4. Measurement of Matter



Laws of chemical combination > Atom - shape, mass, valency
Molecular mass and the concept of mole > Radicals



- 1. What is the Dalton's atomic theory ?
- 2. How are the compounds formed ?
- 3. What are the molecular formulae of common salt, slaked lime, water, lime, limestone ?

In the previous standard we have learnt that compounds are formed by chemical combination of elements. We have also learnt that an important principle of Dalton's atomic theory is that molecules of a compound are formed by joining atoms of different elements to each other.

Laws of chemical combination

The composition of a substance changes during a chemical change. The fundamental experiments in this regard were performed by scientists in the 18th and 19th century. While doing this, they measured accurately, the substances used and formed and discovered the laws of chemical combination. Scientists could then write the molecular formulae of various compounds on the basis of Dalton's atomic theory and the laws of chemical combination. Here we shall verify the laws of chemical combination by means of known molecular formulae.



Apparatus : Conical flask, test tubes, balance, etc.

Chemicals : Calcium chloride $(CaCl_2)$, sodium sulphate (Na_2SO_4) , calcium oxide (CaO), Water (H_2O)

Activity 1	Activity 2
 Take 56 g calcium oxide in a large conical flask and put 18 g water in it. Observe what happens. 	• Take a solution of calcium chloride in a conical flask and a solution of sodium sulphate in a test tube.
 Measure the mass of the substance formed. What similarity do you find? Write your inference. 	 Tie a thread to the test tube and insert it in the conical flask. Seal the conical flask with an airtight rubber cork. Weigh mass of the conical flask using a balance.
	 Now tilt the conical flask so that the solution in the test tube gets poured in the conical flask. Now weigh mass of the conical flask again. Which changes did you notice? Was there any change in the mass?
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4.1 Verification of law of the chemical combination

Law of conservation of matter

In the above activities, the mass of the original matter and the mass of the matter newly formed as a result of the chemical change are equal. In 1785, the French Scientist Antoine Lavoisier inferred from his research that 'there is no rise or drop in the mass of the matter during a chemical reaction.' In a chemical reaction the total mass of the **reactants** is same as the total mass of the **products** formed due to the chemical reactions and this is called the law of conservation of matter.

Law of constant proportion

1794 the French In scientist J. L. Proust stated the law of constant proportions as "The proportion by mass of the constituent elements in the different samples of a compound is fixed," e.g., the proportion by mass of hydrogen and oxygen in water is obtained from any • source 1:8. This means that 9 g water is formed by chemical combination of 1 g hydrogen and 8 g oxygen. Similarly, • the proportion by mass of carbon and oxygen in carbon dioxide obtained from any source is 3:8. This means that in 44 g of carbondioxide there is 12 g of carbon and 32 g of oxygen so that the proportion by mass of carbon and oxygen is 3:8.



An introduction to scientists

Antoine Lavoisier (1743-94)

French scientist, father of modern chemistry, substantial contribution in the fields of chemistry, biology and economics.

- Nomenclature of oxygen and hydrogen.
- Showed that matter combines with oxygen during combustion.
- Was the first to use accurate weighing techniques to weigh mass of reactants and products in a chemical reaction.
- Discovered that water is made up of hydrogen and oxygen.
- First writer of the law of conservation of mass, in a chemical reaction.
- Assigned systematic names to the compounds, e.g. sulphuric acid, copper sulphate, sulphite.
- Authored the first book on modern chemistry- 'Elementary Treatise on Chemistry in 1789.'
- Studied the elements such as oxygen, hydrogen, nitrogen, phosphorus, mercury, zinc and sulphur.



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Verification of the law of constant proportion

Many compounds can be made by different methods. For example, two samples of the compound copper oxide, CuO, were obtained, one by decomposition of copper carbonate, $CuCO_3$, and another by decomposition of copper nitrate, $Cu(NO_3)_2$. From each of these samples, a mass of 8g of copper oxide was taken and each was treated independently with hydrogen gas. Both gave 6.4 g copper and 1.8 g water. Let us see how does this is a verification of the law of constant proportion.

The reaction of copper oxide with hydrogen yielded two known substances, namely, the compound water and the element copper. It is known that, in the compound water, H_2O , the elements H and O are in the proportion 1:8 by mass. This means that in 9g water there are 8g of the element oxygen. Therefore, 1.8g water contains (8x1.8/9 = 1.6)g oxygen. This oxygen has come from 8g copper oxide. It means that 8g of both the samples of copper oxide contained 6.4g copper and 1.6g oxygen; and the proportion by mass of copper and oxygen in it is 6.4:1.6, that is, 4:1. Thus, the experiment showed that the proportion by mass of the constituent elements in different samples of a compound is constant.

Now let us see what the expected proportion by mass of the constituent elements of copper oxide would be from its known molecular formula CuO. To find out this, we need to use the known atomic masses of the elements. The atomic masses of Cu and O are 63.5 and 16 respectively. This means that the proportion by mass of the constituent elements Cu and O in the compound CuO is 63.5 : 16 which is 3.968:1, or approximately 4:1.

The experimental value of proportion by mass of the constituent elements matched with the expected proportion calculated from the molecular formula. Thus, the law of constant proportion is verified.

Atom : size, mass and valency



m

1m = 1

1. From which experiments was it discovered that atoms have an internal structure? When?

2. What are the two parts of an atom? What are they made up of?

We have learnt that at the centre of an atom is the nucleus and that there are moving electrons in the extra-nuclear part. The electrons are negatively charged elementary particles while the elementary particles that make up the nucleus are positively charged protons and electrically neutral neutrons.

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The size of an atom is determined by its radius. The atomic radius of an isolated atom is the distance between the nucleus of an atom and its outermost orbit. Atomic radius is expressed in nanometres.

Approximate size of atom and Molecule						
Atomic radius (in metres)	Example					
10 ⁻¹⁰	Hydrogen atom					
10 ⁻⁹	Water molecule					
10 ⁻⁸	Haemoglobin molecule					
ł	Atomic radius (in metres) $ \frac{10^{-10}}{10^{-9}} $ $ 10^{-8} $					



4.2 Field ion microscope image of iridium atoms (every spot in this image is an atom)





Atoms are very tiny. Modern like instruments electron microscope. field ion microscope, scanning tunneling microscope enlarged images of the atom. Look at the image of an atom fig. 4.2 obtained with a field ion microscope.

The atomic size depends on the number of electron orbits in the atom. The greater the number of orbits the larger the size. For example, an atom of K is bigger than an atom of Na. If two atoms have the same outermost orbit, then the atom having the larger number of electrons in the outermost orbit is smaller than the one having fewer electrons in the same outermost orbit. For example an atom of Mg is smaller than an atom of Na.

The mass of an atom

The mass of an atom is concentrated in its nucleus and it is due to the protons (p) and neutrons (n) in it. The total number (of protons and neutrons) in the atomic nucleus is called the **atomic mass number**. Protons and neutrons are together called **nucleons**.

An atom is very tiny. Then how do we determine its mass? Scientists too, faced this question. It was not possible for scientists of the 19th century to measure atomic mass accurately. Therefore, the concept of 'relative mass of an atom' was put forth. A reference atom was required for expressing the relative mass of an atom. The hydrogen atom being the lightest was initially chosen as the reference atom. The relative mass of a hydrogen atom which has only one proton in its nucleus was accepted as one (1). Therefore, the magnitude of the relative atomic masses of various atoms became equal to their atomic mass number (p+n).

Let us see how to express the relative mass of a nitrogen atom, having accepted the relative atomic mass of hydrogen as 1.

The mass of one nitrogen atom is fourteen (14) times that of a hydrogen atom. Therefore, the relative mass of a nitrogen atom is 14. This is how the relative atomic masses of various elements were determined. On this scale, the relative atomic masses of many elements came out to be fractional. Therefore, in the course of time, some other atoms were chosen as reference atoms. Finally in 1961, the carbon atom was selected as the reference atom. In this scale, the relative mass a carbon atom was accepted as 12. The relative atomic mass of one hydrogen atom compared to the carbon atom becomes $12 \times 1/12$, that is 1. The mass of one proton and of one neutron on the scale of relative atomic masses is approximately one.

1	
ð	Research

The relative atomic masses of some elements in the chart below are given. You have to find the relative atomic masses of the others.

Element	Atomic mass	Element	Atomic mass	Element	Atomic mass
Hydrogen	1	Oxygen	-	Phosphorus	-
Helium	4	Fluorine	19	19 Sulphur	
Lithium	7	Neon	20 Chlorine		35.5
Beryllium	9	Sodium	-	Argon	-
Boron	11	Magnesium	24	Potassium	-
Carbon	12	Aluminium	-	Calcium	40
Nitrogen	14	Silicon	28		

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Today, we have highly accurate methods for measuring the mass of an atom directly. Hence, instead of relative mass, Unified Mass has now been accepted as the unit of atomic mass. It is called Dalton. Its symbol is 'u'. $1u = 1.66053904 \times 10^{-27}$ kg

Chemical symbols of elements

Can you tell?

1. How is an element represented in Chemistry?

Can you tell? 2. Write down the symbols of the elements you know.

3. Write down the symbols for the following elements : antimony, iron, gold, silver, mercury, lead, sodium.

Dalton used certain signs to represent elements. For example \bigcirc for hydrogen, \bigcirc for copper. Today we use the symbols determined by IUPAC (International Union of Pure and Applied Chemistry). These are official names and symbols and are used all over the world. The current method of choosing chemical symbols is based on the method invented by Berzelius. According to this method the symbol of an element is either the first letter or the first and second/another specific letter in its name. Of the two letters, the first is written as capital letter and the second is small.

Molecules of elements and compounds

Atoms of some elements such as helium, neon have independent existence. It means that these elements are in a mono-atomic molecular state. Sometimes, two or more atoms of an element combine to form molecules of that element. Such elements are in a polyatomic molecular state. For example, the elements oxygen, nitrogen are in a diatomic molecular state as O_2 , N_2 respectively. When atoms of different elements combine with each other, the molecules of compounds are formed. In other words, compounds are formed by chemical attraction between different elements.



Make a list of elements that exist in mono-atomic and diatomic molecular states.

Molecular mass and the concept of mole

Molecular mass

The molecular mass of a substance is the sum of the atomic masses of all the atoms in a single molecule of that substance. Like atomic mass, molecular mass is also expressed in the unit Dalton (u).

Molecule	Constituent elements	Atomic mass u	Number of atoms in the molecule	Atomic mass × number of atoms	Mass of the constituents u
H ₂ O	Hydrogen	1	2	1×2	2
	Oxygen	16	1	16 × 1	16
(Molecu	Molecular Mass 18				

How to deduce the molecular mass of H_2O ?







Following are atomic masses of a few elements in Dalton and the molecular formulae of some compounds. Deduce the molecular masses of those compounds.

Atomic masses \rightarrow H(1), O(16), N(14), C(12), K(39), S(32) Ca(40), Na(23), Cl(35.5), Mg(24), Al(27)

Molecular formulae \rightarrow NaCl, MgCl₂, KNO₃, H₂O₂, AlCl₃, Ca(OH)₂, MgO, H₂SO₄, HNO₃, NaOH



1. Weigh mass of single grains of *tur dal, masoor dal* and *chana dal* on a balance. What was your experience?

2. Weigh mass of 10g of *Tur dal, Masoor dal* and *Chana dal* each and count the number of *dal* grains of each kind in the weighed portions. Is the number the same for all or different?

- 3. Draw a line sketch on a paper. Paint it by placing/pasting the *dal* grains in the sequence *Tur*, *Masoor* and Bengal gram. You will need equal number of *dal*-grains of the three kinds. Count that number and also find out how many dozens of the respective *dal*-grains were required. Therefrom deduce the number of grams of *tur dal*, *masoor dal* and *chana dal* required for painting the picture.
- 4. What inference will you draw about the mass of an equal number of its different *dal* grains and the number of its *dal* grains in equal mass of different *dals*?



How much of wheat, jowar and bajra seed is required for sowing one acre of land? Can these masses be correlated to the number of grains of the respective cereals they contain?

1. Is it possible to weigh mass of one molecule using a weighing balance?

- 2. Will the number of molecules be the same in equal quantities of different substances?
- 3. If we want equal number of molecules of different substances, will it work to take equal masses of those substances?

When elements and compounds take part in chemical reactions, it is their atoms and molecules that react with each other, and therefore it is necessary to know the numbers of their atoms and molecules. However, while carrying out a chemical reaction it, is convenient to measure out quantities that can be handled instead of counting the numbers of atoms and molecules. The concept of 'mole' is useful for this purpose.

A mole is that quantity of a substance whose mass in grams is equal in magnitude to the molecular mass of that substance in Daltons. Thus, the molecular mass of oxygen is 32u, and therefore 32g oxygen is 1mole of oxygen. The molecular mass of water is 18u. Therefore, 18g of water make 1 mole of water.

1 mole of a compound is the mass of that subtance in grams equal in magnitude to its molecular mass. The SI unit is mol.	Number of moles of a substances (n) = $\frac{\text{Mass of substance in grams}}{\text{Molecular mass of substance}}$
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Avogadro's number

The number of molecules in one mole of any substance is constant. The Italian scientist Avogadro did fundamental work in this context. Therefore this number is called Avogadro's number and is denoted by the symbol N_A . Later scientists demonstrated experimentally that the value of Avogadro's number is 6.022 x 10^{23} . A mole of any substance stands for 6.022 x 10^{23} molecules. Just as a dozen has 12 items, a century has 100 or a gross has 144, a mole means 6.022 x 10^{23} . For example, a mole of water, that is, 18g of water contains 6.022 x 10^{23} molecules of water.

How many molecules are there in 66 g of CO_2 ?

Method : molecular mass of CO_2 is 44.

Number of moles in the given $CO_2(n) = \frac{Mass of CO_2 in grams}{Molecular mass of CO_2} = \frac{66}{44}$

. n = 1.5 mol

- \therefore 1 mol of CO₂ contains 6.022 x 10²³ molecules.
- \therefore 1.5 mol CO₂ contains 1.5 x 6.022x10²³ molecules = 9.033 x 10²³ molecules



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3. One mole quantities of different substances have different masses measured in grams.

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sample?





Valency



- 1. Determine the valencies of H, Cl, O and Na from the molecular formulae H₂, HCl, H₂O and NaCl.
- 2. What is the type of chemical bond in NaCl and MgCl₂?

The capacity of an element to combine is called its valency. The valency of an element is indicated by a specific number. It is the number of chemical bonds formed by one atom of that element with other atoms. In the 18th and 19th century, the laws of chemical combination were used to find out the valencies of elements. In 20th century, the relationship of the valency of an element with its electronic configuration was recognised.

Sodium atom (Na) Electron configuration (2,8,1) $\xrightarrow{-1e^-}$ Sodium ion Na⁺ (2,8)Chlorine atom (Cl) Electron configuration (2,8,7) $\xrightarrow{+1e^-}$ Chloride ion Cl⁻ (2,8,8)Na⁺ + Cl⁻ \longrightarrow NaCl (sodium chloride)

A sodium atom gives away one electron and a cation of sodium is formed, hence, the valency of sodium is one. A chlorine atom takes up one electron and forms an anion of chlorine (chloride) and thus, the valency of chlorine is 1. After the give and take of electrons is over, the electronic configuration of both the resulting ions has a complete octet. Due to the attraction between the unit opposite charges on the two ions, one chemical bond is formed between Na⁺ and Cl⁻ and the compound NaCl is formed.

Thus, a sodium atom has the capacity to give away one electron while a chlorine atom has the capacity to take up one electron. This means that the valency of both the elements sodium and chlorine is 1. From this the electronic definition of valency is as follows : "The number of electrons that an atom of an element gives away or takes up while forming an ionic bond, is called the valency of that element."

Science capsule

How will the compounds, MgCl₂ and CaO be

Positively charged ions are called **cations** while negatively charged ions are called **anions**. For example, $MgCl_2$ contains Mg^{++} and Cl^- as cation and anion respectively.

The electrons present in the outermost orbit of an atom are called valence electrons.



Use your brain power !

The National Chemical Laboratory (NCL), a unit of the CSIR, was established in 1950. Its objectives are to conduct research in the various branches of chemistry, to aid industry and to develop new technology with a view to making profitable use of the country's natural resources. The Laboratory conducts research in fields such as biotechnology, nanotechnology,

catalysis, drugs, instrumentation, agro chemicals, plant tissue

The number of electrons that are given away or taken up is always a whole number. Therefore, valency is always a whole number.

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culture and polymer science.

formed their elements?

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Complete the following chart.

Element	Atomic number	Electron configu-	Valence elec-	Valen- cy
		ration	trons	
Hydrogen	1	1	1	1
Helium	2	2	2	0
Lithium		2,1		
Beryllium	4			2
Boron	5	2,3		
Carbon		2,4	4	
Nitrogen	7			3
Oxygen		2,6	6	
Fluorine	9		7	
Neon	10			
Sodium		2,8,1	1	1
Magnesium	12		2	
Aluminium	13	2,8,3		
Silicon	14		4	

Variable valency

Under different conditions the atoms of some elements give away or take up different numbers of electrons. In such cases those elements exhibit more than one valency. This property of elements is called variable valency.



Iron (Fe) exhibits the variable valencies 2 and 3. Therefore iron forms two compounds with chlorine $FeCl_2$ and $FeCl_3$.

Some elements that exhibit variable valency

Element	Symbol	Valency	Ion	Nomenclature
Copper	Cu	1 and 2	Cu^+	Cuprous
			Cu^{2+}	Cupric
Mercury	Hg	1 and 2	Hg^+	Mercurous
			Hg^{2+}	Mercuric
Iron	Fe	2 and 3	Fe^{2+}	Ferrous
			Fe ³⁺	Ferric



2. Find out the compounds of the above elements which have variable valency.

Radicals



Write down the cations and anions obtained from the compounds in the following chart.

>>

Base	Cation	Anion	Acid	Cation	Anion
NaOH			HCl		
КОН			HBr		
Ca(OH) ₂			HNO ₃		



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Compounds with ionic bonds have two constituents. These are cations (positively charged ions) and anions (negatively charged ion). They take part independently in chemical reaction and are therefore, called radicals. It is seen from the above chart that different bases such as NaOH, KOH are formed when various cationic radicals are paired with the different anionic radical, hydroxide. Hence the cationic radicals are also called basic radicals. Different bases are distinguished from each other by the basic radicals in them. On the other hand, different acids, such as HCl, HBr are formed when different anionic radicals are paired with the cationic radicals are paired with the cationic radical H⁺. Therefore, the anionic radicals are called acidic radicals. The difference in the composition of various acids becomes clear from the acidic radicals present in them.



Which are the basic radicals and which are the acidic radicals among the following?

Ag⁺, Cu²⁺, Cl⁻, I⁻, SO₄⁻²⁻, Fe³⁺, Ca²⁺, NO₃⁻, S²⁻, NH₄⁺, K⁺, MnO₄⁻, Na⁺

Generally, basic radicals are formed by removal of electrons from the atoms of metals, such as Na⁺, Cu²⁺. But there are some exceptions, such as NH_4^+ . Similarly, the acidic radicals are formed by adding electrons to the atoms of non-metals, such as Cl⁻, S²⁻. But there are some exceptions like MnO_4^- .



Classify the following radicals into two types. While doing this use a criterion other than the sign of the electronic charge on them.

Ag⁺, Mg²⁺, Cl⁻, SO₄⁻²⁻, Fe²⁺, ClO₃⁻, NH₄⁺, Br⁻, NO₃⁻

Monoatomic radicals such as Na⁺, Cu⁺, Cl⁻ are called simple radicals. When a radical is a group of atoms carrying charge, such as SO_4^{2-} , NH_4^{+} , it is called composite radical. The magnitude of charge on any radical is its valency.

Chemical formulae of compounds : A recapitulation.

The characteristic of a compound formed by ionic bonds is that its molecule has two parts. These are a cation and an anion, that is, a basic radical and an acidic radical. These two parts are oppositely charged. The force of attraction between them constitutes the ionic bond. The name of an ionic compound contains two words. The first word is the name of the cation and the second is the name of the anion. For example, the formula of a compound such as sodium chloride is written by writing the symbol of the cation on the left and adjoined to it on the right is the symbol of the anion. The charges are not shown though the number of the ions is written as a subscript on the right of the symbol of the ion. In the case of composite radical the number is written as subscript outside the bracket enclosing its symbol. This number is obtained easily by the method of cross multiplication of the valencies. The steps for writing a chemical formula are shown on the next page.

Using ICT

To study 'Measurement of Matter' further and for additional information, visit the websites given alongside.

Prepare a spreadsheet showing the atomic mass of elements, molecular masses, electronic configurations and valencies.

Website for more information www.organic.chemistry.org www. masterorganicchemistry.com www. rsc.org.learnchemistry

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Step 1: To write the symbols of the radicals. (Basic radical on the left.) Na

SO

Step 2 : To write the valency below the respective radical.

Na SO_4 1 2

Step 3 : To cross-multiply as shown by the arrows the number of the radicals.

$$Na$$
 SO_4 2

Step 4 : To write down the chemical formula of the compound.

Na₂SO₄

In order to write the chemical formulae of compounds, it is necessary to know the valency of the various radicals. The names and symbols along with the charge of common radicals are given in the chart below.

	Ions/Radicals						
	Basic Radicals				Acidic Radicals		
Н+	Hydrogen	Al ³⁺	Aluminium	H⁻	Hydride	MnO_4^-	Permanganate
Na+	Sodium	Cr ³⁺	Chromium	F-	Fluoride	ClO3-	Chlorate
K*	Potassium	Fe ³⁺	Ferric	Cl-	Chloride	BrO3-	Bromate
Ag+	Silver	Au ³⁺	Gold	Br⁻	Bromide	IO ₃ -	Iodate
Hg+	Mercurous	Sn ⁴⁺	Stannic	I-	Iodide	CO ₃ ²⁻	Carbonate
Cu+	Cuprous	NH ₄ +	Ammonium	O ²⁻	Oxide	SO ₄ ²⁻	Sulphate
Cu ²⁺	Cupric/Copper			S ²⁻	Sulphide	SO ₃ ²⁻	Sulphite
Mg ²⁺	Magnesium			N ³⁻	Nitride	CrO ₄ ²⁻	Chromate
Ca ²⁺	Calcium					Cr ₂ O ₇ ²⁻	Dichromate
Ni ²⁺	Nickel			OH-	Hydroxide	PO ₄ ³⁻	Phosphate
Co ²⁺	Cobalt			NO ₃ -	Nitrate		
Hg ²⁺	Mercuric			NO_2^{-}	Nitrite		[]
Mn^{2+}	Manganese			HCO3-	Bicarbonate		
Fe ²⁺	Ferrous (Iron II)			HSO ₄ -	Bisulphate		
Sn ²⁺	Stannous			HSO3-	Bisulphite		
Pt ²⁺	Platinum						6T7E2X

Books are my friends

Essentials of Chemistry, The Encylopedia of Chemistry, Science and Technology Dictionary.

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Using the chart of ions/radicals and the crossmultiplication method, write the chemical formulae of the following compounds : Calcium carbonate, Sodium

bicarbonate, Silver chloride, Calcium hydroxide, Magnesium oxide, Ammonium phosphate, Cuprous bromide, Copper sulphate, Potassium nitrate, Sodium dichromate.

Exercises 4

- 1. Give examples.
 - a. Positive radicals
 - b. Basic radicals
 - c. Composite radicals
 - d. Metals with variable valency
 - e. Bivalent acidic radicals
 - f. Trivalent basic radicals
- 2. Write symbols of the following elements and the radicals obtained from them, and indicate the charge on the radicals.

Mercury, potassium, nitrogen, copper, sulphur, carbon, chlorine, oxygen

3. Write the steps in deducing the chemical formulae of the following compounds.

Sodium sulphate, potassium nitrate, ferric phosphate, calcium oxide, aluminium hydroxide

- 4. Write answers to the following questions and explain your answers.
 - a. Explain the monovalency of the element sodium.
 - b. M is a bivalent metal. Write down the steps to find the chemical formulae of its compounds formed with the radicals : sulphate and phosphate
 - c. Explain the need for a reference atom for atomic mass. Give some information about two reference atoms.
 - d. What is meant by Unified Atomic Mass?
 - e. Explain with examples what is meant by a 'mole' of a substance.

5. Write the names of the following compounds and deduce their molecular masses.

Na₂SO₄, K₂CO₃, CO₂, MgCl₂, NaOH, AlPO₄, NaHCO₃

6. Two samples 'm' and 'n' of slaked lime were obtained from two different reactions. The details about their composition are as follows:

'sample m' mass : 7g Mass of constituent oxygen : 2g Mass of constituent calcium : 5g 'sample n' mass : 1.4g

Mass of constituent oxygen : 0.4g Mass of constituent calcium : 1.0g Which law of chemical combination does this prove? Explain.

7. Deduce the number of molecules of the following compounds in the given quantities.

32g oxygen, 90g water, 8.8g carbon di oxide, 7.1g chlorine.

8. If 0.2 mol of the following substances are required how many grams of those substances should be taken? Sodium chloride, magnesium oxide, calcium carbonate

Project :

Prepare models of various radicals using cardboard, small circular magnets and araldite. From these make models of molecules of various compounds.



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