Chemistry Sept 2019 WS2 Uncertainties **Name:** _____ **Due: next class** **/14**

1. Add the following measurements. (2)
   a. (12.5 ± 0.3) mL + (71.8 ± 0.5) mL = (84.3 ± 0.8) mL
   b. (28.7 ± 0.8) mL + (18.8 ± 0.8) mL = (47.5 ± 1.6) mL $\rightarrow$ (48 ± 2) mL

2. Subtract the following measurements. (2)
   a. (48.5 ± 0.7) mL - (28.8 ± 0.5) mL = (19.7 ± 1.3) mL $\rightarrow$ (20 ± 1) mL
   b. (942.55 ± 0.05) mL - (208.57 ± 0.08) mL = (733.98 ± 0.13) mL $\rightarrow$ (734.0 ± 0.1) mL

Show your work for questions 3, 4 & 5 by giving the formula used. Include units and absolute uncertainty.

3. Multiply (A) (8.51 ± 0.05) mL x (B) (38.82 ± 0.04) mL (3)

$AB = 8.51 \times 38.82$

$= 330.358$

$\delta AB = \left(\frac{\delta A}{A} + \frac{\delta B}{B}\right) AB$

$= \left(\frac{0.05}{8.51} + \frac{0.04}{38.82}\right) 330.358$

$= 2.2814$

$\delta AB = 2$

Final answer $(330 \pm 2)\ mL^2$

4. Divide (A) (105.00 ± 0.04)g ÷ (B) (25.0 ± 0.3) mL (3)

$\frac{A}{B} = \frac{105.00}{25.0}$

$= 4.20000$

$\delta\left(\frac{A}{B}\right) = \left(\frac{\delta A}{A} + \frac{\delta B}{B}\right)\left(\frac{A}{B}\right)$

$= \left(\frac{0.04}{105.00} + \frac{0.3}{25.0}\right)(4.20000)$

$= 0.0520000$

$= 0.05$

Final answer $(4.20 \pm 0.05)\ \frac{g}{mL}$

5. An irregular object that weighs (23.68±0.05)g is placed into a graduated cylinder that contains (50.0±0.5)mL of water. The water level rises to (73.6±0.5)mL. Find the density of the object. Include units and the absolute uncertainty of the final answer. Show all your work. (4)

$\Delta V = V_f - V_i$

$= (73.6 \pm 0.5)mL - (50.0 \pm 0.5)mL$

$= (23.6 \pm 1.0)mL$

$P = \frac{m}{V}$

$= \frac{23.68g}{23.6mL}$

$= 1.003399\ \frac{g}{mL}$

$\delta P = \left(\frac{\delta m}{m} + \frac{\delta V}{V}\right) P$

$= \left(\frac{0.05}{23.68} + \frac{1.0}{23.6}\right) 1.00339$

$= 0.044635$

$= 0.04$

Final answer $(1.00 \pm 0.04)\ g/mL$