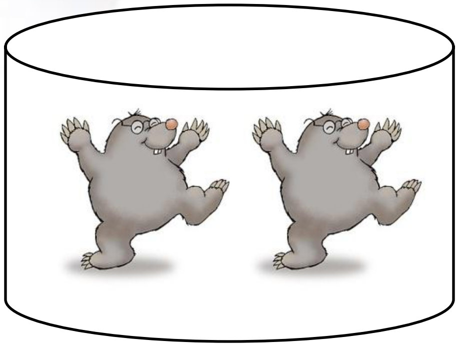
Molar Concentration

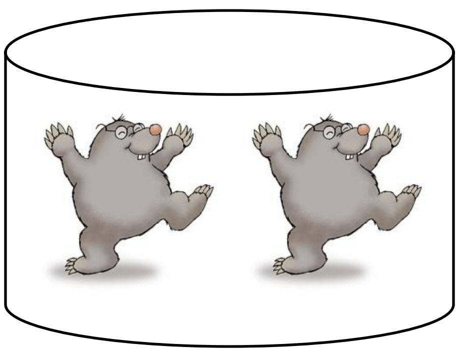
and Preparing Solutions

Molar Concentration

- Consider the following:



1.0 L of H_2O



0.50 L of H_2O

a) How many moles are in 1.0 L of H_2O?

Answer: **1 mole per liter**

b) Now, how many moles are in 1.0 L of H_2O?

Answer: **2 moles per liter**

c) How many moles are in 0.5 L of H_2O?

Answer: **2 moles per 0.5 L**

Or **4 moles per liter**

Molar Concentration

- Mole formula #3

$$\boxed{C = \frac{n}{V} \quad \text{or} \quad n = C \times V}$$

where
C = concentration (mol/L or **M**)
n = # of moles (mol)
V = volume (L)

- [ ] square bracket also a symbol of concentration
  - e.g. [$HCl_{(aq)}$] means "the concentration of HCl……"
  - See sample problem #4 and #5 on page 283-284

Sample problem

1. A sample of ammonia (NH_3) solution has a concentration of 2.6 mol/L.
   a) How many moles of ammonia would be in a 250 mL bottle?
   b) What mass of ammonia was used?

Given: $C = 2.6$ mol/L, $V = 250$ mL $= 0.250$ L

$n = C \times V$

$= 2.6 \text{ mol/L} \times 0.250 \text{ L}$

$= 0.65$ mol

$m(NH_3) = n \times M$

$= 0.65 \text{ mol} \times 17.0 \text{ g/mol}$

$= 11.0$ g

$= 1.1 \times 10^1$ g (2 sig digits)

Your Turn!

- Read through 281-290 as review of lesson
  - See Summary chart on pg 290
- Q#1-6, 8 on pg 284
- Q#12,13, 15,16 on pg 287
- Q#19, 20 on pg 290

Warm-up Question

- Try Q#10 on page 291

Preparing Solutions – from a Solid

Creating a Solution from a Solid

- How would you create 500 mL of a 2.5 mol/L solution of sodium hydroxide?

1. Calculate the number of moles in the solution

   $n = C \times V$

   $\quad = 2.5 \text{ mol/L} \times 0.500 \text{ L}$

   $\quad = 1.25 \text{ mol}$

2. The number of moles can not be measured?

   i. What can we measure? → mass

   ii. Find the mass of solid required

   $m = n \times M$

   $\quad = 1.25 \text{ mol} \times 40.0 \text{ g/mol}$

   $\quad = 50 \text{ g of NaOH (2 sig digits)}$

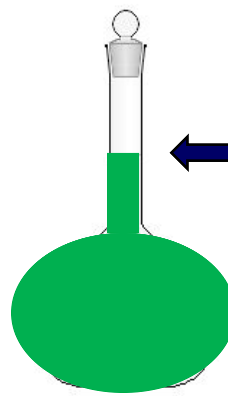
   Use a balance to mass out this amount of solid NaOH.

Preparing Solutions

3. Obtain a 500 mL volumetric flask.
   Add the measured amount of solid to the flask

50.0 g

4. Add approx 250 mL of distilled water to the flask. Cap and invert to mix (several times)

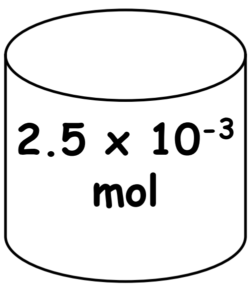


Fill line

5. Add remaining distilled water to the fill line. Cap and invert again.

Preparing Solutions

- Dilutions of a Stock solution to form a weaker solution

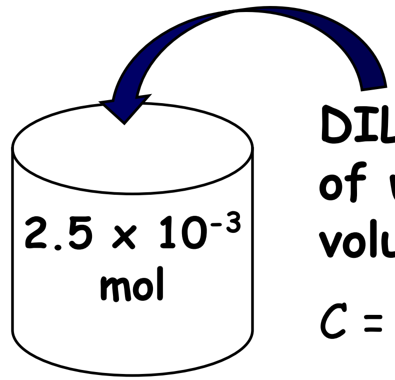


10 mL of 0.25 M HCl

$n = C \times V$

$= 0.25\ \text{mol/L} \times 0.010\ \text{L}$

$= 2.5 \times 10^{-3}\ \text{mol}$



DILUTE by adding 90 mL of water for a TOTAL volume of 100 mL

$C = n / V$

$= 0.0025\ \text{mol} / 0.100\ \text{L}$

$= 0.025\ \text{mol/L}$

$= 2.5 \times 10^{-2}\ \text{M}$

Note: After adding more water, we still have the **same number of moles**, but conc. **decreases** due to increase in volume

Preparing Solutions

- moles before = moles after

$$\boxed{\begin{aligned} n_1 &= n_2 \\ C_1V_1 &= C_2V_2 \end{aligned}}$$

(This formula can only be used for same solution on both sides)

- **Sample Problem:** You have a solution of 6.0 M HCl and you want to create 1.0 L of a 1.5 M acid solution for Mr. Gladden.
- Given: $C_1 = 6.0$ mol/L
  $C_2 = 1.5$ mol/L
  $V_1 = ?$ L
  $V_2 = 1.0$ L

- **Equation**

$$C_1V_1 = C_2V_2$$

$$V_1 = \frac{(1.5\ \mathrm{mol/L})(1.0\mathrm{L})}{6.0\ \mathrm{mol/L}}$$

$$= 0.250\ \mathrm{L}$$

$$= 250\ \mathrm{mL}$$

$\therefore$ you need 250 mL of 6.0 M HCl and 750 mL of water.

Preparing Solutions

Method

- Obtain a 1000 mL volumetric flask. Add about 500 mL of distilled water.
- Measure 250 mL of concentrated $HCl_{(aq)}$ with a graduated solution. Add carefully to the flask.
- Stopper, swirl and invert to mix solute and solvent
- Add more distilled water to fill line. Stopper, swirl and mix.

See sample problem #2 on pg 304.

WFT: Q#1,2,4,5a on pg 302

- Q#6 on pg 306 (top of page)
- Q#4,5,7, 8ab on pg 306 (blue area)