Name: _____ (please print)

Signature: _____

ECE 2300 – Midterm Exam
July 3, 2014

Keep this quiz closed and face up 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 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.

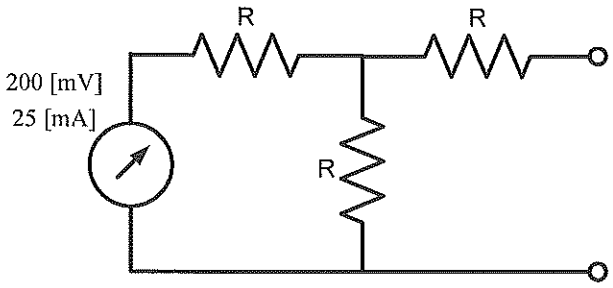
_____/30

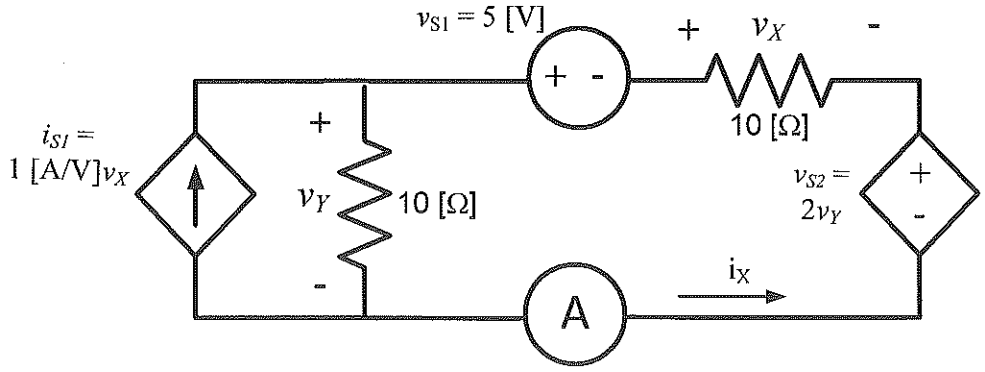
_____/35

_____/35

Room for extra work

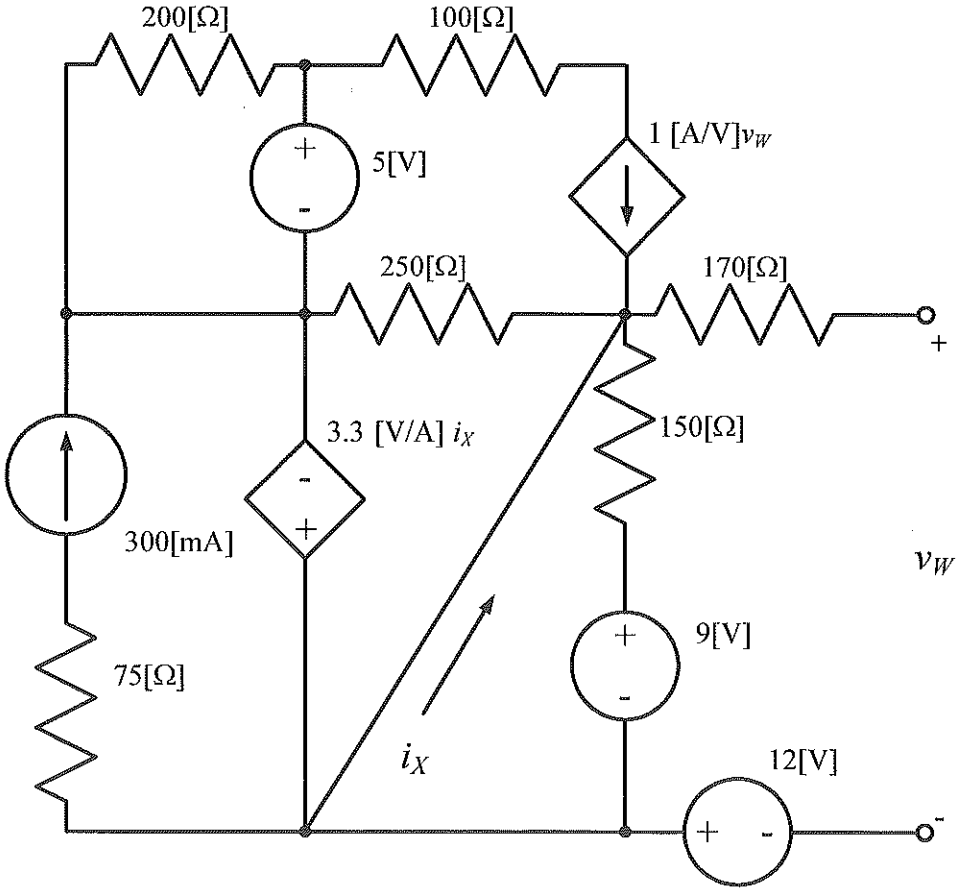
1. (30 points) The d'Arsonval-based ammeter shown in the figure on the left is inserted into the circuit on the right to measure the current i_X. In the circuit, the ammeter is indicated as a circle labeled "A". The resistors R are chosen so that the ammeter can read a full-scale current of 250 [mA]. What does the ammeter read?





Room for extra work

2. (35 points) In the circuit below, find the power delivered by the dependent voltage source.



Room for Extra Work

3. (35 points) The device D in Figure 1 below can be modeled by a current source in parallel with a resistance. When the resistor shown in Figure 2 is connected to the terminals a), b), the current i_R is - 46.31 [A]. When the voltage source and resistance shown in Figure 3 are connected, the power delivered by the voltage source is 47.69 [kW].

i) Draw the current source and resistance. Clearly label their values and the terminals a), b).
ii) How much power would be delivered to a 1 [kΩ] resistor connected at terminals a), b)?

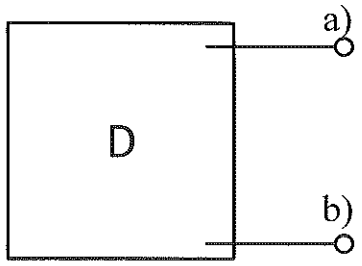


Figure 1

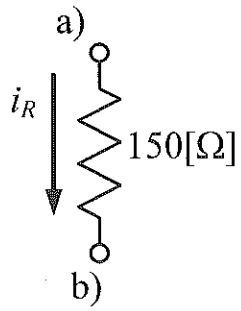


Figure 2

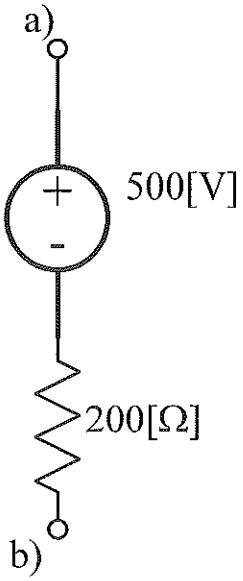


Figure 3

Room for Extra Work

Name: _____ (please print)

Signature: _____

ECE 2300 – Midterm Exam
July 3, 2014

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

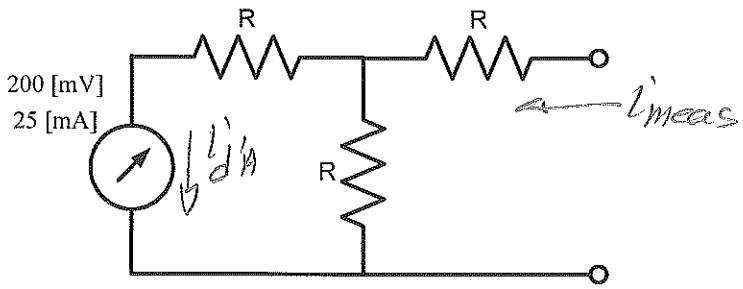
1. This exam is closed book, closed notes. You may use one 8.5" x 11" crib sheet, or its equivalent.
2. Show all work on these pages. Show all work necessary to complete the problem. A solution without the appropriate work shown will receive no credit. A solution which is not given in a reasonable order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

_____/30

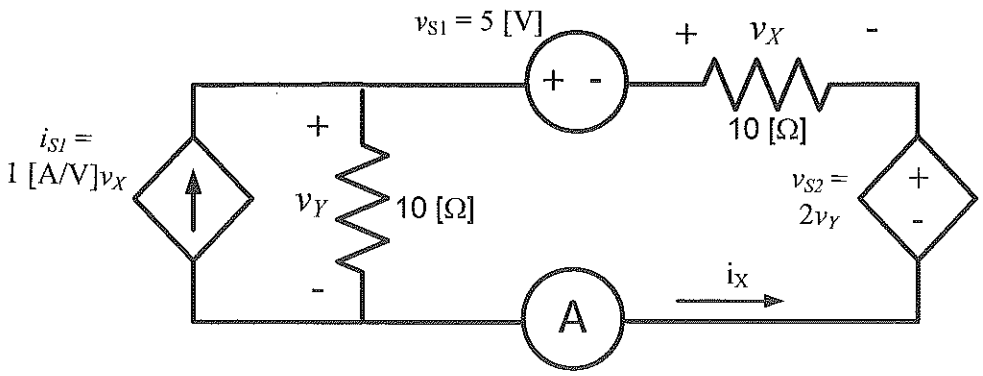
_____/35

_____/35

1. (30 points) The d'Arsonval-based ammeter shown in the figure on the left is inserted into the circuit on the right to measure the current i_X. In the circuit, the ammeter is indicated as a circle labeled "A". The resistors R are chosen so that the ammeter can read a full-scale current of 250 [mA]. What does the ammeter read?



$R_{d'A} = 8\ [\Omega]$

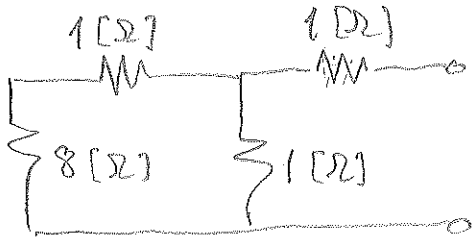


Assuming current enters the ammeter as shown, we have CDR:

$$i'_{d'A} = i'_{meas} \cdot \frac{R}{R + R_{d'A}}$$ so that at full scale

$$0{,}025 = 0{,}250 \ \frac{R}{R+8} \Rightarrow R = 1\ [\Omega]$$

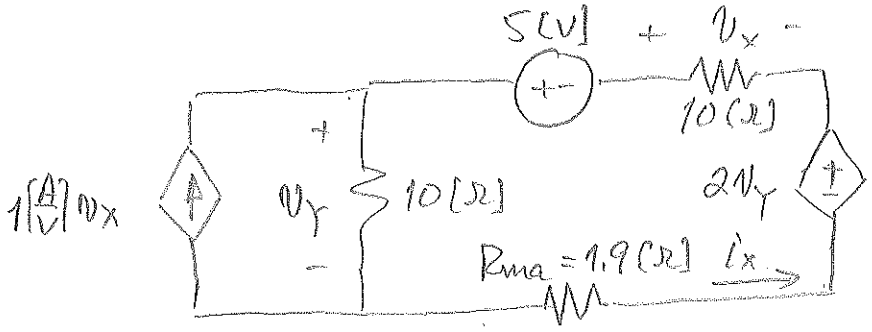
So our meter looks like



$\rightarrow R_{ma} = 1 + 1/\!/9 = 1{,}9\ [\Omega]$

Room for extra work

Re-drawing with the meter in place...



NVM: $\frac{v_y}{10} - 1 \cdot v_x + \frac{v_y - 2v_y - 5}{11.9} = 0$

$v_x = \frac{v_y - 2v_y - 5}{11.9} \cdot 10$

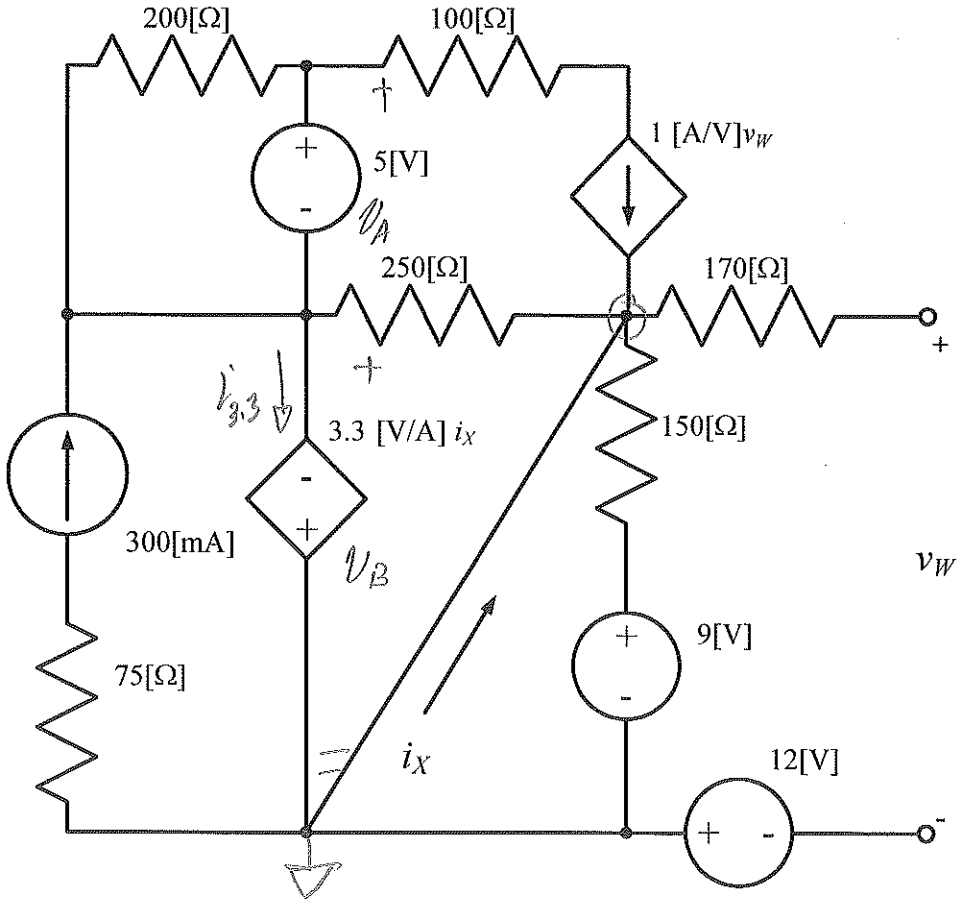
$v_y = -4.416$ [V]

$v_x = -0.4907$ [V]

$\therefore \quad i'_x = -\frac{v_x}{10} = 49.07$ (mA)

This is what the meter reads.

2. (35 points) In the circuit below, find the power delivered by the dependent voltage source.



We will do this using both NVM and MCM...

NVM

(A) $v_A = 5 + v_B$

(B) $v_B = -3.3\, i_X$

(i_X) $-\frac{v_A}{250} - i_X - 1 \cdot v_W - \frac{9}{150} = 0$

(v_W) $v_W = 12$ [V]

Soln: $v_A = 45.40$ [V]

$v_B = 40.40$ [V]

$i_X = -12.24$ [A]

$v_W = 12$ [V]

Room for Extra Work

$$P_{\text{del by } 3.3i_x} = i'_{3.3} \cdot 3.3\, i_x$$

KCL

$$-i'_{3.3} + 0.3 + i_x + \frac{9}{150} = 0 \Rightarrow i'_{3.3} = -11.88 \text{ [A]}$$

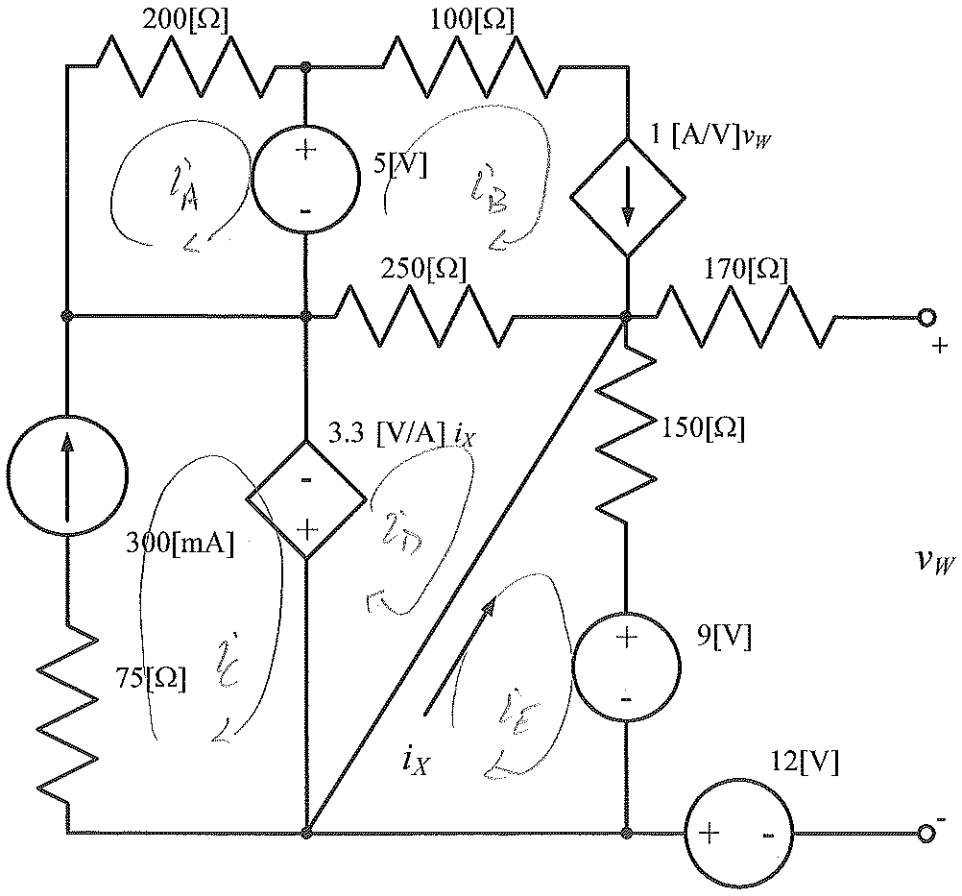
$$P_{\text{del by } 3.3i_x} = (-11.88)(3.3)(-12.24)$$
$$= 479.9 \text{ [W]}$$

- from MCM

$$P_{\text{del by } 3.3i_x} = 3.3 i_x (i'_c - i'_b)$$
$$= 3.3(-12.22)(0.3 - 12.16)$$
$$= 478.3 \text{ [W]}$$

This is the same answer to within round-off error.

2. (35 points) In the circuit below, find the power delivered by the dependent voltage source.



(A) $200\,i'_A + 5 = 0 \Rightarrow i'_A = 25\ [mA]$

(B) $i'_B = 1 \cdot v_W$ (Vb) $v_W = 12\ [V]$

$\Rightarrow i'_B = 12\ [A]$

(C) $i'_C = 0.3\ [A]$

(D) $250\,(i'_D - i'_B) + 3.3\,i'_X = 0$

(E) $150\,i'_E + 9 = 0$

$\Rightarrow i'_E = -60\ [mA]$

(ix) $i'_x = i'_E - i'_D$

$i'_A = 25\ [mA]$

$i'_B = 12\ [A]$

$i'_C = 0.3\ [A]$

$i'_D = 12.16\ [A]$

$i'_E = -60\ [mA]$

$i'_x = -12.28\ [A]$

$v_W = 12\ [V]$

to pg.6

3. (35 points) The device D in Figure 1 below can be modeled by a current source in parallel with a resistance. When the resistor shown in Figure 2 is connected to the terminals a), b), the current i_R is - 46.31 [A]. When the voltage source and resistance shown in Figure 3 are connected, the power delivered by the voltage source is 47.69 [kW].

i) Draw the current source and resistance. Clearly label their values and the terminals a), b).
ii) How much power would be delivered to a 1 [kΩ] resistor connected at terminals a), b)?

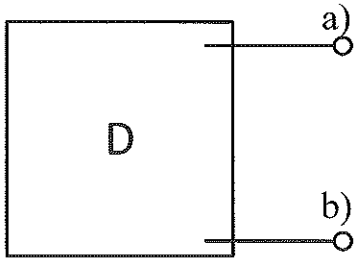


Figure 1

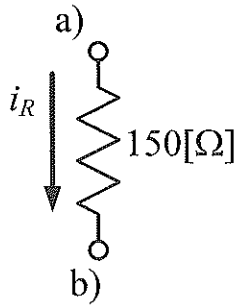


Figure 2

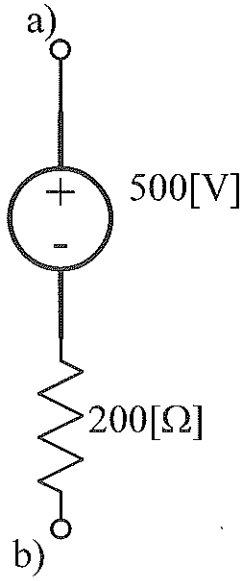
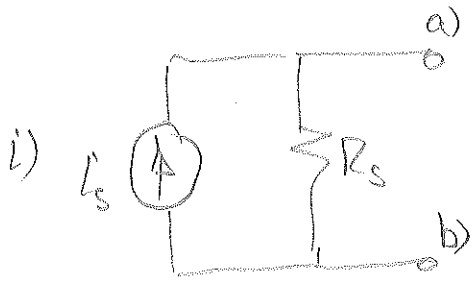


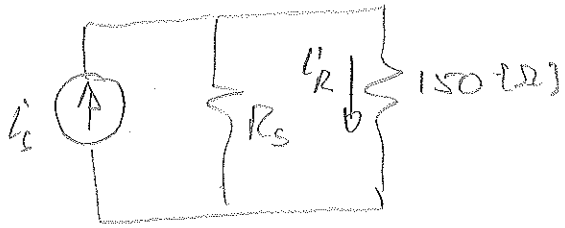
Figure 3

i)



$i_s = -17$ [A]

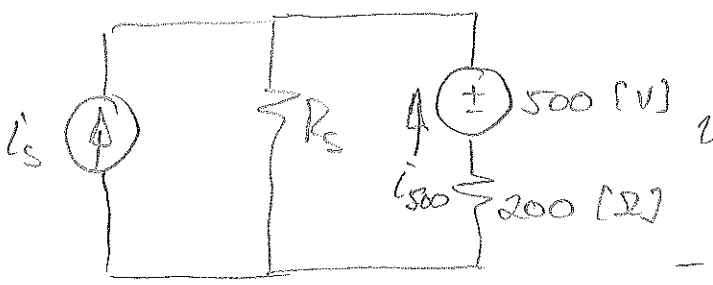
$R_s = 237$ [Ω]



(1)

$$-46.31 - i_s + \frac{150(-46.31)}{R_s} = 0$$

Room for Extra Work



$v_{500} = 500 - 200\, i'_{500} = -18576$ [V]

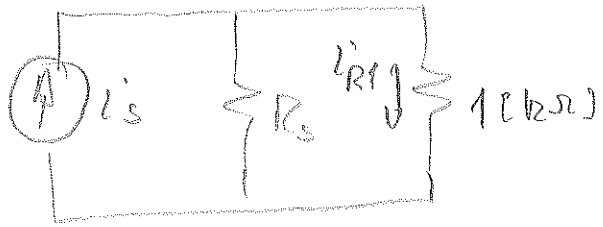
Pdel by 500 [V] $= 47690 = 500 \cdot i'_{500} \Rightarrow i'_{500} = 95.38$ [A]

② $\quad -95.38 - i'_s + \dfrac{(-18576)}{R_s} = 0$

Solving ① and ② gives

$i'_s = -17$ [A] $\qquad R_s = -237$ [Ω]

11)



$i'_{R1} = -17 \cdot \dfrac{R_s}{R_s + 1000}$

$= 5.2805$ [A]

Pdel to 1kΩ $= i'^{2}_{R1} \cdot 1000 = 27.883$ [kW]