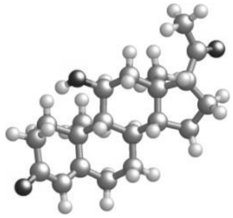


Chem!stry

Name: ……………………… **( )**

Class: ………………

Date: …… **/** …… **/** ……

<u>Five things that you wanted to know about the chemical mole, but were afraid to ask…</u>

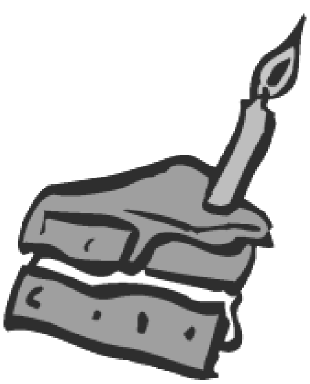
1) What is a chemical mole?

1 mole of a chemical contains 600 000 000 000 000 000 000 000 (or 6×10^{23}) *formula units* of that chemical. This extremely large number, 6×10^{23}, is often referred to as *Avogadro's Constant*.
For example:

- 1 mole of argon, Ar, contains 6×10^{23} *atoms* of argon.
- 1 mole of oxygen, O_2, contains 6×10^{23} *molecules* of oxygen.
- 1 mole of sodium chloride, NaCl, contains 6×10^{23} sodium *ions* <u>and</u> 6×10^{23} chloride *ions*.
- 1 mole of calcium chloride, $CaCl_2$, contains 6×10^{23} calcium *ions* <u>and</u> 12×10^{23} chloride *ions*.

So, essentially, a mole is a very large number that chemists use to count atoms, ions and molecules.

2) Why is it important for chemists to count atoms, ions and molecules?



Imagine baking a delicious cake. The recipe will tell you the amount of each ingredient that is required to successfully create the cake, for example; 100 g of flour, 20 g of sugar and 3 g of baking powder. Just like baking a cake, in chemistry the ingredients (or rather the *reagents*) need to be mixed together in the correct quantities. But how does a chemist know what those quantities are? Consider the following balanced chemical equation:

$$\text{sodium} + \text{chlorine} \rightarrow \text{sodium chloride}$$

$$2Na_{(s)} + Cl_{2(g)} \rightarrow 2NaCl_{(s)}$$

This tells us that 2 moles of sodium react with 1 mole of chlorine molecules to produce 2 moles of sodium chloride. To a chemist, this means that if you take 46.0 g of sodium and you react it with 71.0 g of chlorine, you will produce 117 g of sodium chloride. How does a chemist know that 2 moles of sodium weigh 46.0 g? Keep reading to find out…

3) But atoms are so small! How do chemists obtain 1 mole of an element? You can't *possibly* count out each and every single atom!

Chemists measure out 1 mole of an element by *weighing* it. A similar thing happens if you take a large bag of coins to a bank or post office. The cashier will not waste their time counting out each and every coin in the bag! Instead, they will simply *weigh* the bag of coins to determine the number of coins inside. This is possible because the cashier knows the unique mass of each coin. For example, a 5c coin might weigh 1.0 g, a 10c coin 2.5 g and a 50c coin 5.5 g. In a similar way, chemists can weigh out 1 mole of an element because they know the unique *relative atomic mass* (A_r) of each element. For example, 1 mole of magnesium weighs 24 g, 1 mole of phosphorus weighs 31 g and 1 mole of silver weighs 108 g.

4) So, to obtain 1 mole of an *element*, a chemist will *weigh out the element's relative atomic mass in grams*. But what about *compounds*?

To weigh out 1 mole of a compound, its *relative molecular mass* (for covalent compounds) or *relative formula mass* (for ionic compounds) must be calculated and then weighed out in grams. The relative molecular / formula mass (symbol, M_r) of a compound is the sum of all of the relative atomic masses of the elements that comprise 1 formula unit of that compound. For example, the relative formula mass of aluminium oxide (formula Al_2O_3) is:

$$(A_r)\text{Al} + (A_r)\text{Al} + (A_r)\text{O} + (A_r)\text{O} + (A_r)\text{O}$$
$$= 27.0 + 27.0 + 16.0 + 16.0 + 16.0$$
$$= 102$$

Therefore, 1 mole of aluminium oxide weighs <u>102 g</u>

5) What equations are used to convert a mass in grams into moles and vice-versa?

a) mass in grams → number of moles:

$$\text{amount of substance (in moles)} = \frac{\text{mass of substance (g)}}{\text{relative molecular mass of substance}}$$

b) number of moles → mass in grams:

mass of substance (g) = amount of substance (in moles) × relative molecular mass of substance

The Moles and Molecules Shop

	Customer, "I would like…"	Shop Keeper, "Certainly, I will weigh out…"
1.	4 moles of copper – Cu.	
2.	2 moles of calcium – Ca.	
3.	3 moles of magnesium ions – Mg^{2+}.	
4.	0.5 moles of oxygen *atoms* – O.	
5.	0.5 moles of oxygen *molecules* – O_2.	
6.	2.5 mole of $Al_2(SO_4)_3$.	
7.	15 moles of carbon dioxide – CO_2.	
8.	10 moles of sulphuric acid – H_2SO_4.	
9.	3 moles of $CuSO_4{\cdot}5H_2O$.	
10.	4 moles of sodium chloride – NaCl.	
11.	0.25 moles of calcium hydroxide – $Ca(OH)_2$.	
12.	2 mole of $NH_4Fe(SO_4)_2{\cdot}12H_2O$.	
	Customer, "Could you please weigh out…"	**Shop Keeper, "That will be… …many moles."**
13.	69.0 g of lead – Pb.	
14.	14.0 g of iron – Fe.	
15.	56.0 g of nitrogen – N_2.	
16.	2.01 g of mercury – Hg.	
17.	18.0 g of aluminium – Al.	
18.	25.0 g of calcium carbonate – $CaCO_3$.	
19.	740 g of magnesium nitrate – $Mg(NO_3)_2$.	
20.	57.2 g of $Na_2CO_3{\cdot}10H_2O$.	

- Scan the QR code below for the answers to this assignment.

http://www.chemist.sg/mole/molecules_shop_ans.pdf