SCH 3U

AVOGADRO'S CONSTANT & THE MOLE

DIMENSIONAL ANALYSIS:

- the analysis of the relationships between different physical quantities by identifying their base quantities (such as length, mass, time, volume) and units of measure (such as miles vs kilometers, pounds vs kilograms, minutes vs weeks, mL vs m^3) and tracking these dimensions as calculations are performed. The ***conversion of units*** from one dimensional unit to another is often somewhat complex. Dimensional analysis, or more specifically the **factor-label method**, uses conversion factors to convert between units.

EXERCISE: Perform the following conversions. [Use appropriate significant digits.]

① 245 minutes to years

② 14.75 mg water to cubic metres of water

③ 0.0628 kg of air to litres of air [Density of air = 0.001225 g/cm^3]

④ 6 molecules of $Mg_3(PO_4)_2$ to...

A) number of phosphate ions

B) number of oxygen atoms

THE MOLE

WARM-UPS: What number is associated with the following words?

1.	pair	_____	2.	dozen	_____
3.	baker's dozen	_____	4.	gross of pens	_____
5.	ream of paper	_____	6.	a gross	_____
7.	quartet	_____	8.	mole	_____

A MOLE (*abbr. mol*) is the number of atoms found in 12 grams of carbon – 12.

This number can be associated with any type of particle or object.

For instance,

1 mol of Zn (**element**) contains 6.02×10^{23} **atoms** of Zn.

1 mol of CO_2 (**covalent compound**) contains 6.02×10^{23} **molecules** of CO_2.

1 mol of $MgCl_2$ (**ionic compound**) contains 6.02×10^{23} **formula units** of $MgCl_2$.

1 mol of donuts (food type) contains 6.02×10^{23} **donuts**.

1 mol of loonies (money) consists of **$**602 000 000 000 000 000 000 000.

1 mol of H_2O contains _____

1 mol of NaBr contains _____

1 mol of Au contains _____

1 mol of Reese's pieces contains _____

$$N_A = Avogadro's\ number = 6.02 \times 10^{23}\ particles$$

where particles may be... atoms, molecules, formulas, ions, etc.

Avogadro's number and the mole can be used as a conversion factor in the process of Dimensional Analysis.

Since $\mathbf{1}\ \boldsymbol{mol} = \mathbf{6.02} \times \mathbf{10^{23}}\ \boldsymbol{particles}$,

we can use either $\frac{\mathbf{1}\ \boldsymbol{mol}}{\mathbf{6.02}\times\mathbf{10^{23}}\ \boldsymbol{particles}}$ or $\frac{\mathbf{6.02}\times\mathbf{10^{23}}\ \boldsymbol{particles}}{\mathbf{1}\ \boldsymbol{mol}}$ for calculations.

EXERCISE:

① How many atoms are in 4.27 mol of copper?

② How many molecules are in 0.073 mol of NH_3?

③ How many formula units are in 27.54 mol of $Mg(NO_3)_2$?

④ How many oxygen atoms are in #③ above?

⑤ How many moles are in a sample of 2.57×10^{21} atoms of tin?

⑥ How many moles of CO_2 are in a sample containing 7.15×10^{25} molecules?

⑦ A sample of $Al_2(SO_4)_3$ contains 4.83×10^{24} oxygen atoms. How many moles of the compound are there?

⑧ How many atoms are in a sample of 1.25 mol nitrogen dioxide?

⑨ A sample of calcium phosphate consists of 1.684×10^{25} atoms. How many moles of the compound are in the sample?

⑩ A sample of dichlorine heptoxide contains 4.592×10^{21} atoms. How many atoms of oxygen are there in the sample? How many moles of the compound are in the sample?