

## Using Concentration and % weight

**Why?** Chemists use shorthand to express various concentrations. This saves time and allows easy comparison between different analytes, especially at very low concentrations (for example, do you like writing  $-\log(1 \times 10^{-7})$  or  $\text{pH}=7?$ ).

### Learning Outcomes:

- Recognize the meaning of ppm and use it correctly with dilute aqueous solutions
- Recognize that % weight is related to ppm; be able to interconvert
- Be able to follow and write directions on preparing solutions using %wt or ppm

Study the model. Make sure your group discusses and understands the relationships. The recorder should write down the group answer only after all members agree on the answer.

### Model 1: Concentration units for small amounts

Like trying to find one needle / 1 haystack

One in a million

1 person per 1,000,000 people =  $1 / 10^6 = 1$  ppm (part per million)

1 person / 100,000 people = \_\_\_\_\_ ppm

1 person / 10,000 people = \_\_\_\_\_ ppm

1 person / 1,000 people = \_\_\_\_\_ ppm

**For dilute aqueous solutions, (density = 1 g/1ml):**

One mg of anything dissolved per  $10^6$  mg solution =  $1 \text{ mg} / 1,000,000 \text{ mg} = 1$  ppm

- 1) Fill in the missing information in the model.
- 2) If you see 3 red jellybeans in a large bowl of 1000 total jelly beans (!), what is the concentration of red jellybeans expressed in ppm?
- 3) Show mathematically, that 3 mg of sugar dissolved in aqueous solution to make  $10^6$  mg of solution (3 ppm) is the same as 3 mg/L sugar solution.
- 4) No calculator allowed here. A bottle containing a dilute aqueous solution has the following label:  
**10.2 ppm Pb(II)**
  - a) If one uses 1.00 L of this solution, how many mg of Pb(II) are in 1.0L?
  - b) If one uses 100.0 ml of this solution, how many mg of Pb are in 100.0 ml?

- c) If one transfers 100.0 ml of this solution into a 1.0 L flask and fills it to the mark with water, what is the new concentration of Pb(II) expressed in ppm?

### Model 2: % by weight is related to concentration

Sometimes it is easier to weigh out materials rather than use volumes:

1 g of  $\text{H}_2\text{SO}_4$  with 99 g of water added = 1 g / 100 g total =  $0.01 \times 100\% = 1\%$  by weight  $\text{H}_2\text{SO}_4$

Since this is **not** a dilute solution, one needs the density of 96.0%wt  $\text{H}_2\text{SO}_4$  (1.8 g/ml)

-100 grams of this solution contains \_\_\_\_\_ g  $\text{H}_2\text{SO}_4$  and \_\_\_\_\_ g water

-100 ml of this solution weighs \_\_\_\_\_ grams

Molarity = mole substance / 1 L of solution

- 5) Fill in the missing information in Model 2.  
6) How many grams of sulfuric acid are contained in a 100.0 ml volumetric flask of 96.0% sulfuric acid?



- 7) How many moles of acid are in this flask? (FW  $\text{H}_2\text{SO}_4 = 98.08$ ).

- 8) What is the molarity of the 96.0%  $\text{H}_2\text{SO}_4$ ?

- 9) An analysis of a paint sample gives 0.01 %wt Pb.

a) How many mg of Pb are in a 100 mg sample?

b) If one dissolves 100 mg of this sample in acid to make 1000 g of total solution, what is the concentration of Pb in ppm?

- 10) In grammatically correct English, write a sentence that describes how to prepare a 5.0 %wt solution of sodium chloride.