Name: _____ (please print)

Signature: _____

ECE 2300 – Quiz #2
February 25, 2013

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.

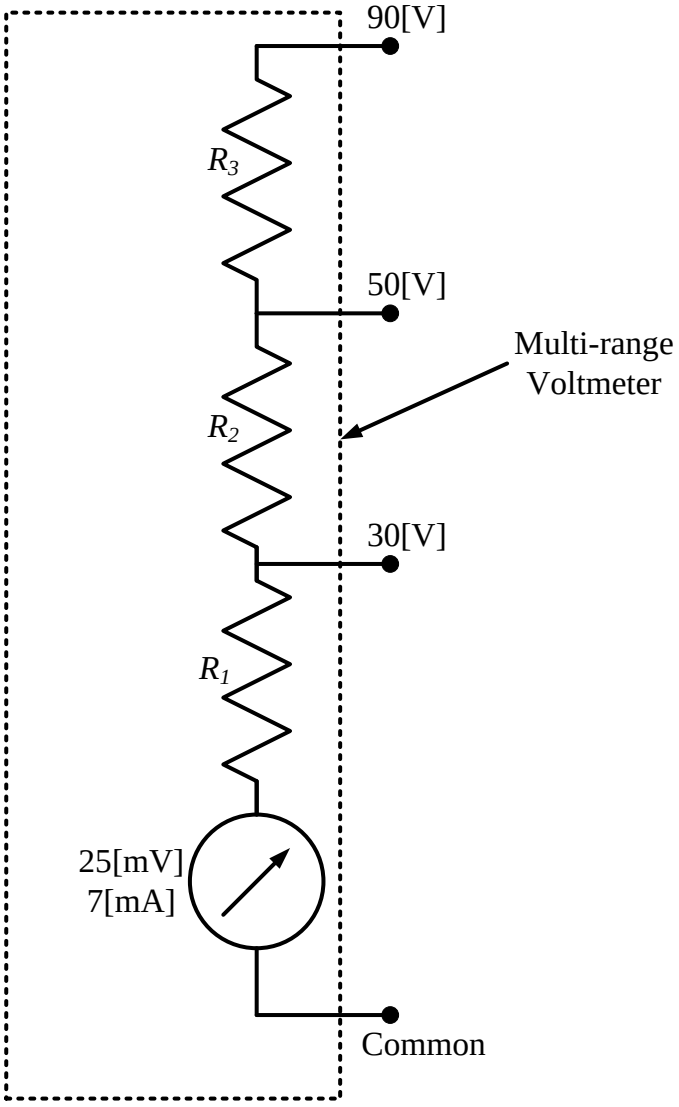
_____/20

Room for extra work

The circuit shown in the diagram below is a multi-range voltmeter, with three full-scale voltages, 30[V], 50[V], and 90[V]. By adding a resistor between the 30[V] terminal and the Common terminal, an accurate measurement of voltages up to 250[V] can be made using the 90[V] terminal and the Common terminal.

a) Find the value of the resistor you could add between the 30[V] terminal and the Common terminal to be able to measure voltages up to 250[V] using the 90[V] terminal and the Common terminal.

b) Explain how you would use the reading on the 50[V] scale to determine the unknown voltage connected between the 90[V] terminal and the Common terminal in the situation in part a).



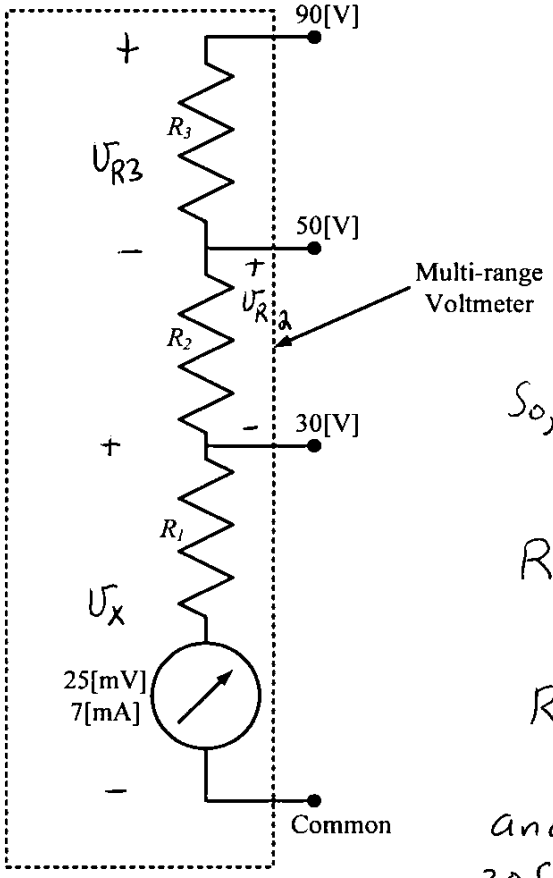
Room for extra work

ECE 2300 -- Quiz #2 – February 25, 2013 – Solution

The circuit shown in the diagram below is a multi-range voltmeter, with three full-scale voltages, 30[V], 50[V], and 90[V]. By adding a resistor between the 30[V] terminal and the Common terminal, an accurate measurement of voltages up to 250[V] can be made using the 90[V] terminal and the Common terminal.

a) Find the value of the resistor you could add between the 30[V] terminal and the Common terminal to be able to measure voltages up to 250[V] using the 90[V] terminal and the Common terminal.

b) Explain how you would use the reading on the 50[V] scale to determine the unknown voltage connected between the 90[V] terminal and the Common terminal in the situation in part a).



At full-scale,

$$V_{R3} = 90\{V\} - 50\{V\} = 40\{V\}$$

$$V_{R2} = 50\{V\} - 30\{V\} = 20\{V\}$$

$$V_X = 30\{V\}$$

So, with a full-scale current of $7\{mA\}$,

$$R_3 = \frac{40\{V\}}{7\{mA\}} = \frac{40}{7}\{k\Omega\}$$

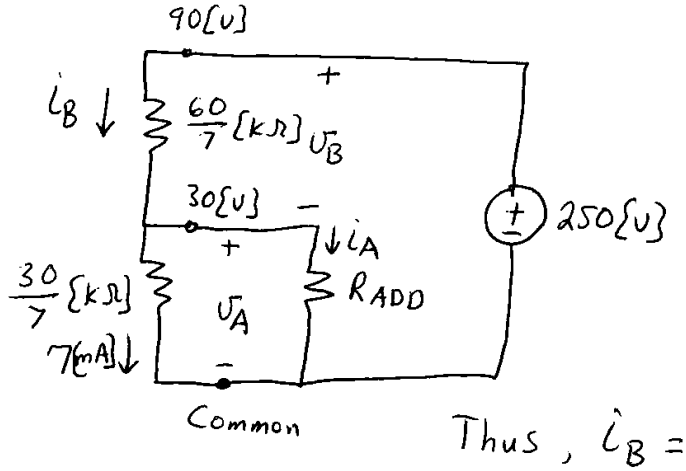
$$R_2 = \frac{20\{V\}}{7\{mA\}} = \frac{20}{7}\{k\Omega\}$$

and the resistance between the 30{V} terminal and Common will be R_x, where

$$R_x = \frac{30\{V\}}{7\{mA\}} = \frac{30}{7}\{k\Omega\}$$

See next page

a) Redrawing, and combining R_3 and R_2 in series,



Since it is full-scale,

$V_A = 30[V]$,

So by KVL,

$V_B = (250 - 30)[V] = 220[V]$.

Thus, $i_B = \dfrac{220[V]}{(60/7)[k\Omega]} = 25.667[mA]$

Then, by KCL,

$$i_A = i_B - 7[mA] = 18.667[mA]$$

Thus,

$$R_{ADD} = \frac{30[V]}{18.667[mA]} = \boxed{1.607[k\Omega]}$$

b) Since the effective full-scale voltage with R_{ADD} is 250 [V], we could multiply the reading on the 50[V] scale by $\dfrac{250[V]}{50[V]} = 5$, because all the scales are proportional.

$$\boxed{V_{UNKNOWN} = 5\, V_{READING}}$$