Colegio de
San Francisco de Paula

Stoichiometry step by step

Remember that in a chemical reaction the atoms never get lost nor created. Taking this into account and understanding the balancing of equations and the concept of the mole you will be able to do some stoichiometry very soon. Remember that the mole is just a unit of quantity, like a dozen (12) for example. So have a look at the following equation.

$2HCl + Zn \rightarrow ZnCl_2 + H_2$
Or in words: 2 molecules of hydrochloric acid react with one zinc atom to form one zinc chloride molecule and 1 hydrogen gas molecule.
In stoichiometry you can change those coefficients for any other unit.

- You could state that if 2 dozen HCl reacts with 1 dozen zinc atoms to form one dozen zinc chloride moleculsa and 1 dozen hydrogen gas molecules.
- Or you state that if 2 moles of hydrochloric acid reacts with one mole of zinc atoms it will form one mole of zinc chloride molecules and 1 mole hydrogen gas molecules.

So have a look at these examples:

Question 1a
How many moles of chlorine gas (Cl_2) would react with 5 moles of sodium (Na) according to the following chemical equation?

$Na + Cl_2$ --> NaCl

1st Balance the equation

2Na + Cl_2 --> 2NaCl

2nd Mole/Mole ratio

1: The conclusion you come to is; *Two moles of sodium would react with one mole of Chlorine gas to produce 2 moles of sodium chloride*

2: So now you simply calculate (using the rule of three if you like) how many moles of Cl_2 would react wilt the 5 moles of Na.

Well if 2 mole of Na is needed for 1 mole of Cl_2, than we need clearly half of the amount. **So 5 mole of Na would react with 2.5 moles of Cl_2**, as simple as that!

If you know how many moles are created you can convert those to mass by applying the formula to calculate moles, which is:

- **Amount of the substance (g) / Atomic or molecular mass = Mol**
- **Or, Mol x Atomic or molecular mass = Amount of substance (g)**

So have a look at this example:

Question 1b

Using the equation (after it is balanced) of question **1a,** determine the amount of product that can be produced from 66g Na.

1st covert mass to mole

To know how many mole we need we first need to convert the mass to moles. As you know 1 mole of a substance is its molecular or atomic mass (in case of a pure element) in grams. So the question is how many atomic masses of Na are there in 66g?

Easy, the atomic mass of Na is 23g, so if you divide the grams we have by the Molecular Mass, so 66/23=**2.5 mole**

2nd Do the Mole to mole ratio again

Remember: 2Na + Cl_2 --> 2NaCl (or two moles of Na reacts with 1 mole of Cl_2 to produce 2 mole of NaCl)

So: 2.5 mole of Na would react with 1.25 mole of Cl2 to produce 2.5 mole of NaCl.

3rd Convert mole back to mass

The molecular mass of $NaCl_2$ is once the atomic mass of Na plus twice the atomic mass of Cl_2. So; 23 + (2x35.5)= 93g (this is the molecular mass of $NaCl_2$). We have 2.5 mole so; 2.5x93=**232.5g of NaCl2**

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Question 1c. How many molecules of product would be produced from 63g of Na?

Fact: Each mole has 6.02×10^{23} molecules, or atoms in the case of pure elements.

So, if we have 2.5 mole, we **$2.5 \times 6.02 \times 10^{23}$ molecules** OR **15.05×10^{23} molecules**