Mole, molecule, atom, molarity, mass and volume problems

CLASS NOTES

1. **Finding quantity of moles (mol)**

a- Use mole formula: n=m/mm	b- Set up as ratio
How many moles are in 20.0 g of HCl?	How many moles of HCl are in 750 mL of a 4.3 M solution?

1.01
35.45
36.46

$n = \frac{m}{mm}$ $\frac{20.0\,g}{36.46\,g/mol}$

$n = 0.549\,mol$

÷1000

$\frac{4.3\,mol}{1\,L} = \frac{x\,mol}{0.75\,L}$ $x = 3.2\,mol$

$n = C \times V$

$4.3\,mol/L \times 0.75\,L = 3.2\,mol$

2. **Finding the molecule (molecule)**

1- Use mole formula: n=m/mm
2- Use molecule ratio (6.02×10^{23})

* use avogadro's #

How many molecules are in 5.00 g of H_2SO_4?

1.01
1.01
32.07
16.00
16.00
16.00
16.00

$n = \frac{m}{mm}$ $\frac{5.00\,g}{98.09\,g/mol} = .05097359157\,mol = \frac{1\,mol}{6.02 \times 10^{23}}$

$= 3.07 \times 10^{22}$ molecule

faster

$\frac{5.00\,g}{98.09} \times 6.02 \times 10^{23} = 3.07 \times 10^{22}$

3. **Finding the number of atoms in a molecule (atoms)**

1- Use mole formula: n=m/mm
2- Use molecule ratio (6.02×10^{23})
3- Multiply answer by number of atoms molecule has

How many oxygen atoms are in 250 g of $CaCO_3$?

40.08
12.01
16.00
16.00
16.00

$n = \frac{m}{mm}$ $\frac{250\,g}{100.09\,g/mol} = 2.497752023\,mol = \frac{1\,mol}{6.02 \times 10^{23}}$

$1.503646718 \times 10^{24}$ x 3 atoms of O

$= 4.5 \times 10^{24}$ atoms of O

x 3

4. **Finding the volume (L)**

1- Use mole formula: n=m/mm 2- Use answer in mol/L ratio
What volume of a 1.5 M solution of NaCl contains 6.0 g of solute?

$22.99 + 35.45 = 58.44$

$n = \frac{m}{mm} \quad \frac{6.0\,g}{58.44\,g/mol} = 0.1026694045\,mol$

$C = \frac{n}{V}$

$V = \frac{n}{C} = \frac{0.1026694045\,mol}{1.5\,mol/L} = 0.068\,L$

5. **Finding the molarity (mol/L)**

1- Use mole formula: n=m/mm 2- Divide answer by the volume	1- Set up ratio to find grams 2- Use mole formula: n=m/mm
Calculate the molarity of a solution by dissolving 24 g of NaOH in enough water to make 1.75 L of solution.	There are 600 g/400 mL of fructose $C_6H_{12}O_6$ in a Coke can. What is the molar concentration of the drink?

$22.99 + 16.00 + 1.01 = 40.0$

$n = \frac{m}{mm} \quad \frac{24\,g}{40\,g/mol} = 0.6\,mol$

$C = \frac{n}{V} \quad \frac{0.6\,mol}{1.75\,L} = 0.34\,mol/L$

$0.4\,L \times \frac{1000}{1\,L} = 400\,mL$

$12.01(6) + 1.01(12) + 16.00(6) = 180.18\,g/mol$

$n = \frac{m}{mm} \quad \frac{600\,g}{180.18\,g/mol} = 3.330000333\,mol$

$\frac{3.330000333\,mol}{0.4\,L} = \frac{x}{1\,L}$

$x = 8.3 = 8\,mol/L$

6. **Finding mass (g) and process**

1- Use mass formula m = n x mm 2- Find mole with ratio mol/L	**5 step process**
How many grams of $CaCO_3$ are in 250 ml of a 0.75 M solution?	How would you prepare 250 mL of a 0.75 M solution of $CaCO_3$?

m = n x mm

n = C x V

0.75 mol/L x 0.25 L = .1875 mol

÷1000

m = n x mm

0.1875 mol x 100.09 g/mol

m = 18.79 g = 19 g

40.08
12.01
16.00
16.00
16.00

① Weigh 19 g of $CaCO_3$ on a balance

② Put solute in 250 mL flask

③ add a bit of water + swirl

④ add water to 250 mL Line

⑤ check meniscus

7. **Comparing concentrations g/L or Mol/L**

Unit- g/L 1- Use mass formula: m=n x mm 2- Divide answer by volume	Unit- mol/L 1- Use mole formula: n=m/mm 2- Divide answer by volume
3.0 moles of KBr in 2.5 litres of solution OR 1.5 moles of NaOH in 400.0 mL of solution	3.0 g of KBr in 2.5 litres of solution OR 1.5 g of NaOH in 400.0 mL of solution

39.10
+ 79.90
119.00

m = n x mm

3.0 mol x 119.00 g/mol

÷1000

m = 357 g / 2.5 L = 142.8 g/L = 140 g/L

n = m / mm = 3.0 g / 119.00 g/mol = .025210084 mol

C = n / V = .025210084 mol / 2.5 L = .010 mol/L

22.99
+ 16.00
+ 1.01

m = n x mm

1.5 mol x 40.00 g/mol

m = 60 g / 0.4 L = 150 g/L

n = m / mm = 1.5 g / 40 g/mol = 0.0375 mol / .4 L = 0.094 mol/L