Dimensional Analysis: Molar Mass, Particles, Ionic, & Covalent Compounds

Molar Mass (MM) = mass of one mole of a substance

Example 1) Molar Mass of $AlCl_3$ = molar mass of one Al + molar mass of three Cl
= (26.98) + (3 x 35.45)

Molar Mass of $AlCl_3$ = **133.33 g/mol**

Example 2) Molar Mass of $Ba(NO_3)_2$ = MM of one Ba + MM of two N + MM of six oxygens
= (137.33) + (2 x 14.01) + (6 x 16)

Molar Mass of $Ba(NO_3)_2$ = **261.35 g/mol**

	Formula	I/M	Name	Molar Mass (g/mol)
Example	$AlCl_3$			(26.98) + (3 x 35.45) = **133.33**
1.			Carbon tetrachloride	
2.	ZnS			
3.	$(NH_4)_2CO_3$	I	Ammonium carbonate N(2) H(8) C(1) O(3)	(14.01x2) + (1.01x8) + (12.01x1) + (16.00x3) = 96.11 g/mole
4.			Chlorine	
5.	Cu_2SO_4			
6.	$Pb_3(PO_4)_2$		Lead (II) phosphate Pb(3) P(2) O(8)	(207.20x3) + (30.97x2) + (16.00x8) = 811.54 g/mole

Also, instead of 1 mole = 6.02 x 10^{23} atoms it is ***1 mole = 6.02x10^{23} particles***

Class example 1: How many moles are in 54.6 grams of lead (II) phosphate?
(? = moles; given = 54.6 grams)

$$54.6\ g\ Pb_3(PO_4)_2 \left| \frac{1\ mole\ Pb_3(PO_4)_2}{811.54\ g\ Pb_3(PO_4)_2} \right. = 0.0673\ mole\ Pb_3(PO_4)_2$$

(811.54 g = molar mass)

Class example 2: How many particles are in 321.2 grams of ammonium carbonate?
(? = particles; given = 321.2 grams)

$$321.2\ g\ (NH_4)_2CO_3 \left| \frac{1\ mole\ (NH_4)_2CO_3}{96.11\ g\ (NH_4)_2CO_3} \right| \frac{6.02\times10^{23}\ particles}{1\ mole\ (NH_4)_2CO_3} = 2.01\times10^{24}\ particles\ (NH_4)_2CO_3$$

(96.11 g = molar mass)

Molar mass

1. CCl_4 : C: 12.01 + atom Cl: (4×35.45) = $153.81\ g$ / 1 mole

2. Zinc sulfide: ZnS — Zn: 65.39 + S: 32.07 = $97.46\ g$ / 1 mole

3. $(NH_4)_2CO_3$: N: (14.01×2) + H: (1.01×8) + C: 12.01 + O: (16.00×3) : $96.11\ g$ / 1 mole

4. Cl_2 : (35.45×2) : $70.90\ g$ / 1 mole

$BrINCl_2HOF_2$

5. Copper(I) sulfate Cu_2SO_4 : Cu: (63.55×2) + S: 32.07 + O: (16.00×4) : $223.17\ g$ / 1 mole

6. $Pb_3(PO_4)_2$: Pb: (207.20×3) + P: (30.97×2) + O: (16.00×8) : $811.54\ g$ / 1 mole

Solve each of the problems. Remember to use the grid.

1) How many moles are present in 34 grams of copper (II) hydroxide? Formula= $Cu(OH)_2$ (Cu^{+2} $(OH)^{-1}$)

34g $Cu(OH)_2$
?mole
MM = $\frac{97.57g}{1mole}$

$$34g\ Cu(OH)_2 \left| \frac{1mole\ Cu(OH)_2}{97.57g\ Cu(OH)_2} \right.$$

0.35 mole $Cu(OH)_2$ (2 S.F.)

3) How many moles are present in 2.45×10^{23} particles of carbon tetrahydride? Formula= CH_4

2.45×10^{23} particles CH_4
?mole CH_4
1mole = 6.02×10^{23} particle

$$2.45 \times 10^{23}\ particles \left| \frac{1mole}{6.02 \times 10^{23}\ particle} \right.$$

0.407 mole CH_4 (3 s.f.)

4) How many grams are there in 4.5×10^{22} particles of Barium Nitrite? Formula= $Ba(NO_2)_2$ (Ba^{+2} $(NO_2)^{-1}$)

4.5×10^{22} particles $Ba(NO_2)_2$
?g $Ba(NO_2)_2$
MM = $\frac{229.35g}{1mole}$
1mole = 6.02×10^{23} particles

$$4.5 \times 10^{22}\ particles \left| \frac{1mole}{6.02 \times 10^{23}\ particles} \right| \frac{229.35g}{1mole}$$

17g $Ba(NO_2)_2$ (2 s.f.)

5) How many particles are there in 9.34 grams of Lithium chloride? Formula= $LiCl$ (Li^{+1} Cl^{-1})

9.34g LiCl
? particles LiCl
1mole = 6.02×10^{23} particles
MM = $\frac{42.39g}{1mole}$

$$9.34g \left| \frac{1mole}{42.39g} \right| \frac{6.02 \times 10^{23}\ particle}{1mole}$$

1.33×10^{23} particle LiCl (3 s.f.)