

## Friday worksheet 2b – concentration calculations to find amount of solute

To find the amount of a substance present in a given volume of a solution we need to know its concentration.

In this worksheet we will be manipulating formulae and converting units.

Example 1. What is the amount, in mol, of lead in 30.0 mL of a 0.101M solution of  $\text{Pb}(\text{NO}_3)_2$ .

*Step 1 find the amount ( $\text{Pb}(\text{NO}_3)_2$ ) of substance using the formula*

$$\Rightarrow A = C \times V$$

*=> make sure all units are correct.  $C = \text{mol/L}$ ,  $V = \text{L}$*

$$\Rightarrow \text{Pb}(\text{NO}_3)_2 (\text{mol}) = 0.101 \text{ mol/L} \times 0.0300 \text{ L} = 3.03 \times 10^{-3} \text{ mol.}$$

*Step 2 Find the mol of Pb.*

*Since there is one mol of Pb for every mol of  $\text{Pb}(\text{NO}_3)_2$*

$$\Rightarrow n_{\text{Pb}} = 3.03 \times 10^{-3} \text{ mol.}$$

Example 2 What is the mass of nitrate in 60.0 mL of a 1.32M  $\text{Al}(\text{NO}_3)_3$ ?

*Step 1 Find the mol of aluminium nitrate present in 60.0 mL.*

$$\Rightarrow \text{amount} = C \times V = 1.32 \text{ mol/L} \times 0.0600 \text{ L} = 0.0792 \text{ mol}$$

*Step 2 Find the mol of  $\text{NO}_3^-$*

*=> Since for every mol of  $\text{Al}(\text{NO}_3)_3$  there are three mol of  $\text{NO}_3^-$ .*

$$\Rightarrow 3 \times 0.0792 = 0.2376 \text{ mol of nitrate}$$

*Step 3 find the mass of nitrate*

$$\Rightarrow \text{mass} = 0.2376 \times 62.0 = 14.7 \text{ g}$$

Example 3 What is the volume, in mL, of a 0.2 M  $\text{AgNO}_3$  solution that contains exactly 8.5 grams of  $\text{AgNO}_3$ ?

*Step 1 Transform the formula to make it equal to volume.*

$$\Rightarrow A/C = V$$

*=> amount is 8.5 grams but the concentration is given in mol/L so convert the units.*

*Step 2 Convert from grams to mol of  $\text{AgNO}_3$*

$$\Rightarrow 8.5 \text{ g of } \text{AgNO}_3 = 8.5/170 = 0.050 \text{ mol}$$

*Step 3 Find the volume in mL*

$$\Rightarrow 0.050 \text{ mol} / 0.2 \text{ mol/L} = 0.25 \text{ L} = 250 \text{ mL}$$

Concentration = C  
Volume = V  
Amount = A

$$A = C \times V$$

1. A brand of wine has the alcohol (ethanol) content clearly labelled as 13.5%v/v. Given that the density of ethanol, at room temperature, is 0.7892 g/mL calculate the mass of ethanol in 75 mL of wine:

*Step 1 Find the volume of ethanol in 75 mL of wine.*

*=> 13.5%v/v = 13.5 mL of ethanol in 100 mL of wine*

*=> (13.5mL/100mL) X 75mL = 10.125mL*

*Step 2 Calculate the mass using the density of ethanol*

*=> mass (g) = 0.7892 g/mL X 10.125 mL = 8.0g*

2. Calculate the mass, in grams, of  $\text{Ca}(\text{NO}_3)_2$  found in 135.0 mL of a 0.12M  $\text{Ca}(\text{NO}_3)_2$ .

*Step 1 calculate the mol of  $\text{Ca}(\text{NO}_3)_2$*

*=> mol of  $\text{Ca}(\text{NO}_3)_2 = C \times V$*

*=> mol = 0.12 mol/L X 0.135L = 0.0162 mol*

*Step 2 Calculate the mass of  $\text{Ca}(\text{NO}_3)_2$*

*=> mass = mol X formula mass = 0.0162 mol X 164.1 g/mol = 2.7 grams*



3. What is the mass, in grams, of ammonium in a 150 mL of a 0.342 M  $(\text{NH}_4)_3\text{PO}_4$ .

*Step 1 Find the mol of  $(\text{NH}_4)_3\text{PO}_4$  in 150 mL*

*=> mol = C X V = 0.342 mol/L X 0.150L = 0.0513 mol*

*Step 2 Find the mol of ammonium*

*=> Looking at the formula, for every mole of  $(\text{NH}_4)_3\text{PO}_4$ , three mol of  $\text{NH}_4^+$  exist.*

*=> mol of ammonium = 0.0513 X 3 = 0.1539 mol*

*Step 3 Find the mass in grams of ammonium.*

*=> mass(g) = 0.1539 X 18.0 = 2.77 g*

4. A sample of seawater taken from the Bay has an NaCl concentration of 0.600 M.

- a. Calculate the volume, in litres, of sea water that would contain exactly 35.6 grams of NaCl.

*Step 1 Find the mol of NaCl since the concentration of NaCl is given in mol/L*

*=> 35.6g / formula mass of NaCl = 35.6 / 58.5 = 0.609 mol*

*Step 2 Find the volume in litres*

*=> V = amount/concentration = 0.609 / 0.600 mol/L = 1.01 L*

- b. What mass, in kilograms, of  $\text{Cl}^-$  ions is present in 345 mL of seawater?

*Step 1 Find the mol of NaCl in 345 mL*

*=> mol = C X V = 0.600 mol/L X 0.345 L = 0.207 mol*

*Step 2 Find the mol of  $\text{Cl}^-$*

*=> For every mol of NaCl there is one mol of  $\text{Cl}^-$  ions also present.*

*=> mol of  $\text{Cl}^-$  = 0.207*

*Step 3 find the mass of  $\text{Cl}^-$*

*=> mass = 0.207 X formula mass of Cl = 0.207 X 35.5 = 7.35 g or 7.35 X 10<sup>-3</sup> kg*