

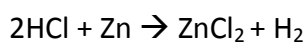


Colegio de

# 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.



*Or in words:* 2 molecules of hydrochloric acid react with one zinc atom to form one zinc chloride molecule and 1 hydrogen gas molecule.

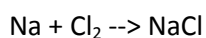
In stoichiometry you can change those coefficients for any other unit.

- You could state that if 2 dozen HCl reacts with 1 dozen zinc atoms to form one dozen zinc chloride molecules 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.

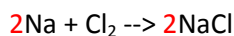
*So have a look at these examples:*

### Question 1a

How many moles of chlorine gas ( $\text{Cl}_2$ ) would react with 5 moles of sodium (Na) according to the following chemical equation?



1<sup>st</sup> Balance the equation



2<sup>nd</sup> 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  $\text{Cl}_2$  would react with the 5 moles of Na.



Colegio de  
**San Francisco de Paula**

Well if 2 mole of Na is needed for 1 mole of  $\text{Cl}_2$ , than we need clearly half of the amount. **So 5 mole of Na would react with 2.5 moles of  $\text{Cl}_2$** , 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.

1<sup>st</sup> 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**

2<sup>nd</sup> Do the Mole to mole ratio again

**Remember:**  $2\text{Na} + \text{Cl}_2 \rightarrow 2\text{NaCl}$  (or two moles of Na reacts with 1 mole of  $\text{Cl}_2$  to produce 2 mole of NaCl)

**So:** 2.5 mole of Na would react with 1.25 mole of  $\text{Cl}_2$  to produce 2.5 mole of NaCl.

3<sup>rd</sup> Convert mole back to mass

The molecular mass of  $\text{NaCl}_2$  is once the atomic mass of Na plus twice the atomic mass of  $\text{Cl}_2$ . So;  $23 + (2 \times 35.5) = 93\text{g}$  (this is the molecular mass of  $\text{NaCl}_2$ ). We have 2.5 mole so;  $2.5 \times 93 = 232.5\text{g}$  of  **$\text{NaCl}_2$**



Colegio de  
**San Francisco de Paula**

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

Fact: Each mole has  $6.02 \times 10^{23}$  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  $15.05 \times 10^{23}$  molecules