HOMEWORK #1 prob 4 solution

EX: a) Perform the following calculation using the appropriate number of decimal digits, and write the answer with appropriate prefixes (such as μ, m, k, etc.) for engineering units: (Note that V/Ω = A)

$$i = 40.6 \text{ mA} - \frac{9.0 \text{ V}}{1.5 \text{ k}\Omega}$$

b) Discuss how many digits of accuracy the answer might have if the measurements of current and voltage are accurate to three digits and the resistor value is based on the label on the resistor, which is accurate to 5%.

SOL'N: a) The value of 1/k is m. The quotient of V and Ω is A.

$$i = 40.6 \text{ mA} - 6 \text{ mA} = 34.6 \text{ mA} = 2.8 \text{ V}$$

b) The idea here is to determine the minimum and maximum values that i could have. To find these we first find the minimum and maximum possible values of each term.

min i_1 = 40.55 mA   max i_1 = 40.65 mA (max err is 1/2 last digit)

min v = 8.95 V   max v = 9.05 V (max err is 1/2 last digit)

min R = 1.5 kΩ (0.95) = 1.425 kΩ (min is 95% of value)

max R = 1.5 kΩ (1.05) = 1.575 kΩ (max is 105% of value)

Armed with these values, the next task is to determine the combinations of max and min values that yield the smallest and largest possible values of i.

$$\min i = \min i_1 - \max v / \min R = 40.55 \text{ mA} - 9.05 \text{ V}/1.425 \text{ k}\Omega$$

$$\max i = \max i_1 - \min v / \max R = 40.65 \text{ mA} - 8.95 \text{ V}/1.575 \text{ k}\Omega$$

or

$$\min i = 34.199 \text{ mA}.$$

$$\max i = 34.967 \text{ mA}.$$

We see that the first two digits stay the same. So we have two digits of accuracy in our answer, but not more.