Chemistry 20 - Unit 2 - Concentration as a Percent

Name: _____

You may find the following formulas useful:

$C = \frac{n}{V}$ $m = Mn$ $d = \frac{m}{V}$	$C_{v/v} = \frac{V_{solute}}{V_{solution}} \times 100\%$ $C_{w/w} = \frac{m_{solute}}{m_{solution}} \times 100\%$

1. Write dissociation formulas for each of the following compounds. Following that, predict the solubility of each compound in water.

a. Barium chloride (aq)

$BaCl_2 \rightarrow Ba^{2+} + 2Cl^-$

b. Rubidium oxalate (aq)

$Rb_2OOCCOO \rightarrow 2Rb^+ + OOCCOO^-$

c. Strontium sulfate (s)

$SrSO_4 \rightarrow Sr^{2+} + SO_4^{2-}$

d. Iron (III) hydroxide (s)

$Fe(OH)_3 \rightarrow Fe^{3+} + 3OH^-$

e. Copper (I) fluoride (aq)

$CuF \rightarrow Cu^+ + F^-$

f. Ammonium chlorate (aq)

$NH_4ClO_3 \rightarrow NH_4^+ + ClO_3^-$

g. Cesium perchlorate (s)

$CsClO_4 \rightarrow Cs^+ + ClO_4^-$

h. Vanadium (V) carbonate (s)

$V_2(CO_3)_5 \rightarrow 2V^{5+} + 5CO_3^{2-}$

i. Lithium phosphate (aq)

$Li_3PO_4 \rightarrow 3Li^+ + PO_4^{3-}$

j. Lead (II) sulfate (s)

$PbSO_4 \rightarrow Pb^{2+} + SO_4^{2-}$

2. Rubbing alcohol, $C_3H_7OH_{(l)}$, is typically sold in many drugstores as 70.0% by volume.

a. What volume of pure $C_3H_7OH_{(l)}$ is present in a 500 mL solution?

$$V_{C_3H_7OH} = \frac{70.0\% \cdot 500mL}{100\%} = 350mL$$

b. Under standard conditions, the density of rubbing alcohol is 0.786 g/mL. How many grams of rubbing alcohol are in a typical bottle?

$$m_{C_3H_7OH} = 0.786 g/mL \times 350mL = 275g$$

c. How many moles of rubbing alcohol are ~~in a typical bottle~~?

$$n = \frac{m}{M} = \frac{275g}{60.11 g/mol} = 4.58mol$$

3. Hydrogen peroxide is a common disinfectant. Calculate the mass of $H_2O_{2(aq)}$ needed to make 1000 bottles of rubbing alcohol if each bottle contains 250 g of solution and the concentration by weight is 3.0%.

$$m_{H_2O_2} = \frac{3.0\% \cdot 250g}{100\%} = 7.5g \text{ per bottle}$$

$$\frac{7.5g}{bottle} \times 1000 \text{ bottles} = 7.5 \times 10^3 g$$

4. A typical 355 mL can of Coca-Cola contains 39 g of sucrose, $C_{12}H_{22}O_{11(aq)}$.

a. What chemical amount of sucrose is in a case of 24 cans of Coca-Cola?

$$m_{C_{12}H_{22}O_{11}} = \frac{39\,g}{can} \times 24\,cans = 936\,g \text{ or } 9.4\times10^{2}\,g$$

b. Under standard conditions, the density of sucrose is 1.59 g/mL. What is the percentage concentration by volume of sucrose in 1 can of Coca-Cola?

$$V_{solute} = 39\,g \times \frac{1\,mL}{1.59\,g} = 25\,mL$$

$$C_{v/v} = \frac{25\,mL}{355\,mL} \times 100\% = 6.9\%$$

5. A solution of sodium hydroxide has a concentration of 15.0% by volume.

a. If a beaker contains 425 mL of this solution, what volume of sodium hydroxide is present?

$$V_{solute} = \frac{15.0\% \cdot 425\,mL}{100\%} = 63.8\,mL$$

6. A brine solution in a home water-softening system has a salt concentration of 25.0% by mass. In grams, what mass of salt is dissolved if the tank holds 60.0 kg of solution?

$$m_{salt} = \frac{25.0\% \cdot 60.0\,kg}{100\%} = 15.0\,kg$$

7. A 0.175 kg solution contains 0.470 moles of unknown metal with a 15.0% concentration by weight.

a. In grams, what mass of metal is dissolved in the solution?

$$m_{solute} = \frac{15.0\% \cdot 175\,g}{100\%} = 26.3\,g$$

b. What is the **most likely** identity of the unknown metal?

$$M = \frac{m}{n} = \frac{26.3\,g}{0.470\,mol} = 55.9\,g/mol$$

Iron!