Chemistry Calculations

Molar Mass

Review of Significant Digits

- Regardless of decimal position, any of the digits 1 to 9 is a significant digit; 0 may be significant. For example:

123 0.123 0.00230 2.30×10^3

- all have 3 significant digits

- Leading zeros are not significant. For example:

0.12 and 0.012

each have two significant digits

- All trailing zeros are significant. For example:

200 has three significant digits

0.123 00 and 20.000 each have five significant digits

- Exact values are numbers obtained by counting or by definition, i.e. there are exactly 100 cm in 1 metre.

- Exact values have an infinite number of significant digits.

Significant digits in calculations

- When adding or subtracting measured quantities, the calculated answer should be rounded to the same degree of precision as that of the least precise number used in the computation if this is the **only** operation.

Example: Add the following

12.3 (least precise)
0.12
12.34
24.76
49.52

The answer should be rounded to 49.5.

- When multiplying or dividing measured quantities, the calculated answer should be rounded to the same number of significant digits as are contained in the quantity with the fewest number of significant digits if this is the only operation.

Example

- (1.23)(54.321) = 66.81483
- The answer should be rounded to 66.8.

- When a series of calculations is performed, each interim value should **not** be rounded before carrying out the next calculation.
- The final answer should be rounded to the same number of significant digits as are contained in the quantity in the original data with the fewest number of significant digits.

Example

$$\frac{(1.23)(4.321)}{(3.45-3.21)}$$

- three calculations are required:

$$3.45-3.21=0.24$$

$$(1.23)(4.321) = 5.31483$$

$$\frac{5.31483}{0.24}=$$

The final answer should be rounded to 22.1.

Molar mass

- Symbol M
- Mass of 1 mole of atoms or molecules
- Atoms and molecules can't be weighed separately so we use moles
- Physical property of each element or pure substance
- Molar mass of atoms are on the periodic table

Example molar mass of BaS

Ba	137.33 g/mol
S	32.07 g/mol
M =	169.40 g/mol

Remember the rule for adding!

The units are important too!!

$CaCO_3$

Ca		40.08 g/mol
C		12.01
3 O	3 x 16.00	48.00
	M =	100.09 g/mol

$(NH_4)_2HPO_4$

2 N	2 x 14.01 g/mol	= 28.02
8 H	8 x 1.01	= 8.08
1 H		= 1.01
1 P		= 30.97
4 O	4 x 16.00	= 64.00

M = 132.08 g/mol

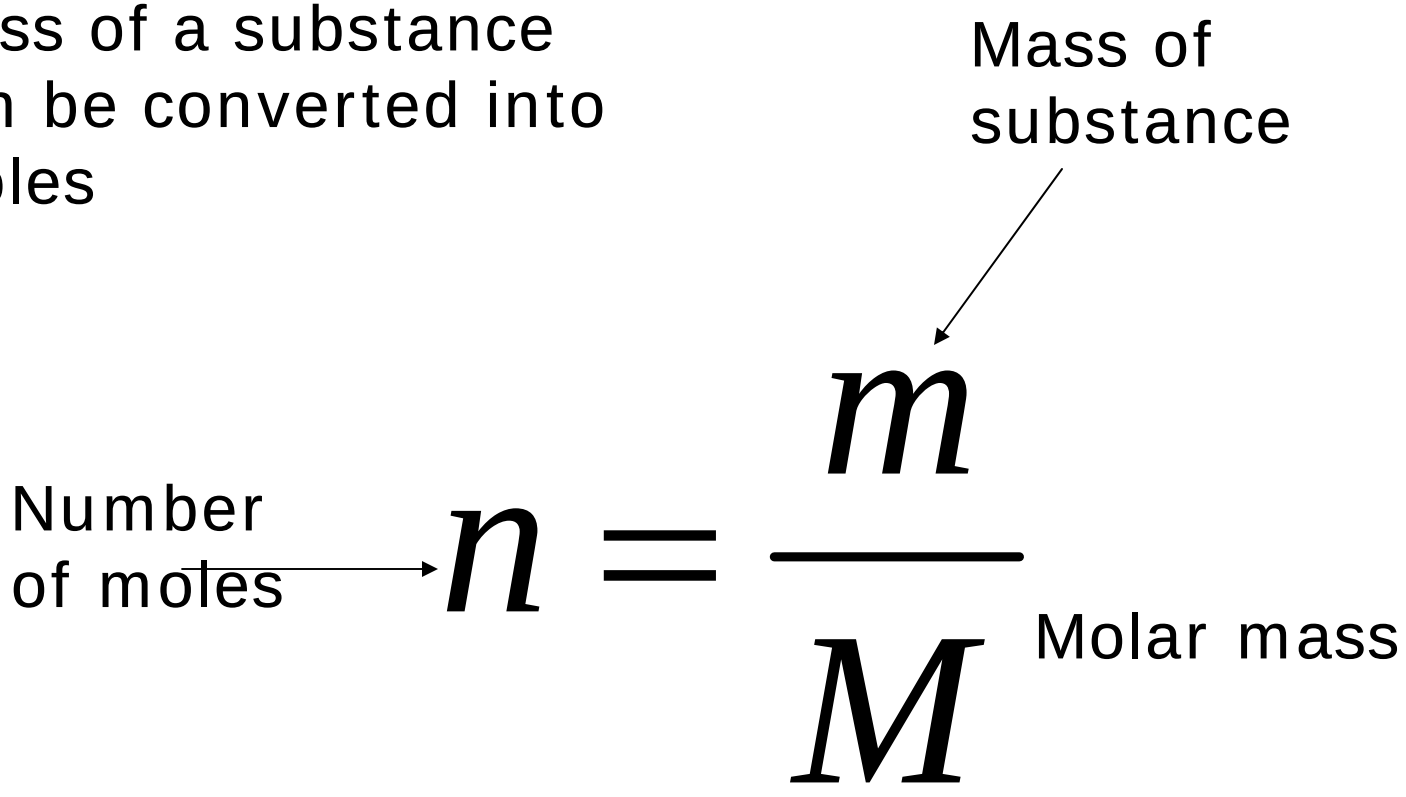
Manganese (IV) oxide

MnO_2

Mn	54.94 g/mol
2 O	32.00
M =	86.94 g/mol

Mass to moles

- Mass of a substance can be converted into moles



Example

- How many moles is 8.67 g of CO_2?
- n = ?
- m = 8.67 g

$$n = \frac{m}{M}$$

M = 44.01 g/mol

$$n = \frac{m}{M} = \frac{8.67\,g}{44.01\,g/mol}$$

n = 0.197 mol

Example

What is the mass of 0.439 moles of $F_{2(g)}$

m = ?

n = 0.439 mol

M = 38.00 g/mol

$$n = \frac{m}{M} \qquad \mathrm{m} = \mathrm{nM}$$

$$m = 0.439 mol \left(38.00 \frac{g}{mol} \right)$$

$$m = 16.682 g$$

m = 16.7 g

Example

- A student has 2.99 moles of a substance. The mass of the substance is 46.05 g. Determine the molar mass.

n = 2.99 mol

m = 46.05 g M = ?

$$n = \frac{m}{M} \qquad m = nM$$

$$M = \frac{m}{n} = \frac{46.05 mol}{2.99 g}$$

M = 15.4 g/mol