

# CHEM 370 Week 2 Activity

## Introduction

This assignment covers Chapter 2 of *Analytical Chemistry 2.1* by Harvey. It is a review of basic chemical principles you have studied in the past.

Consult Scientific Tools by Roland Stull for a concise overview of these topics.

*You should work in groups to complete this activity.*

*Remember to maintain physical distance even when working in groups!* You may use the whiteboards to aid in working through problems.

## Units and Dimensions

Scientists often talk in numbers and charts. When presenting these items, it is important that we all use the same language and clearly specify our units so that we avoid confusion.

There are seven basic dimensions from which we base all other measurements; these define the SI (international system) *base units*. All other units are *derived units*.

Any data value may be broken into four parts:

**value = number × magnitude × prefix × units**

For example:

concentration value =  $1.3 \times 10^3 \mu\text{M}$

A value **must** have a number and units; magnitude and prefix are optional. A chemical species may be included as part of the unit.

Thus, units can be treated like numbers algebraically. This gives rise to *dimensional analysis* in which a value is successively multiplied by *values* of 1 using unit conversions to remove undesired units and add the desired units.

1. If you have 5.24 mM aqueous solution of copper, what is the concentration of copper in  $\text{mg L}^{-1}$ ?
2. Express this value in parts per million (ppm).
3. List the number, units, prefix, and magnitude for 5.24 mM; if it doesn't have an item state such.

## Significant Figures

When chemists write a number, they don't arbitrarily decide how to round. Rather, they consider how many digits carry *significance*. Any digits that contains meaningful information *must* be included; any digit which does not contain meaningful information *must not* be included. Using the correct number of significant figures is important because it tells other scientists about the uncertainty of your measurements.

The number of significant figures in a measurement is the number of digits known exactly plus one digit whose value is uncertain. Significant digits in the lab are usually determined by your choice of glassware, instrumentation, etc.

1. How many significant figures are in each of the following values? Convert each measurement to its equivalent scientific notation or decimal form (you may use SI prefixes if desired).
  1. 0.2550 g NaCl
  2. 50% methanol
  3.  $5.32 \times 10^{-9}$  m

2. You have a 10-mL graduated cylinder containing water, with the meniscus at the 5.2 mL mark. How many significant figures do you record? The cylinder is marked every 0.2 mL.

## Preparing Solutions

Although we try to be explicit when writing chemical methods, we often use significant figures to imply important details. Learning to understand this implied advice makes life in the chemistry lab easier.

When preparing a solution, consider how accurate and precise you need to be. Look to the method and your chemical knowledge for clues. While it's best to err on the side of caution, being more careful than you need to be is also a waste of time and resources.

1. You've been asked to prepare 1 L of a "50/50 solution of methanol in water" as a general-purpose extraction solvent. You have the following available: (1) a 500-mL graduated cylinder, (2) a 1000-mL volumetric flask, (3) a 1-L bottle with 100-ml gradation printed on it, (4) a high-capacity balance, (5) an analytical balance. Which glassware/equipment would you choose and why?
2. You've been asked to prepare 1 L of a 500.0 mg/L nicotine (a liquid at room temperature) stock solution in 50/50 methanol water solution. You have the following available: (1) a 10-mL graduated cylinder, (2) a 1000-mL volumetric flask, (3) a 1-L bottle with 100-ml gradation printed on it, (4) a high-capacity balance, (5) an analytical balance. Assuming you're given 100% pure nicotine and pre-made 50/50 methanol/water, Which glassware/equipment would you choose and why?

3. Building on the previous question, suppose:
1. That you made the stock with a graduated cylinder (marked in 0.2-mL increments) and  $1000 \pm 0.3$  mL volumetric flask. How many significant digits should you report the concentration to? What limits your uncertainty?
  2. That you made the stock with an analytical balance (displays to 0.0001 mg) and a  $1000 \pm 0.3$  mL volumetric flask. How many significant digits should you report the concentration to? What limits your uncertainty?
4. Now suppose you're asked to create 100 mL of 50.0 mg/L nicotine from the stock solution. How much of the stock do you need?

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