Name: _____ (please print)

Signature: _____

ECE 2201 – Midterm Exam
June 22, 2021
Online

1. This quiz is open book, open notes. You may not work with another person or try to obtain the answer to the quiz online.
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 quiz 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 quiz.

1. _____/30

2. _____/30

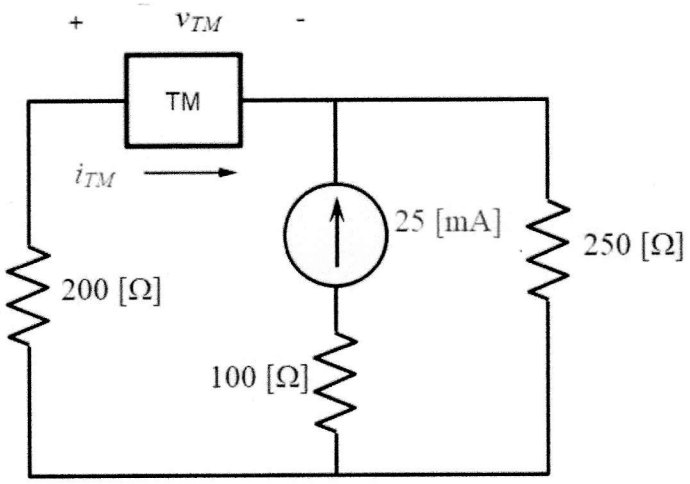
3. _____/40

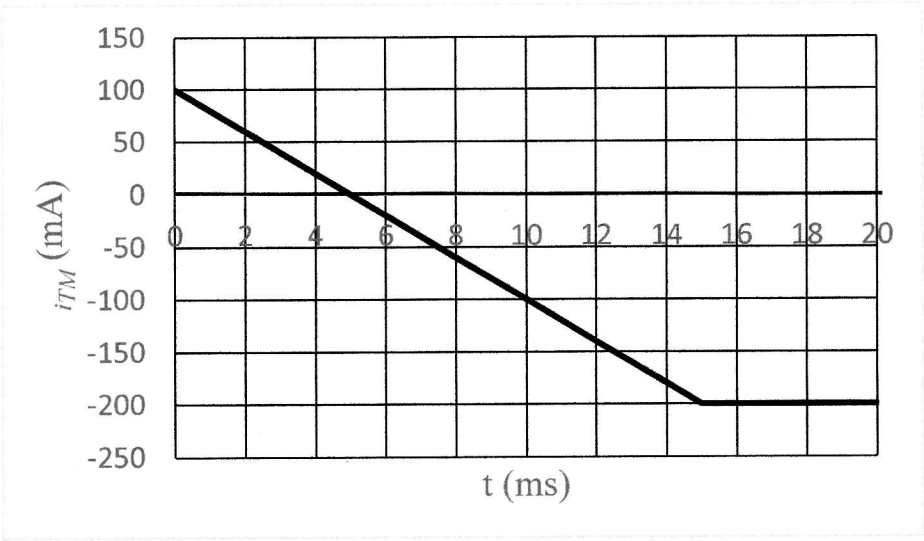
Total_____/100

Room for extra work

1. (30 points) A revolutionary new device called the TrombettaMax C3P0 (TM) is installed in the circuit below. The graph shows the current produced by the TrombettaMax as a function of time.

a) Find the voltage v_{TM} at t = 0.01 [s].
b) Find the energy delivered to the 250 [Ω] resistor over the time period 2 [ms] to 18 [ms].

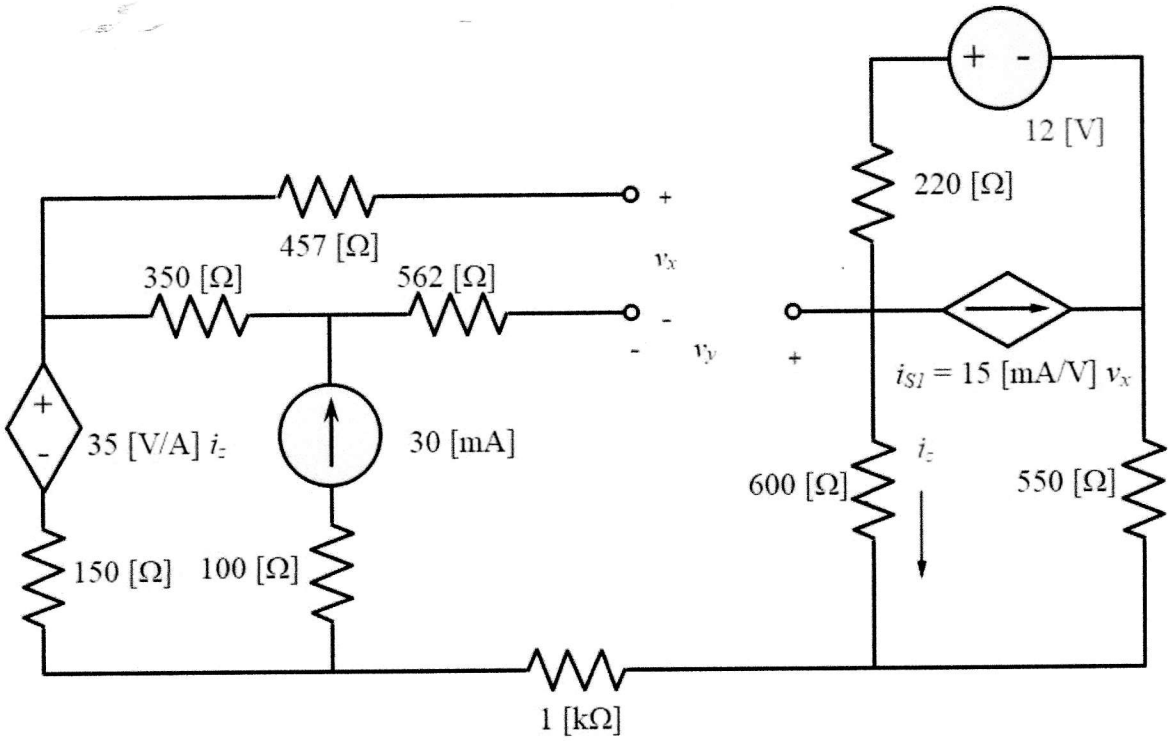




Room for extra work

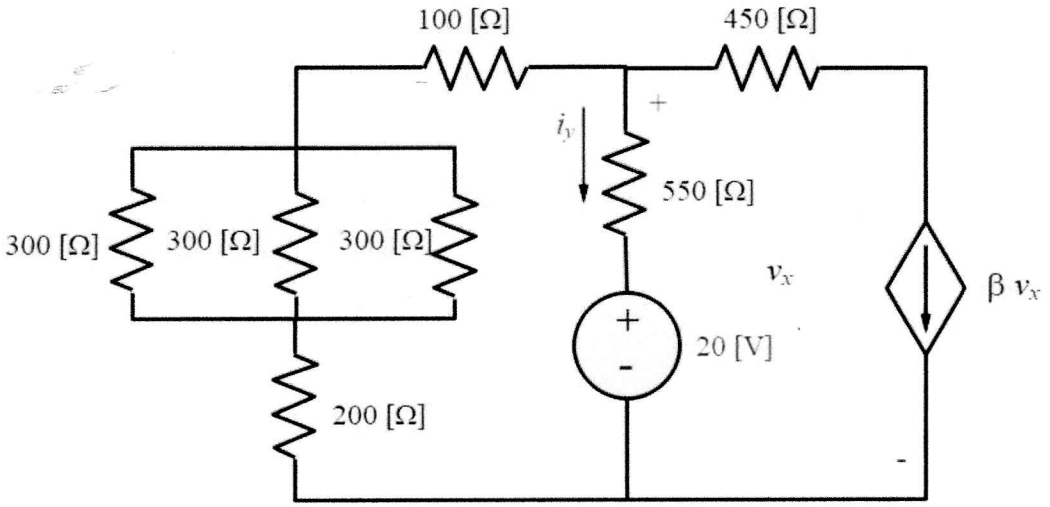
2. (30 points) For the circuit below, do the following.

a) Find the power delivered by the dependent current source.
b) Find v_y.



Room for extra work

3. (40 points) The value of i_y is known to be -35.53 [mA]. Find the value of the dependent current source parameter β. Be sure to include any units associated with β.



Room for extra work

1. (30 points) A revolutionary new device called the TrombettaMax C3P0 (TM) is installed in the circuit below. The graph shows the current produced by the TrombettaMax as a function of time.

a) Find the voltage v_{TM} at t = 0.01 [s].
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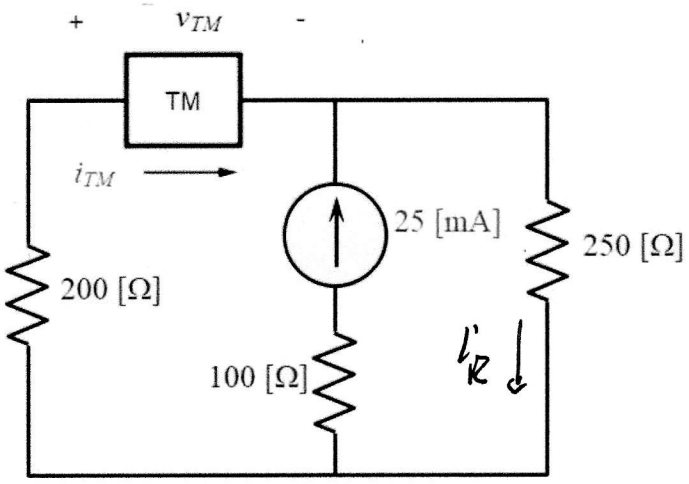

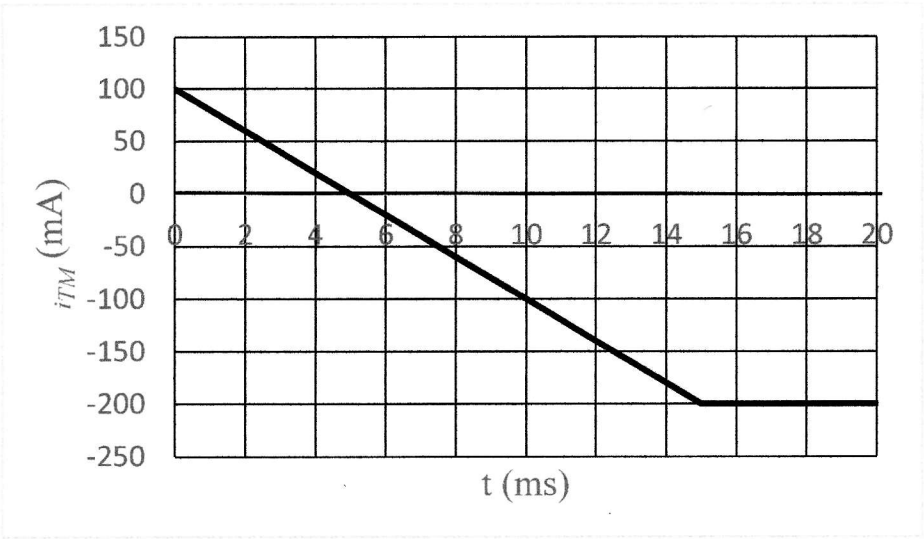

a) $i'_{TM}(t) = 100\,[mA] - 20\left[\frac{mA}{ms}\right]t \qquad 0 < t \leq 15\ [ms]$

$i'_{TM}(t) = -200\,[mA] \qquad t \geq 15\ [ms]$

+5

Room for extra work

$$v_{TH} + i'_{TH}(250+200) + 250(25) = 0$$

+6 $$v_{TH} = -450\, i'_{TH} - 25 \cdot 250$$

+2 $$v_{TH}(10[ms]) = -450(100 - 20t)\Big|_{10[ms]} - 25 \cdot 250$$

+2 Units: $mV = \Omega \cdot mA$

$$\underline{v_{TH}(10[ms]) = 38750\,[mV] = 38.75\,[V]}$$

b) $$i'_R = i'_{TH} + 25\,[mA] = (25\,[mA] - 20\,[\tfrac{mA}{ms}]t \quad 0 \le t \le 15[ms]$$

$$i'_R = -200 + 25 = -175\,[mA] \quad t \ge 15[ms]$$

+2 +3 $$W_{abs\ by\ 250[\Omega]} = 250 \int_{2[ms]}^{15[ms]} (125 - 20t)^2\, dt + 250 \int_{15[ms]}^{18[ms]} (-175)^2\, dt$$

Units +2 $nJ = \Omega \cdot (mA)^2 \cdot (ms)$

+3 $$W_{abs\ by\ 250\ [\Omega]} = 2.489 \times 10^7 + 2.2969 \times 10^7 \quad [nJ]$$

$$= 4.7859 \times 10^7\,[nJ] = 47.859\,[mJ]$$

2. (30 points) For the circuit below, do the following.

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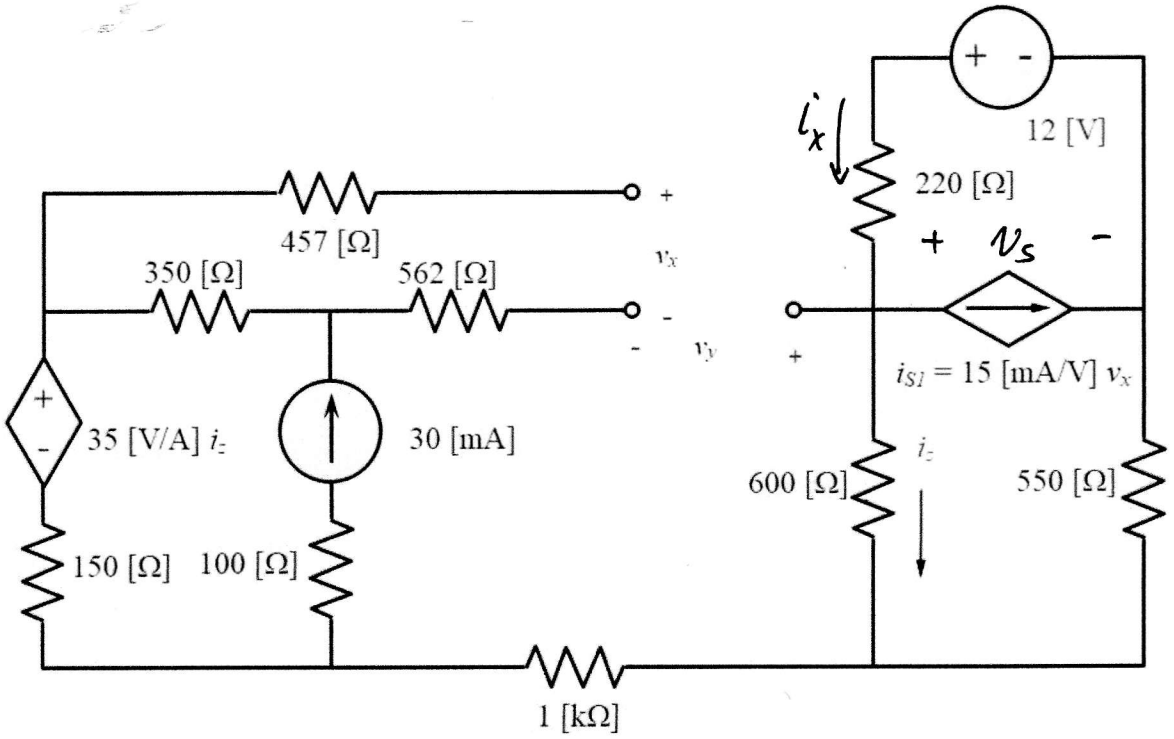
b) Find v_y.



a) we will need v_s...

+4 $-12 + 220\, i_x' + 1150\, i_z' = 0$

+4 $i_x' = i_z' + 0.015\, v_x$

$\Rightarrow$ $i_x' = -123.45$ [mA] +2

$i_z' = 34.051$ [mA]

+3 +1 $v_x + 350(0.03) = 0 \Rightarrow v_x = -10.5$ [V]

+3 +1 $-12 + 220\, i_x' + v_s = 0 \Rightarrow v_s = 39.159$ [V]

+3 +1 $P_{del\ by\ DCS} = -v_s \cdot i_{s1} = -39.159 \cdot 0.015\,(-10.5)$

$= 6.167$ [W]

Room for extra work

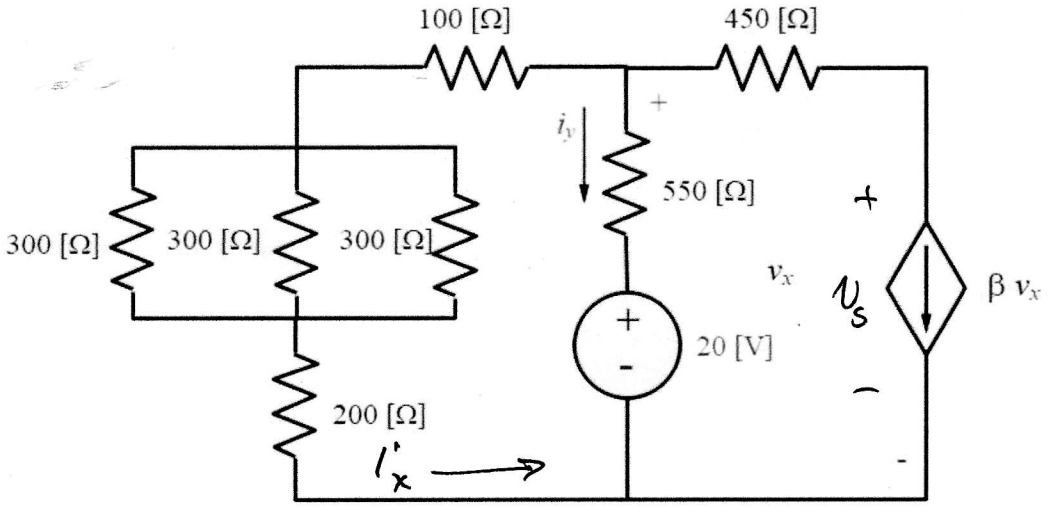
+7 $-v_y + 600(i_z') - 150(0.03) - 35(i_z') - 350(0.03) = 0$

$v_y = (600 - 35)\, i_z' - (150 + 350)\, 0.03$

$\boxed{v_y = 4.2388 \text{ [V]}}$

+1

3. (40 points) The value of i_y is known to be -35.53 [mA]. Find the value of the dependent current source parameter β. Be sure to include any units associated with β.



+2 $300\Omega \,//\, 300\Omega \,//\, 300\Omega = 100\ [\Omega]$

+6 $i'_x + i'_y + \beta v_x = 0$

+8 $(100 + 100 + 200)\, i'_x - 20 - 550\, i'_y = 0$

+8 $450 \cdot \beta v_x + v_s - 20 - 550\, i'_y = 0$

+8 $v_x = 450\, \beta v_x + v_s$

Given $i'_y = -0.03553$ [A]

Solve: $i'_x = 1.146$ [mA]

+5 $v_x = 0.4585$ [V]

$v_s = -15.01$ [V]

units: +3 $\beta = 75 \left[\frac{mA}{V}\right]$