

CHEM 120
Fall 2009
Quiz 1

Name: _____

1. (5 Points) Give the number of significant figures in the following numbers.

0.3050	4
9060	ambiguous
15.9705	6
60.	2
0.00566	3

2. (5 Points) Perform the following calculations and report the final values to the correct number of significant figures and with the correct units.

$$45.03 \text{ g sample} \left(\frac{10.03 \text{ g Bi}}{100 \text{ g sample}} \right) = \underline{\underline{4.516 \text{ g Bi or } 4.517 \text{ g Bi}^*}}$$

$$\sqrt{15.06 \text{ m}^2} = \underline{\underline{3.881 \text{ m}}}$$

$$1.50 \times 10^{-3} \text{ ml water} \left(\frac{0.99938 \text{ g water}}{1 \text{ ml water}} \right) = \underline{\underline{1.50 \times 10^{-3} \text{ g water}^*}}$$

$$3.340 \times 10^{-3} \text{ m} + 2.789 \times 10^{-2} \text{ m} = \underline{\underline{3.123 \times 10^{-2} \text{ m}}}$$

$$30.0 \text{ sec} \left(\frac{1 \text{ min}}{60 \text{ sec}} \right) \left(\frac{1 \text{ hr}}{60 \text{ min}} \right) \left(\frac{1 \text{ day}}{24 \text{ hr}} \right) \left(\frac{1 \text{ fortnight}}{14 \text{ day}} \right) = \underline{\underline{2.48 \times 10^{-5} \text{ fortnight}^*}}$$

**These calculations involve conversion factors that are exact definitions (the % by mass is the mass per exactly 100 g, density is mass per exactly 1 ml, and the relationships between the time units).*

3. (3 Points) An analysis of the composition of a mineral is performed and it is found to be, on average, 23.46% calcium by mass. The standard deviation is found to be 0.03% and the uncertainty is $\pm 0.04\%$ at 95% confidence. Give the two ways in which these results could be reported.

The composition is $23.46 \pm 0.04\%$ calcium by mass at the 95% confidence limit.

or

The composition is 23.46% calcium by mass with a standard deviation of 0.03%.

or

The composition is 23.46(3)% calcium by mass.

The lack of a complete sentence was not penalized on this quiz, but will be in the future.

4. (6 Points) Fill in the blanks.

Scientific evidence must be **quantitative, independently verifiable** and **reproducible**.

A(n) **law** is a concise statement of a relation that seems to always hold under the same set of conditions.

Error is the general term for anything that decreases the accuracy or the precision of a measurement.

A(n) **systematic** error is one that affects all the data in the same way.

5. (5 Points) Convert 19.79 in^2 to m^2 . You are given that $2.54 \text{ cm} = 1 \text{ in}$ (exactly).

$$19.79 \text{ in}^2 \left(\frac{2.54 \text{ cm}}{1 \text{ in}} \right)^2 \left(\frac{1 \text{ m}}{100 \text{ cm}} \right)^2 = 19.79 \text{ in}^2 \left(\frac{6.4516 \text{ cm}^2}{1 \text{ in}^2} \right) \left(\frac{1 \text{ m}^2}{1 \times 10^4 \text{ cm}^2} \right) = 1.277 \times 10^{-2} \text{ m}^2$$

An area of 19.79 in^2 is the same as $1.277 \times 10^{-2} \text{ m}^2$.

Note that the intermediate step (where the squares of the conversion factors have been written) out is not usually necessary. Also note that the conversion factors are exact definition and so for all practical intents and purposes have an infinite number of significant figures.

One final note: not writing the answer in a complete sentence was not penalized on this quiz, but will be in the future.

6. (3 Points) What is the percent error associated with the density measurement reported as $2.345 \pm 0.002 \text{ g/cm}^3$ at 95% confidence?

The percent error cannot be determined because the true value is not known.

However, the relatively high precision (as indicated by the low uncertainty) would indicate an accurate value; if we were assured that there were no systematic errors.