

Chemistry 103 lab-supplement (for Sections 321 & 322), due February 4 (it counts 10 points).

Name _____ Section _____

Imagine that in order to calculate the density of a liquid, a chemist takes these readings, and estimates (how might this be done?) the "uncertainty" of each measurement:

mass of beaker is 21.5 g \pm .2 g
mass of beaker + liquid is 60.8 g \pm .3 g
initial buret reading is 0.59 mL \pm .06 mL
final buret reading is (45.89 \pm .08) mL

If we believe the uncertainty estimates, what is the possible range and the "center value" for each measurement?

For example, the MINIMUM, CENTER and MAXIMUM values for "**5 \pm 2**" would be **3** (because with \pm 2 we estimate the lowest possible value to be $5 - 2 = 3$), **5**, and **7** (because $5 + 2 = 7$).

	<u>MINIMUM</u>	<u>CENTER</u>	<u>MAXIMUM</u>
mass of beaker:	<u>21.3 g</u>	<u>21.5 g</u>	<u>21.7 g</u>
mass of beaker + liquid:	<u> </u>	<u> </u>	<u> </u>
initial buret reading:	<u> </u>	<u> </u>	<u> </u>
final buret reading:	<u> </u>	<u> </u>	<u> </u>

Using these values, calculate the MINIMUM, CENTER and MAXIMUM values for

the mass of liquid: 38.8 g 39.3 g
the volume of liquid: 45.44 mL

Hint: 38.8 and 39.3 are correct. Figure out which of the 9 possible subtraction-combinations produce them, and why these give the minimum and "center" values for the mass of liquid. Then use this strategy for "finding the extremes" to fill in the three blanks. { "45.44" is also correct }

Using these six values (and a similar "logic of extremes"), find MINIMUM, CENTER and MAXIMUM densities:

the density of liquid: .854 g/mL

Now report these in the standard \pm format, and calculate the "% error":

the mass of liquid is 39.3 g \pm .5 g ; the error is 1.27 %
the volume of liquid is mL \pm mL ; the error is %
the density of liquid is g/mL \pm .0135 g/mL ; the error is %

What is the exact numerical relationship between ABSOLUTE ERRORS (the \pm 's) when you subtract?

What is the approximate relationship between the RELATIVE ERRORS (the %'s) when you divide?

Based on the "allowable range" of density (it might be anything from to), could the liquid be *benzene* (density = .879 g/mL)? Explain:
Could it be *methyl alcohol* (density = .810 g/mL)? Explain:



If Barb is taller than Cathy but shorter than Ann, and Mary is taller than Cathy, what can you say for certain? What is uncertain and why? Think about this (no need to write anything) and we'll discuss it in lab.

Based on information from Part D (on page 11), fill in the five "missing arrows" at the right. { I've drawn the first arrow, which symbolically shows that if an Al wire does melt, the temperature can be anything from 660 upward. }

What combination of observations would lead you to conclude that the temperature is in the range shown by

- A (),
B (),
C (),
or D ()?

One combination of observations that is theoretically impossible is .