Chemistry 11

Solution Chemistry I

Name:
Date:
Block:

1. Vocabulary
2. Molarity
3. Dilutions

Vocabulary

SOLUTION CHEMISTRY:

- What is a solution?
  - Homogeneous mixture
  - Exists in one phase
  - Examples:
    1. Chocolate milk 2. sea water 3. rubbing alcohol
- Components of a solution:
  - Solute: the substance being dissolved (added to liquid)
  - Solvent: the substance doing the dissolving (liquid)
  - Example: Kool-aid

    Solute: crystals/powder Solvent: water
- Water – the most common solvent
  - Referred to as "aqueous" solutions
  - From now on, assume that the solutions discussed are "aqueous" solutions

Molarity

Practice 1.

What is the molar concentration of NaCl in a solution containing 5.12 g of NaCl in 250.0 mL of solution?

⇒ What are we given?

5.12g NaCl 250.0mL

⇒ What unit(s) should our final answer have? molar concentration = molarity = M = $\frac{mol}{L}$

$$\frac{5.12g\,NaCl}{250.0mL} \times \frac{1mol\,NaCl}{58.44g\,NaCl} \times \frac{1000mL}{1L} = 0.350\frac{mol}{L} = 0.350M\ NaCl$$

or $5.12g\,NaCl \times \frac{1mol\,NaCl}{58.44g\,NaCl} = 0.0876mol$ $C = \frac{n}{V} = \frac{0.0876mol}{0.2500L}$

$= 0.350M\ NaCl$

Practice 2.
What mass of NaOH is contained in 3.50 L of 0.200 M NaOH?

⇒ What are we given?

3.50L NaOH 0.200M NaOH

⇒ What unit(s) should our final answer have? g

$$3.50\text{L NaOH} \times \frac{0.200\text{mol NaOH}}{\text{L}} \times \frac{40.00\text{g NaOH}}{1\text{mol}} = \boxed{28.0\text{g NaOH}}$$

Practice 3.
How many moles of $AlCl_3$ are contained in 350.0 mL of 0.250 M $AlCl_3$?

$$350.0\text{mL } AlCl_3 \times \frac{1\text{L}}{1000\text{mL}} \times \frac{0.250\text{mol } AlCl_3}{1\text{L}}$$

$$= \boxed{0.0875\text{mol } AlCl_3}$$

Practice 4.
How many grams of $CaCl_2$ are contained in 225 mL of 0.0350 M $CaCl_2$ solution?

$$225\text{mL } CaCl_2 \times \frac{1\text{L}}{1000\text{mL}} \times \frac{0.0350\text{mol } CaCl_2}{1\text{L}} \times \frac{110.98\text{g } CaCl_2}{1\text{mol } CaCl_2}$$

$$= \boxed{0.874\text{g } CaCl_2}$$

Practice 5.
How many grams of Na_3PO_4 are contained in 3.45 L of 0.175 M Na_3PO_4?

$$3.45\text{L} \times \frac{0.175\text{mol } Na_3PO_4}{1\text{L}} \times \frac{163.94\text{g } Na_3PO_4}{1\text{mol } Na_3PO_4}$$

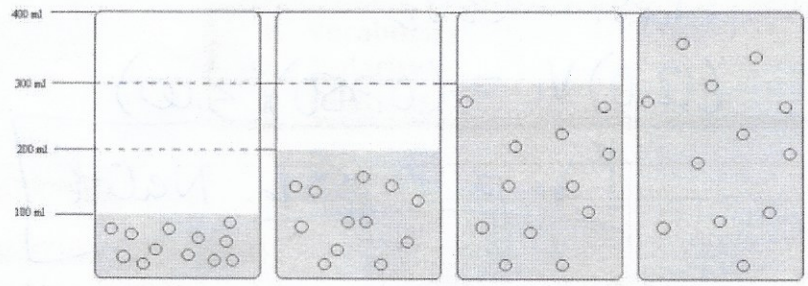
$$= \boxed{99.0\text{g } Na_3PO_4}$$

Practice 6.
The molar concentration of pure $HClO_4$ is 17.6 M. What is the density (g/mL) of pure $HClO_4$?

$$\frac{17.6\text{mol } HClO_4}{\text{L}} \times \frac{1\text{L}}{1000\text{mL}} \times \frac{100.46\text{g } HClO_4}{1\text{mol}}$$

$$= \boxed{1.77\text{g/mL } HClO_4}$$

Dilutions



n = number of moles

V = volume

c = molarity = concentration

The amount of the chemical (number of moles and mass) does not change – only the concentration.

$\frac{mol}{L} \cdot L = mol$

Therefore, $n_1 = n_2$

Since $n_1 = c_1 \times V_1$ and $n_2 = c_2 \times V_2$

Because....

$n_1 = n_2$

Therefore, $c_1 \times V_1 = c_2 \times V_2$

[ ] = Concentration

Example 1:
If 200.0 mL of 0.500 M NaCl is added to 300.0 mL of water, what is the resulting [NaCl] in the mixture?

$V_1 = 200.0 mL$

$C_1 = 0.500 M$

V_2 = total volume
(200.0 mL + 300.0 mL = 500.0 mL)

$C_2 = ?$

$C_1V_1 = C_2V_2$

$(0.500)(200.0) = C_2(500.0)$

$C_2 = 0.200 M$ NaCl

Example 2:
If 20.0 mL of 0.75 M HBr is diluted to a total volume of 90.0 mL, what is the molar concentration of the HBr in the resulting solution?

$V_1 = 20.0 mL$

$C_1 = 0.75 M$

$V_2 = 90.0 mL$

$C_2 = ?$

$C_1V_1 = C_2V_2$

$(0.75)(20.0) = (C_2)(90.0)$

$C_2 = 0.17 M$ HBr

Example 3:
What volume of 12.0 M NaOH is required in order to prepare 3.00 L of 0.750 M NaOH?

$V_1 = ?$
$C_1 = 12.0M$
$V_2 = 3.00L$
$C_2 = 0.750M$

$C_1V_1 = C_2V_2$
$(12.0)V_1 = (0.750)(3.00)$
$V_1 = 0.188L$ NaOH

Example 4:
When 350.0 mL of 0.250 M $MgCl_2$ is boiled down to a final volume of 275.0 mL, what is the molarity of the $MgCl_2$ in the resulting solution?

evaporated

$V_1 = 350.0mL$
$C_1 = 0.250M$
$V_2 = 275.0mL$
$C_2 = ?$

$C_1V_1 = C_2V_2$
$(0.250)(350.0) = C_2(275.0)$
$C_2 = 0.318M$ $MgCl_2$

Molarity & Dilutions Worksheet