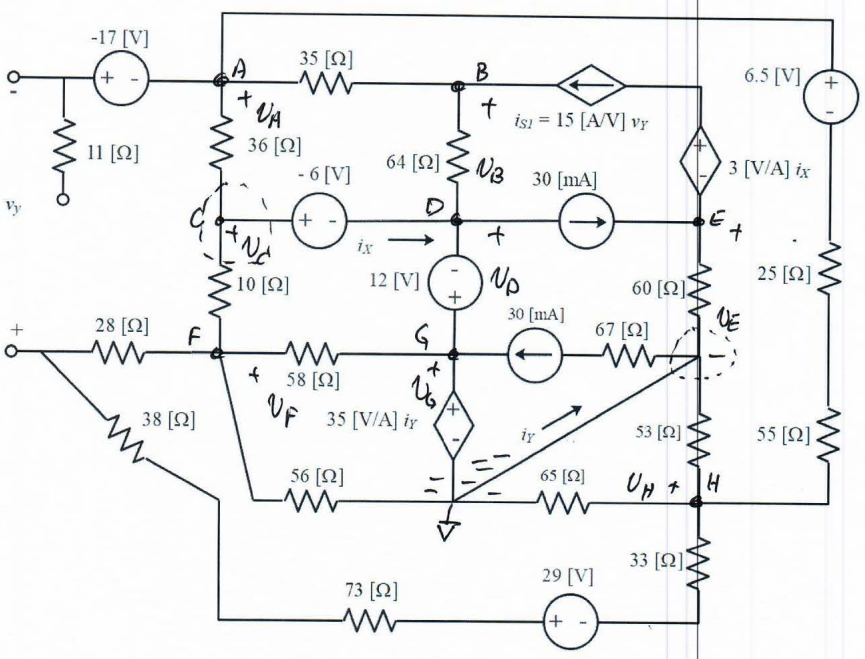
3. (35 points) Use the node voltage method to write a set of equations that could be used to solve the circuit below. Do not simplify the circuit. Do not solve the equations. Be sure to label all node voltages.




Answers will of course vary, depending on your choice of reference node and labeling.

+8 A: $\frac{v_A - v_C}{36} + \frac{v_A - v_B}{35} + \frac{v_H - v_H - 65}{25+55} = 0$

+8 B: $\frac{v_B - v_D}{64} - 15\left[\frac{A}{V}\right] v_y + \frac{v_B - v_A}{35} = 0$

+5 C: $v_C = -6\,[V] - 12\,[V] + 35\left[\frac{V}{A}\right] i_Y$ +3

+4 D: $v_D = -12\,[V] + 35\left[\frac{V}{A}\right] i_Y$

7 G: $v_G = 35\left[\frac{V}{A}\right] i_Y$

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+8 E: $-0.03 + \frac{v_E}{60} + 15\left[\frac{A}{V}\right] v_y$

+8 F: $\frac{v_F - v_C}{10} + \frac{v_F - v_G}{58} + \frac{v_F}{56} + \frac{v_F - v_H - 29}{33+73+38+28} = 0$

+8 H: $\frac{v_H}{65} + \frac{v_H}{53} + \frac{v_H - v_F + 29}{33+73+38+28} \Rightarrow + \frac{v_H - v_A + 6.5}{55+25} = 0$

auxiliaries:

+6 $v_y$: $v_y - 17[V] + v_A - v_F + \frac{v_F - v_H - 29}{33+73+38+28} \times 28 = 0$

+6 $i'_y$: $-i'_y + 0.03 - \frac{v_E}{60} - \frac{v_H}{53} = 0$

+6 $i_x$: $i_x + \frac{v_C - v_A}{36} + \frac{v_C - v_E}{10} = 0$