Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (please print)

Signature: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

ECE 2300 – Quiz #3

March 3, 2015

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. It is assumed that your work will begin on the same page as the problem statement. If you choose to begin your work on another page, you must indicate this on the page with the problem statement, with a clear indication of where the work can be found. **If your work continues on to another page, indicate clearly where your work can be found. Failure to indicate this clearly will result in a loss of credit.**

4. Show all units in solutions, intermediate results, and figures. Units in the quiz will be included between square brackets.

5. Do not use red ink. Do not use red pencil.

6. You will have 30 minutes to work on this quiz.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_/20

Room for extra work

Two voltmeters are put in series, and used to measure an unknown voltage. The unknown voltage is determined by adding the readings of the two voltmeters. Voltmeter #1 can read a maximum voltage of 50[V], and has a meter resistance of 2.35[M]. Voltmeter #2 can read a maximum voltage of 20[V], and has a meter resistance of 1.65[M].

a) What is the largest voltage that can be measured in this way, by adding the readings of the two voltmeters?

b) Assume that a resistor of 2.35[M] is now placed in parallel with Voltmeter #2, and that parallel combination is placed in series with Voltmeter #1. What is the largest voltage that can be measured in this way, by adding the readings of the two voltmeters?

Room for extra work

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Room for extra work

Two voltmeters are put in series, and used to measure an unknown voltage. The unknown voltage is determined by adding the readings of the two voltmeters. Voltmeter #1 can read a maximum voltage of 50[V], and has a meter resistance of 2.35[M]. Voltmeter #2 can read a maximum voltage of 20[V], and has a meter resistance of 1.75[M].

a) What is the largest voltage that can be measured in this way, by adding the readings of the two voltmeters?

b) Assume that a resistor of 2.35[M] is now placed in parallel with Voltmeter #2, and that parallel combination is placed in series with Voltmeter #1. What is the largest voltage that can be measured in this way, by adding the readings of the two voltmeters?

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Room for extra work

Two voltmeters are put in series, and used to measure an unknown voltage. The unknown voltage is determined by adding the readings of the two voltmeters. Voltmeter #1 can read a maximum voltage of 50[V], and has a meter resistance of 2.35[M]. Voltmeter #2 can read a maximum voltage of 20[V], and has a meter resistance of 1.85[M].

a) What is the largest voltage that can be measured in this way, by adding the readings of the two voltmeters?

b) Assume that a resistor of 2.35[M] is now placed in parallel with Voltmeter #2, and that parallel combination is placed in series with Voltmeter #1. What is the largest voltage that can be measured in this way, by adding the readings of the two voltmeters?

Room for extra work

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March 3, 2015

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\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_/20

Room for extra work

Two voltmeters are put in series, and used to measure an unknown voltage. The unknown voltage is determined by adding the readings of the two voltmeters. Voltmeter #1 can read a maximum voltage of 50[V], and has a meter resistance of 2.35[M]. Voltmeter #2 can read a maximum voltage of 20[V], and has a meter resistance of 1.95[M].

a) What is the largest voltage that can be measured in this way, by adding the readings of the two voltmeters?

b) Assume that a resistor of 2.35[M] is now placed in parallel with Voltmeter #2, and that parallel combination is placed in series with Voltmeter #1. What is the largest voltage that can be measured in this way, by adding the readings of the two voltmeters?

Room for extra work

Sample Solution: Quiz #3, Spring 2015

Two voltmeters are put in series, and used to measure an unknown voltage. The unknown voltage is determined by adding the readings of the two voltmeters. Voltmeter #1 can read a maximum voltage of 50[V], and has a meter resistance of 2.35[M]. Voltmeter #2 can read a maximum voltage of 20[V], and has a meter resistance of 1.65[M].

a) What is the largest voltage that can be measured in this way, by adding the readings of the two voltmeters?

b) Assume that a resistor of 2.35[M] is now placed in parallel with Voltmeter #2, and that parallel combination is placed in series with Voltmeter #1. What is the largest voltage that can be measured in this way, by adding the readings of the two voltmeters?

Solution:

1. Voltmeter #1 has a full-scale current of 50[V]/2.35[M] = 21.277[A].

Voltmeter #2 has a full-scale current of 20[V]/1.65[M] = 12.121[A].

Since the two voltmeters are placed in series, they will have the same current flowing through them. If you are going to add the readings of the two voltmeters, you cannot allow either meter to go beyond full scale. Thus, we are limited to the lower of the two full-scale currents, or 12.121[A]. So, the largest voltage we can measure in this way, is

*vLARGEST* = 20[V] + 12.121[A] x 2.35[M] =

*vLARGEST* = 48.48[V].

Note that this is a strange result; we tried to extend our voltage measurement by combining two voltmeters, but we ended up reducing the largest voltage that could be measured to a value below that obtained using just one voltmeter by itself. This is caused by the smaller full-scale current in Voltmeter #2. This is an example of why we include the study of meters in this course.

1. The current through the added 2.35[M] resistor, at full scale for Voltmeter #2, will be

*iADDED* = 20[V] / 2.35[M] = 8.51[A].

This current will be added to the current at full scale through Voltmeter #2, since they are in parallel, so the total current through Voltmeter #1 will be the sum of these two currents,

*iADDED* + 12.121[A] = 20.632[A].

This current is still smaller than the full-scale current for Voltmeter #1, so that voltmeter will still be below full scale, and will have 20.632[A] flowing through it, when Voltmeter #2 is full scale. So, the largest voltage we can measure in this way, is

*vLARGEST* = 20[V] + 20.632[A] x 2.35[M] =

*vLARGEST* = 68.48[V].