Name: _____ (please print)

Signature: _____

ECE 2201 –Exam 1
October 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.

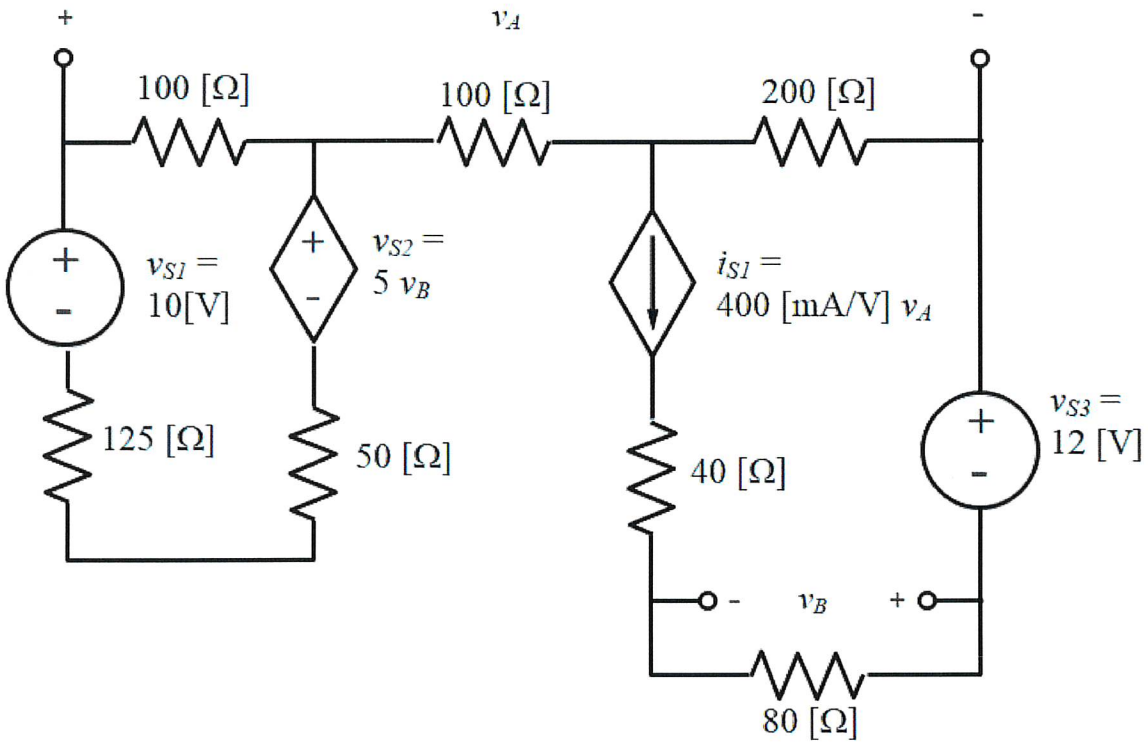
1. _____/30
2. _____/35
3. _____/35

Total = 100

Room for extra work

1. (30 points) For the circuit below, do the following.

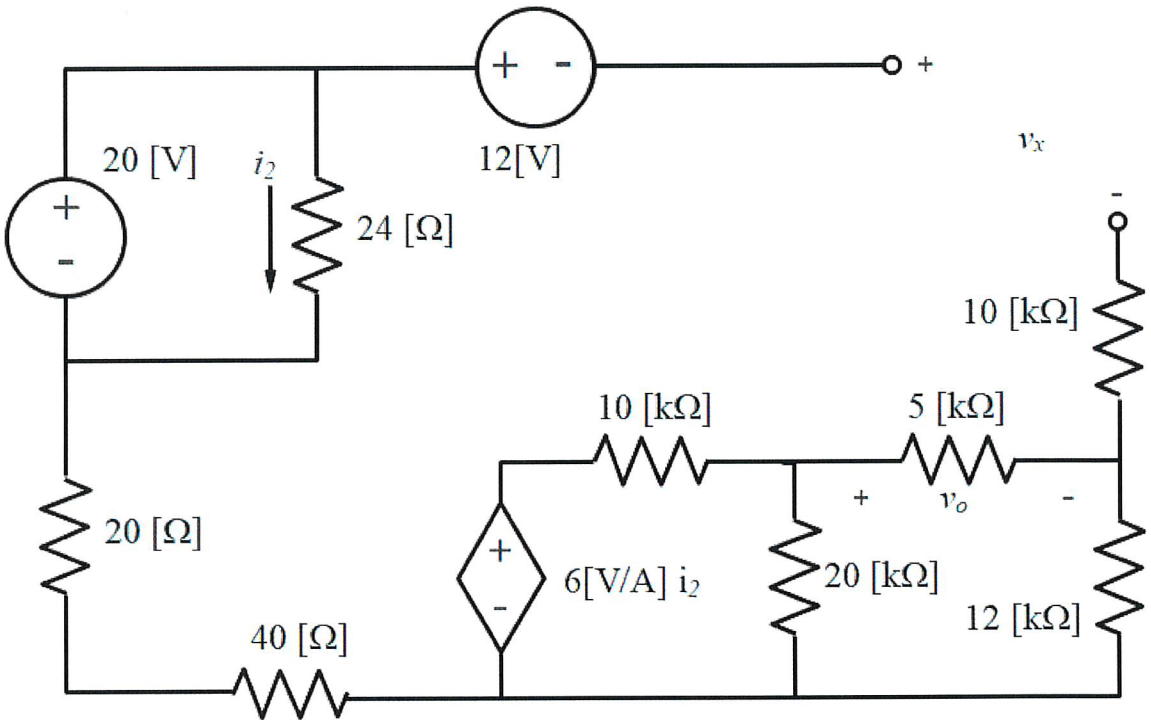
a) Find the power delivered by the dependent voltage source v_{S2}.
b) Find the power delivered by the dependent current source i_{S1}.



Room for Extra Work

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

a) Find the voltage v_x.
b) Find the voltage v_o.



Room for extra work

3. (35 points) Devices 1 and 2 are connected as shown in Figure 1. Device 1 delivers energy described by the time dependent function

$$W_{del\ by\ D1}(t) = t^3 - 2t^2$$

with W measured in [mJ]. The voltage across Device 1 is shown in Figure 2.

a) Find an expression for the power delivered by Device 1. Your expression should be a function of time.
b) Find the current $i_1(t)$. Make a neat plot of $i_1(t)$ for $t \leq 8$[s].
c) Determine the time intervals during which power is delivered by Device 1, and when power is absorbed by Device 1. Consider only $t \leq 8$[s].
d) Do electrons gain or lose energy as they pass through Device 2 at 7[s]?

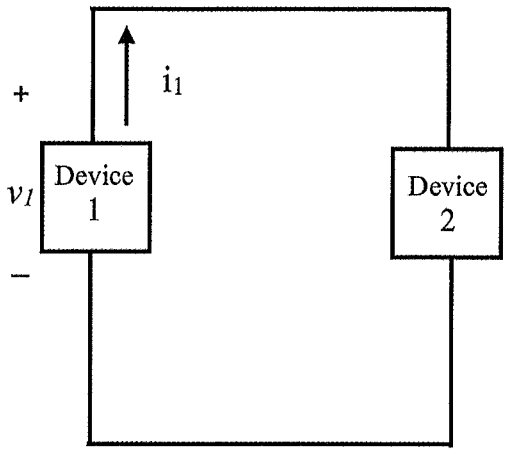


Figure 1.

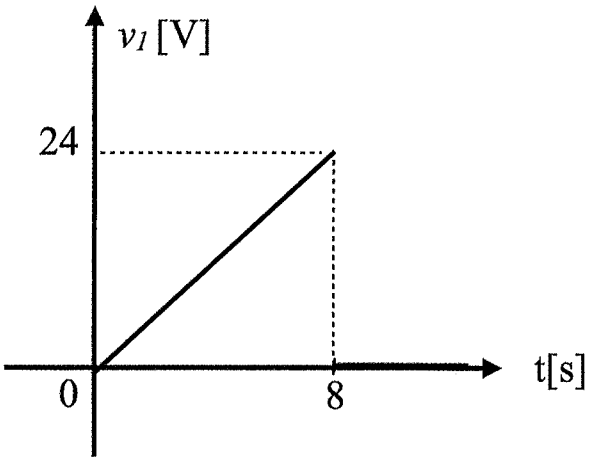
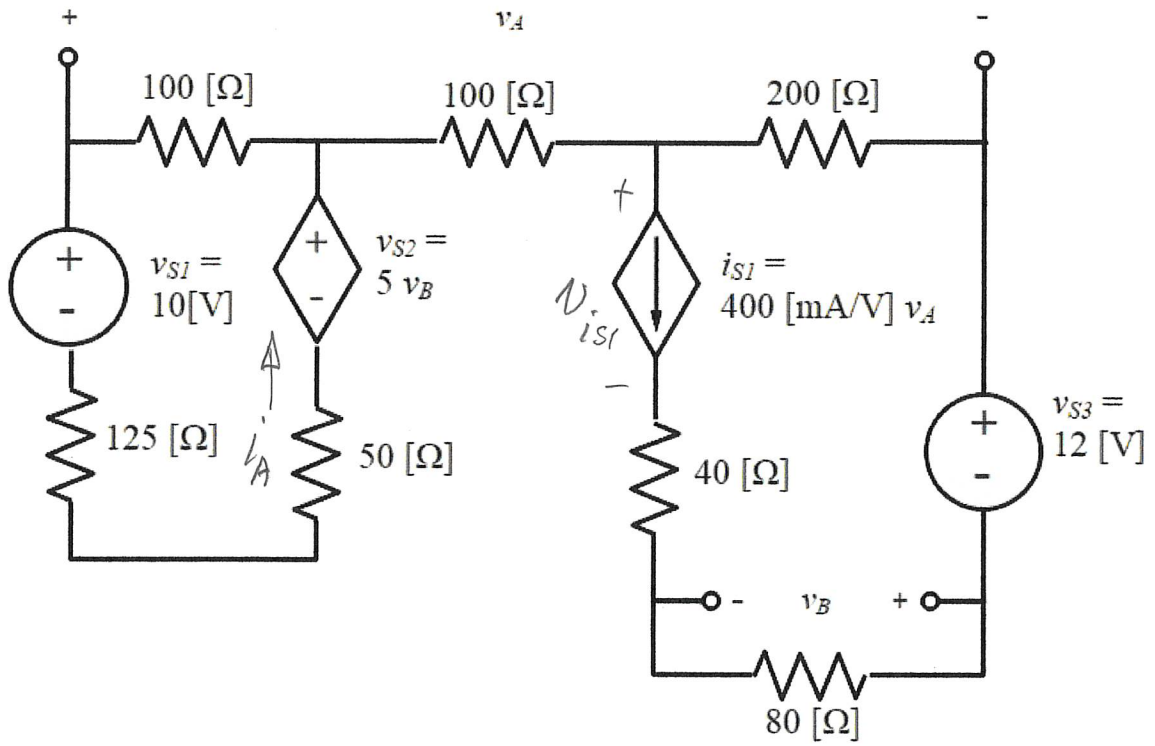


Figure 2.

Room for extra work

1. (30 points) For the circuit below, do the following.

a) Find the power delivered by the dependent voltage source v_{S2}.
b) Find the power delivered by the dependent current source i_{S1}.



$p_{del\ by\ v_{S2}} = v_{S2} \cdot i_A = 5 v_B \cdot i_A = 3,29\ [W]$ +3 +1

$p_{del\ by\ i_{S1}} = -v_{i_{S1}} \cdot i_{S1} = 0,536\ [W]$ +3 +1

+5 KVL: $10 + 125 i_A + 50 i_A - 5 v_B + 100 i_A = 0$ +3

(1) $10 + 275 i_A - 5 v_B = 0$

+3 (2) Ohm $v_B = -0,4 v_A \cdot 80$

+5 (3) KVL $v_A = -100 i_A - 200(0,4 v_A)$

$i_A = -129,1\ [mA]$

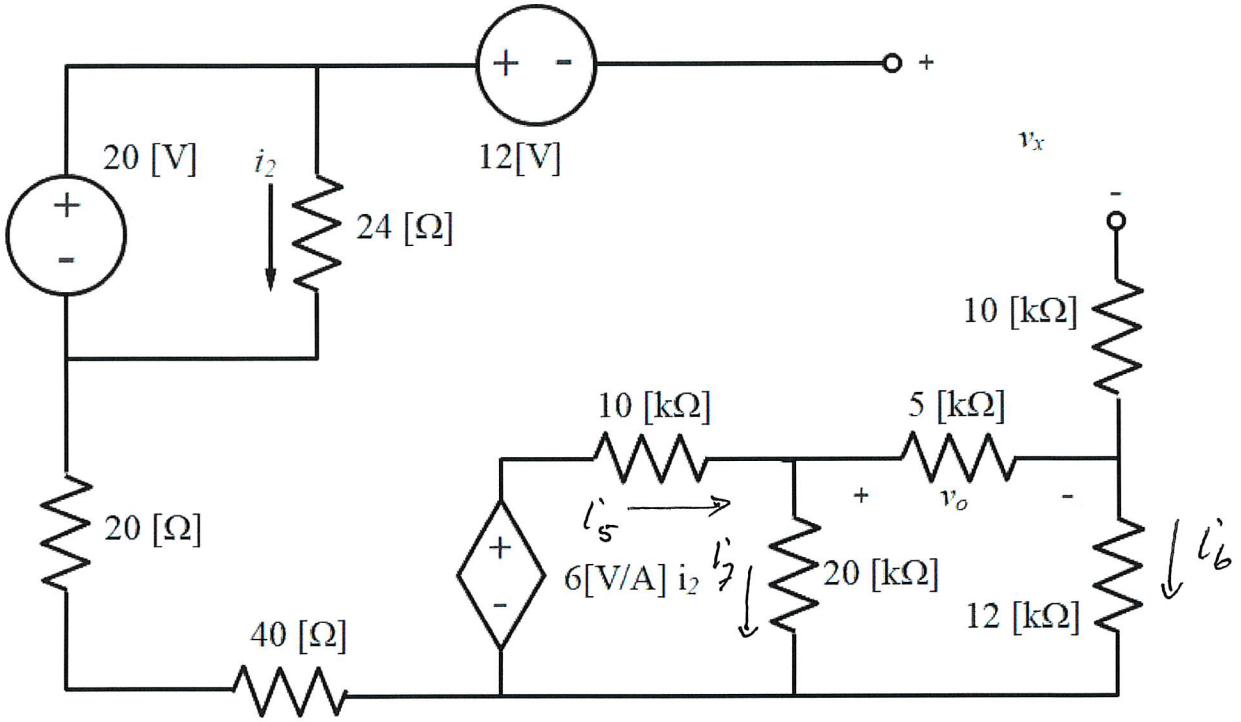
$v_A = 159,4\ [mV]$

$v_B = -5,10\ [V]$

+5 $v_{i_{S1}} + 320(0,4 v_A) - 12 = 0 \Rightarrow v_{i_{S1}} = -8,40\ [V]$ +1

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

a) Find the voltage v_x.
b) Find the voltage v_o.



$$i_2' = \frac{20\,[V]}{24\,[\Omega]} = 0.833\,[A]$$

KCL: $i_5' = i_6' + i_7'$

KVL: $-6i_2' + 10000\,i_5' + 20000\,i_7' = 0$

KVL: $-20000\,i_7' + 5000\,i_6' + 12000\,i_6' = 0$

$$\begin{cases} i_5' = 2.606 \times 10^{-4}\,[A] \\ i_6' = 1.408 \times 10^{-4}\,[A] \\ i_7' = 1.197 \times 10^{-4}\,[A] \end{cases}$$

$$v_o = 5000\,i_6' = 0.704\,[V]$$

v_x: $v_x + 12000\,i_6' - 20 + 12 = 0$

$$v_x = 6.3\,[V]$$

3. (35 points) Devices 1 and 2 are connected as shown in Figure 1. Device 1 delivers energy described by the time dependent function

$$W_{del\ by\ D1} = t^3 - 2t^2$$

with W measured in [mJ]. The voltage across Device 1 is shown in Figure 2.

a) Find an expression for the power delivered by Device 1. Your expression should be a function of time.
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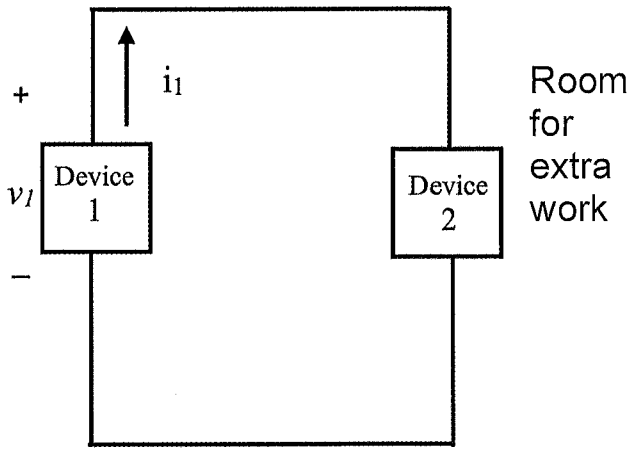


Figure 1.

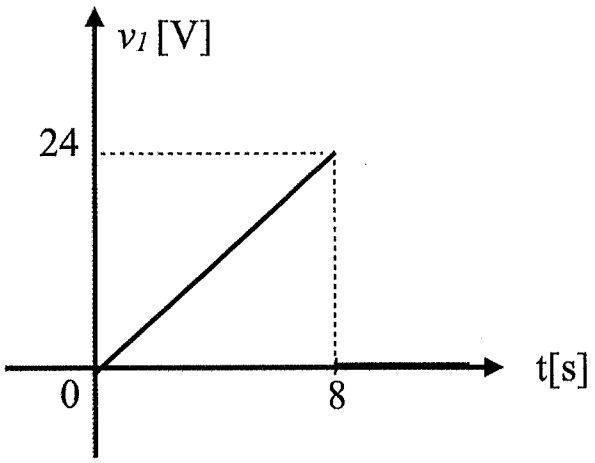


Figure 2.

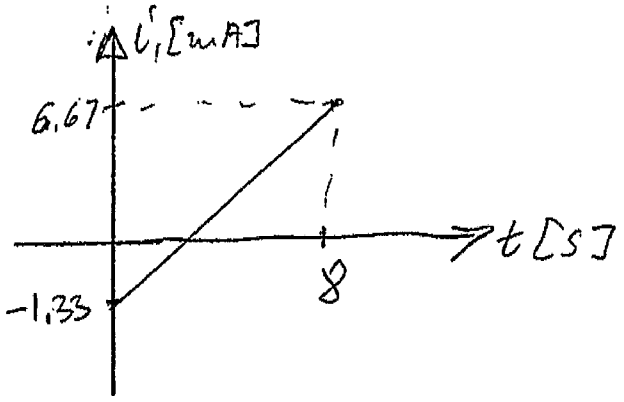
a) Power delivered by Device 1

$$p(t) = \frac{dW}{dt} = 3t^2 - 4t$$

b) $$i_1(t) = \frac{p(t)}{v_1(t)}$$

From Fig. 2 $$v_1(t) = \frac{24[V]}{8[s]} \cdot t = 3[V/s] \cdot t$$

so $$i_1(t) = \frac{3t^2 - 4t}{3t} = 1\left[\frac{mA}{s}\right] \cdot t - 1.33[mA]$$



c) From the schematic, power will be delivered by Device 1 if $i_1 > 0$ & $v_1 > 0$.

To find $i_1(t) > 0$

$$i_1(t_0) = 1\left[\frac{mA}{s}\right] \cdot t_0 - 1.33\,[mA] = 0$$

$$t_0 = 1.33\,[s]$$

$P_{ABS\ by\ D_1}$ $\quad t < 1.33\,[s]$

$P_{Del\ by\ D_1}$ $\quad t > 1.33\,[s]$

d) The voltage on Device 2 is the same as on Device 1. From current direction in Device 2 we can conclude that Device 2 absorbs power @ 7[s]. So electrons lose energy as they pass through.