Name: _____ (please print)

Signature: _____

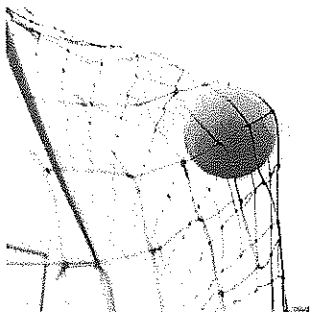
ECE 2300 – Quiz #3
June 26, 2014

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

1. This quiz 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 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 30 minutes to work on this quiz.

_____/25

Clint Dempsey (US Men's Team)



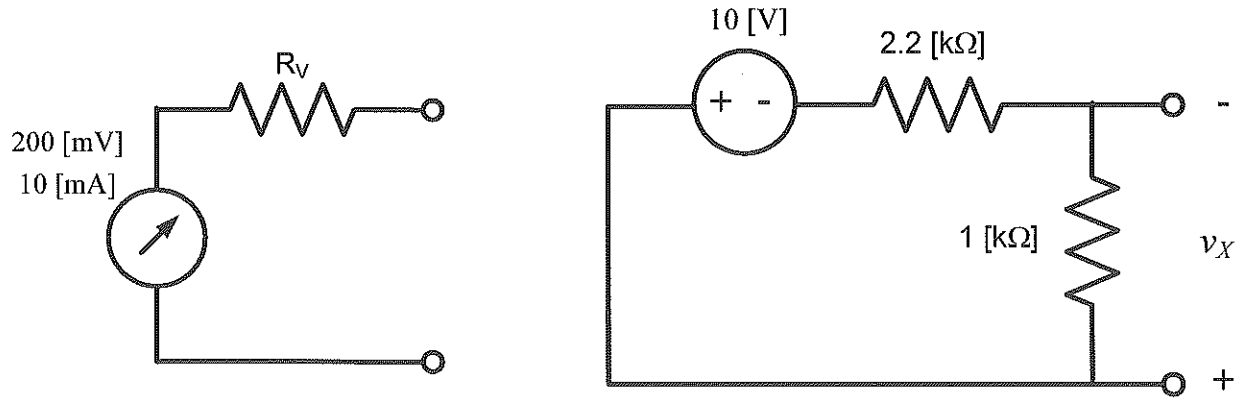
German goal

When the d'Arsonval-based voltmeter shown in the figure on the left is used to measure the voltage v_X in the circuit on the right, it is found that the error in the measurement is - 3.78%. The error is defined as

$$error = \frac{v_{x,meas} - v_{x,true}}{v_{x,true}} x100\%$$

where $v_{x,meas}$ is the measured value and $v_{x,true}$ is the value *without* the meter in place.

a) What is the full-scale range of the voltmeter?
b) If the full-scale range of the voltmeter doubles, what is the error in the measurement?



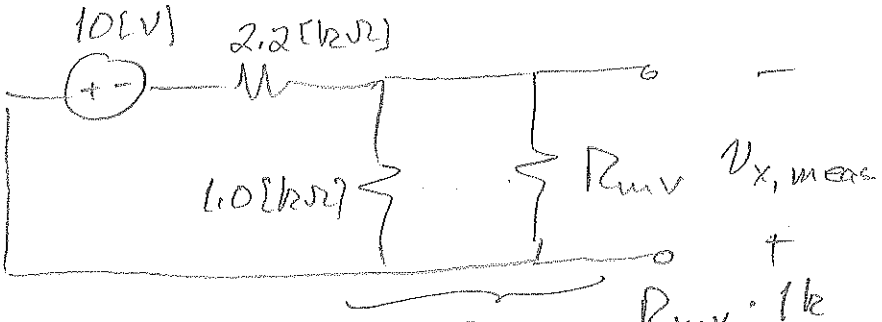
a) From the information given, we can find the meter resistance R_{mv}. From there we can find the full-scale reading.

$$v_{x,true} = 10 \frac{1k}{1k + 2.2k} = 3.125 \text{ [V]}$$

$$\frac{v_{x,meas} - v_{x,true}}{v_{x,true}} = -0.0378 \Rightarrow v_{x,meas} = 3.0069 \text{ [V]}$$

With the meter in place we have ...

Room for extra work



$$V_{x,meas} = 10 \frac{R_{eq}}{R_{eq} + 2.2k} = 3.0069 \Rightarrow R_{eq} = 0.94596\ [k\Omega]$$

$$\frac{R_{mv} \cdot 1k}{R_{mv} + 1k} = 0.94596\ [k\Omega] \Rightarrow R_{mv} = 17.505\ [k\Omega]$$

$$V_{meas,fs} = R_{mv} \cdot I_{DA,fs} = 17505 \times 0.01 = 175.05\ [V]$$

Assuming there was round-off error, the full-scale range is

$$\boxed{V_{meas\,fs} = 175\ [V]}$$

b) If $V_{meas,fs} = 350\ [V]$, then $R_{mv} = \frac{350}{0.01} = 35\ [k\Omega]$.

Then $R_{eq} = \frac{(35k)(1k)}{(35k)+(1k)} = 0.9722\ [k\Omega]$

$$V_{x,meas} = 10 \frac{R_{eq}}{R_{eq} + 2.2k} = 3.0648\ [V]$$

$$\%\ error = \frac{3.0648 - 3.125}{3.125} \times 100\% = -1.92\%$$