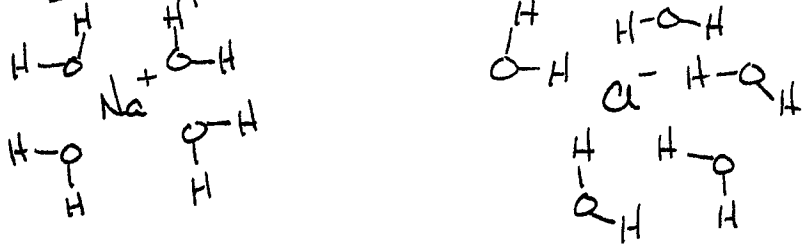
Activity 17 Solutions Worksheet

1. When dissolving in water, NaCl is more soluble than I_2. Explain.

NaCl is ionic. Ionic materials dissociate in H_2O.

$$NaCl_{(s)} \xrightarrow{H_2O} Na^+_{(aq)} + Cl^-_{(aq)}$$

The H_2O is polar and able to solvate the ions.



I_2 is non-polar covalent.

no partial + or partial −
$\delta+$ $\delta-$

Remember: Like dissolves Like

2. How does a saturated solution differ from an unsaturated one?

A saturated solution cannot dissolve any more solute. The solute will precipitate, or simply not dissolve if more is added.

An unsaturated solution can dissolve more solute. If more solute is added the material will dissolve forming a homogeneous solution.

3. The solubility of sucrose at 70°C is 320. g/100. g H_2O.

a. How much sucrose can dissolve in 200.0 g of water at 70. °C?

$$200.0\ g\ H_2O \times \frac{320.\ g\ \text{Sucrose}}{100.\ g\ H_2O} = \boxed{640.\ g\ \text{Sucrose}}$$

b. Will 400.0 g sucrose dissolve in a teapot that contains 200.0 g of water at 70 °C? Explain.

$$200.0\ g\ H_2O \times \frac{320\ g\ \text{Sucrose}}{100.\ g\ H_2O} = 640.\ g\ \text{sucrose}$$

$\Longrightarrow$ The 200.0 g H_2O can hold 640. g Sucrose, so yes the 400.0 g will dissolve.

4. If the solubility of sucrose at 0°C is 180. g/100 g H_2O, will 400.0 g of sucrose dissolve in a pitcher of 200.0 g of iced tea at 0°C? If not, how many grams will dissolve?

$$200.0\ g\ H_2O \times \frac{180.\ g\ \text{Sucrose}}{100.\ g\ H_2O} = \boxed{360.\ g\ \text{Sucrose will dissolve}}$$

The additional 40. g Sucrose will remain as solid in the bottom of the pitcher.

5. What is the difference between a mass/mass % concentration and a mass/volume % concentration?

$$\text{mass/mass \% concentration} = \frac{\text{g solute}}{\text{g solute} + \text{g solvent}} \times 100$$

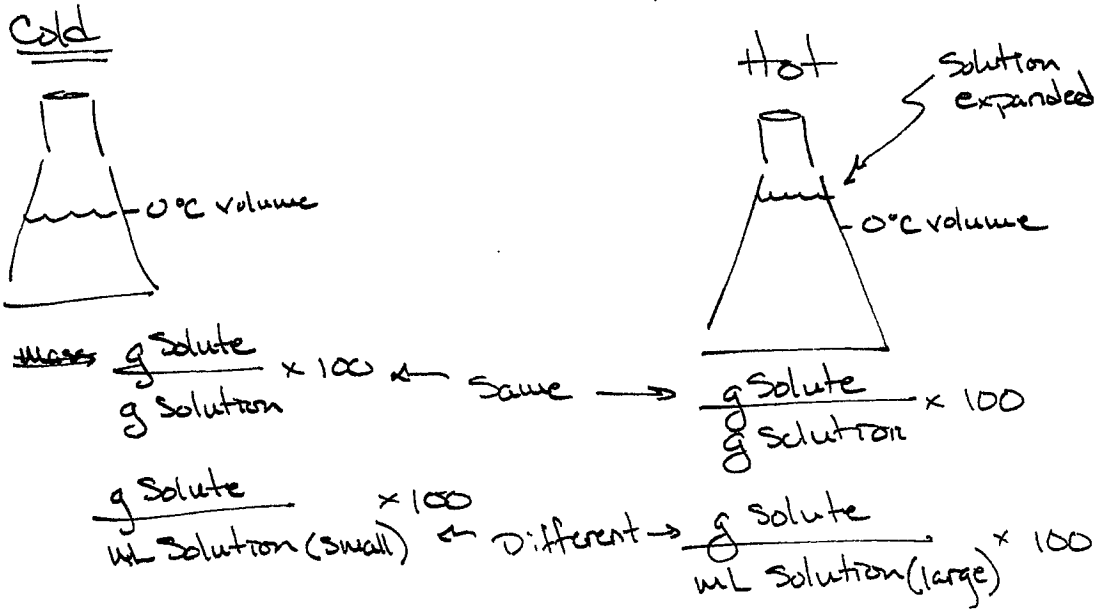
or

$$\frac{\text{g solute}}{\text{g solution}} \times 100$$

Because the solution is measured in mass of grams it is temperature independent.

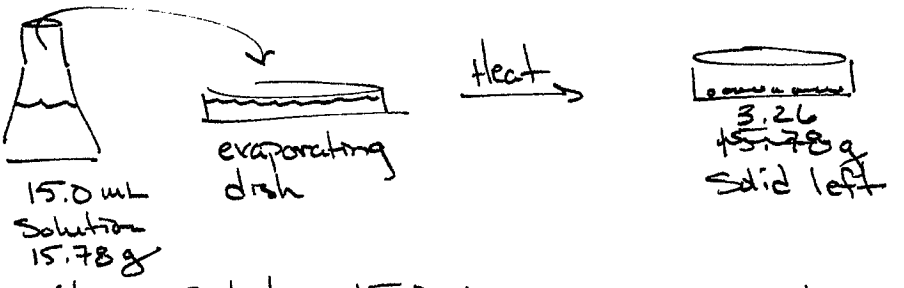
$$\text{mass/volume \% concentration} = \frac{\text{g solute}}{\text{mL solution}} \times 100$$

volume is temperature dependent. As the temperature increases, the volume increases. Thus a mass/volume % can change with temperature but a mass/mass % will not



% mass/volume decreases with temp.

6. A 15.0 mL sample of sodium chloride solution that has a mass of 15.78 g is placed in an evaporating dish and evaporated to dryness. The residue has a mass of 3.26 g. Calculate the following concentrations for the NaCl solution:



Volume solution 15.0 mL mass solution 15.78 g

mass NaCl ~~15.78 g~~ 3.26 g

a. mass/mass %

$$\frac{g\ Solute}{g\ Solution} \times 100 = \frac{3.26\ g}{15.78\ g} \times 100 = 20.659062\ \%$$

$$= \boxed{20.7\ \%}$$

b. mass/volume %

$$\frac{g\ Solute}{mL\ Solution} \times 100 = \frac{3.26\ g}{15.0\ mL} \times 100 = 21.73333\ \%$$

$$= \boxed{21.7\ \%}$$

c. Molarity

$$\frac{Moles\ Solute}{L\ solution}$$ Road Map $\frac{g\ solute}{mL\ Solution} \rightarrow$ moles Solute $\rightarrow$ L Solution

$$\frac{3.26\ g\ NaCl}{15.0\ mL\ Solution} \times \frac{1\ mole\ NaCl}{58.44\ g\ NaCl} \times \frac{1000\ mL\ Solution}{1\ L\ Solution} = 3.718913986\ mols/L$$

$$= \boxed{3.72\ \underline{M}\ NaCl}$$

7. A 3.0% (g/mL) KI solution has a volume of 25.0 mL. How many grams of KI are in the sample?

$$25.0 \text{ mL Solution} \times \frac{3.0 \text{ g KI}}{100 \text{ mL Solution}} = \boxed{0.75 \text{ g KI}}$$

8. How many grams of a 25% mass/mass NaCl solution contains 150.0 g NaCl?

$$150.0 \text{ g NaCl} \times \frac{100 \text{ g Solution}}{25 \text{ g NaCl}} = 600 \text{ g Solution}$$

$$= \boxed{6.0 \times 10^2 \text{ g Solution}}$$

9. What is the molarity of a solution that contains 80.0 g of NaOH (molar mass 40.0 g/mol) dissolved in 500.0 mL of solution?

$$\text{Molarity} = \frac{\text{Mols Solute}}{\text{L Solution}}$$

Given $\frac{\text{g Solute}}{\text{mL Solution}}$ → moles → Liters

$$\frac{80.0 \text{ g NaOH}}{500.0 \text{ mL Sol.}} \times \frac{1 \text{ mole NaOH}}{40.0 \text{ g NaOH}} \times \frac{1000 \text{ mL}}{1 \text{ L}} = \frac{4.00 \text{ moles NaOH}}{\text{L solution}}$$

$$= \boxed{4.00 \text{ M NaOH}}$$

10. How many milliliters of a 2.50 M $MgCl_2$ solution contain 17.5 g of $MgCl_2$?

$$17.5\ g\ MgCl_2 \times \frac{1\ mole\ MgCl_2}{95.205\ g\ MgCl_2} \times \frac{1\ L\ solution}{2.50\ moles\ MgCl_2} \times \frac{1000\ mL\ Solution}{1\ L\ Solution} =$$

$$= 73.5\overset{+1}{2}5550\ mL\ solution$$

$$= \boxed{73.5\ mL\ solution}$$

11. Consider a 1 M NaCl solution.

a. What is the concentration of Sodium in in Eq/L in this solution?

⟹ Forgot to show you this. Eq ÷ stands for equivalents. Equivalents is the number of charges or moles of charge (either positive for cations or negative for anions) per Liter solution.

Na^+	= 1 equivalent	Cl^-	= 1 equivalent
Ca^{2+}	= 2 equivalent	SO_4^{2-}	= 2 equivalent
Fe^{3+}	= 3 equivalent	PO_4^{3-}	= 3 equivalent

$$\frac{1\ mole\ NaCl}{L\ solution} \times \frac{1\ mole\ Na^+}{1\ mole\ NaCl} \times \frac{1\ eq}{1\ mole\ Na^+} = \boxed{1\ eq/L\ Na^+}$$

b. What is the osmolarity?

$$\frac{1\ mole\ NaCl}{L\ solution} \times \frac{2\ moles\ Ions}{1\ mole\ NaCl} = \boxed{2\ \underline{OSM} \quad or \quad \frac{2\ moles\ Ions}{L\ solution}}$$