Topic: 1.1 Moles and Molar Mass

Enduring Understanding:	
SPQ-1	The mole allows different units to be compared

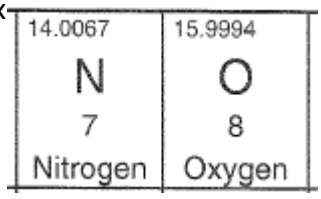
Learning Objective:	
SPQ-1.A	Calculate quantities of a substance or its relative number of particles using dimensional analysis and the mole concept.

Essential Knowledge:	
SPQ-1.A.1	One cannot count particles directly while performing laboratory work. Thus, there must be a connection between the masses of substances reacting and the actual number of particles undergoing chemical changes.
SPQ-1.A.2	Avogadro's number (N_A = 6.022 x 10^{23} particles/mole) provides the connection between the number of moles in a pure sample of a substance and the number of constituent particles (or formula units) of that substance.
SPQ-1.A.3	Expressing the mass of an individual atom or molecule in atomic mass units (amu) is useful because the average mass in amu of one particle (atom or molecule) or formula unit of a substance will always be numerically equal to the molar mass of that substance in grams. Thus, there is a quantitative connection between the mass of a substance and the number of particles that the substance contains.

Equation(s):	
	n = m/M moles = mass/molar mass

Notes:

It is impractical to count atoms as they are so small, so in chemistry we can "count" atoms by weighing them or measuring them in some other way. We need to convert the measurements that we make into numbers of atoms so that we can be sure to react the right amounts of materials. Atomic masses are measured in atomic mass units, amu, which is a relative unit, based on the carbon-12 isotope being assigned a mass of ex
A mole is a term used to describe a group of atoms containing 6.022 x 10^{23} items.
Chemists use moles to discuss amounts of atoms because using the actual amount of atoms is such a large number it is often impractical. You can calculate the mass for one mole of a substance by referring to the periodic table to find the average atomic mass of each atom then adding up the total mass for the formula.



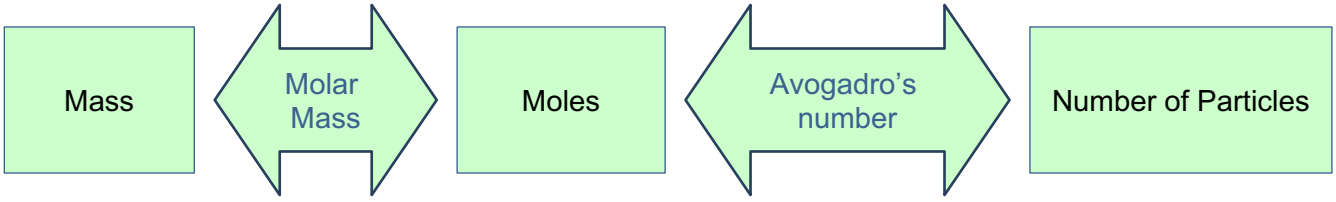
How to calculate Molar Mass:

1) List the atoms
2) Count the atoms
3) Find the mass of each atom from the periodic table
4) Multiply the number of atoms (#2) by the mass of each atom (#3)
5) Add together the values (#4)

Calculate the molar mass of dinitrogen tetroxide:
N_2O_4
N = 2 x 14.0067 = 28.0134
O = 4 x 15.9994 = 63.9976
92.0110 g/mole

Molar mass can be used as a conversion factor to convert between moles and grams. It is unique for each sample.

Avogadro's Number, 6.022 x 10^{23} particles/mole, is the conversion factor to convert between number of particles (molecules, atoms, formula units, ions) and moles.



I do:

How many moles of Lead (II) iodide, PbI_2, are there in a 25.0 gram sample?

$25.0\text{g } PbI_2 \times \frac{1\text{mol } PbI_2}{461.0\text{g } PbI_2} = 0.0542\text{mol } PbI_2$

Molar Mass, PbI_2
Pb = 1 x 207.2 = 207.2
I = 2 x 126.9 = 253.8
461.0g

How many atoms of lead, Pb, ~~are~~ in the sample?

$0.0542\text{ mol } PbI_2 \times \frac{1\text{mol Pb}}{1\text{mol } PbI_2} \times \frac{6.022\times10^{23}\text{ atoms Pb}}{1\text{mol Pb}} = 3.27\times10^{22}\text{ atoms Pb}$

We do:

A 0.244 g sample of calcium carbonate, $CaCO_3$, was recovered from a sample of hard water. How many formula units of $CaCO_3$ were in the sample?

SCAN ME

You do:

1) Methane, CH_4, is the gas commonly found in labs to fuel Bunsen burners.
   a) How many moles of methane are there in a 7.21 gram sample?
   b) How many particles of methane are there in the sample?
   c) How many atoms of hydrogen are found in the sample?

2) Helium, He, is used in balloons, deep sea diving tanks, and in industry. While it is the second most abundant element in the universe, in 2019 there was a shortage of helium which caused the prices to rise. If 150. grams of helium is needed to cool a superconductor, how many atoms of helium are used?

3) If you know the mass and identity of a sample, what other information do you need in order to find the number of each atom in the sample?

4) Given 10.0 gram samples of LiCl, LiBr, LiF and LiI, place the samples in order of least to greatest number of atoms of Lithium, Li.

5) What is the mass of one atom of carbon-12?

6) What is the mass of 2.30×10^{24} particles of water, H_2O?

7) Which is a greater mass, 0.25 moles of carbon dioxide, CO_2, or 1.5×10^{23} particles of carbon monoxide, CO?