Class 9 Science Chapter 4 - MeasurementOf Matter

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Question 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

ANSWER:

Given examples of the following are as follows :

a. Positive Radicals : Na^{+}, Fe^{2+},Ag^{+} Al^{3+},Cr^{3+},Fe^{3+},Au^{3+},Co^{2+},Ni^{2+},Hg^{2+},Sn^{2+}.

b. Basic Radical : Na^{+}, Fe^{2+},Ag^{+}, Al^{3+},Cr^{3+},Fe^{3+},Au^{3+},Co^{2+},Ni^{2+},Hg^{2+},Sn^{2+}.

c. Composite Radical : SO_4^{2-} ,NH_4^{+} ,HCO_3^{-} , HSO_4^{-} , NO_4^{-}.

d. Metal With Variable Valency : Cu(1+,2+), Hg(1+,2+) ,Fe(2+,3+).

e. Bivalent Acidic Radical : S^{2-} ,O^{2-} ,Se^{2-} .

f. Trivalent Basic Radical : Al^{3+} ,Cr^{3+},Fe^{3+},Au^{3+}.

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Question 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

ANSWER:

Element	Symbols	Free radicals
1. Mercury	Hg	Mercurous- Hg^{+}
2. Potassium	K	Potassium- K^{+}
3. Nitrogen	N	Azide- N_3^{-} Nitrate- NO_3^{-} Nitrite-NO_2^{-}
4. Copper	Cu	Cuprous- Cu^{+}
5. Sulphur	S	Sulphide- S^{2-} Sulphate- SO_4^{2-} Sulphite- SO_3^{2-}

6. Carbon	C	Carbide-C^{-} ,triple carbene(**:**CH_2)
7. Chlorine	Cl	Chloride- Cl^{-}
8. Oxygen	O	Oxide- O^{2-}

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Question 3:

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

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

ANSWER:

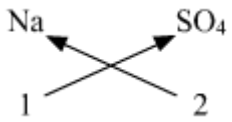
a.Sodium sulphate :
Step 1 : Write the symbols of the radicals.

Na SO_4

Step 2 : Write the valency below the respective radical.

Na SO_4
1 2

Step 3 : Cross-multiply symbols of radicals with their respective valency.



Step 4 : Write down the chemical formula of the compound.

Na_2SO_4

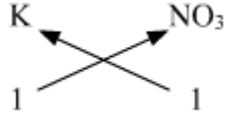
b. Potassium nitrate :
Step 1 : Write the symbols of the radicals

K NO_3

Step 2 : Write the valency below the respective radical.

K NO_3
1 1

Step 3 : Cross-multiply symbols of radicals with their respective valency.



Step 4 : Write down the chemical formula of the compound.

KNO_3

c. Ferric phosphate :

Step 1 : Write the symbols of the radicals

Fe PO_4

Step 2 : Write the valency below the respective radical.

Fe PO_4

3 3

Step 3 : Cross-multiply symbols of radicals with their respective valency.

Step 4 : Write down the chemical formula of the compound.

$FePO_4$

d. Calcium oxide :

Step 1 : Write the symbols of the radicals

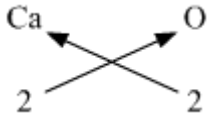
Ca O

Step 2 : Write the valency below the respective radical.

Ca O

2 2

Step 3 : Cross-multiply symbols of radicals with their respective valency.



Step 4 : Write down the chemical formula of the compound.

CaO

e. Aluminium hydroxide :

Step 1 : Write the symbols of the radicals

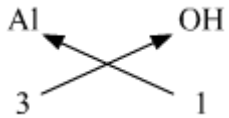
Al OH

Step 2 : Write the valency below the respective radical.

Al OH

3 1

Step 3 : Cross-multiply symbols of radicals with their respective valency.



Step 4 : Write down the chemical formula of the compound.

$Al(OH)_3$

Question 4:

Write answers to the following questions and explain your answers.

a. Explain how the element sodium is monovalent.
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.

ANSWER:

a. Sodium is a metal which has atomic number 11. It has 1 electron in its last shell which means it has 1 valence electron. In order to get stability by acquiring nearest noble gas configuration. Sodium prefers to loose 1 electron. Hence, we say that sodium has a valency of one and is thus monovalent.

b. M is a bivalent metal that is : M^{2+}

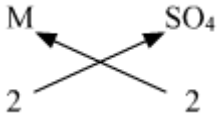
Step 1 : M SO_4

Step 2 :

M SO_4

2+ 2-

Step 3 :



Step 4 : MSO_4

M is a bivalent metal that is : M^{2+}

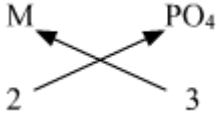
Step 1 :

M PO4

Step 2 : M PO4

2 3

Step 3 :



Step 4 : $M_3(PO4)_2$

c. Mass of an atom is concentrated in its nucleus. It is th sum of proton(p) and neutron(n). The number(p+n) is called atomic mass number.
As we know that atom is very small in size, then how do we determine its mass? Therefore, the concept of reference atom for atomic mass is taken into consideration.
Initially hydrogen atom being lightest was chosen as the reference atom.The relative mass of hydrogen atom was accepted as (1). this is how relative atomic masses of various elements were determined in reference of hydrogen. For example: the mass of one nitrogen atom is fourteen(14) times that of a hydrogen atom.

Finally, the carbon was selected as reference atom. The relative mass of carbon atom was accepted as 12. The relative atomic mass of hydrogen compared to the carbon atom becomes 12 x 1/12 =1.

d. The Unified Atomic Mass Unit or Dalton is a standard unit of mass that quantifies mass on an atomic or molecular scale.

- One unified atomic mass unit is approximately equivalent to 1g/mol.
- It is denoted by a symbol :1u or
  Da.

e. One **mole** is defined as the amount of **substance** containing as many elementary entities (atoms, molecules, ions, electrons, radicals, etc.) as there are atoms in 12 grams of carbon-12 (6.023×10^{23}).
The mass of one **mole** of a **substance** equals to its relative molecular mass expressed in grams. Mole defines the quantity of a substance. One mole of any substance will always contain $\mathbf{6.022 \times 10^{23}}$ particles, no matter what that substance is. Therefore, we can say:

- 1 mole of potassium atoms (K) contains 6.022×10^{23} potassium atoms.
- 1 mole of potassium ions (K^+) contains 6.022×10^{23} potassium ions.
- 1 mole of hydrogen atoms (H) contains 6.022×10^{23} hydrogen atoms.
- 1 mole of hydrogen molecules (H_2) contains 6.022×10^{23} hydrogen molecules.

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Question 5:

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

Na_2SO_4 , K_2CO_3 , CO_2 , $MgCl_2$, NaOH, $AlPO_4$, $NaHCO_3$

ANSWER:

a. Na_2SO_4 - Sodium sulphate
Molecular mass= sum of masses of individual components

2 (23) + 32 + 4 (16)= **142g**

b. K_2CO_3 - Potassium carbonate
2 (39) + 12 + 3 (16) = **138g**

c. CO_2 - Carbon dioxide
12 + 2 (16) = **44g**

d. $MgCl_2$ - Magnesium chloride
24 + 2 (35.5) = ***95g***

e. NaOH - Sodium hydroxide
23 + 16 + 1 = **40g**

f. $AlPO_4$ - Aluminium phosphate
27 + 31 + 4 (16) = **122g**

g. $NaHCO_3$ - Sodium bicarbonate
23 + 1 + 12 + 3 (16) = **84g**

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Question 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.

ANSWER:

As it is mentioned already:
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

Out of all the laws of chemical combination, this is proved by "Law Of Constant Proportion". Law Of Constant Proportion states that "The proportion by weight of the constituent elements

in various samples of compound is fixed in ratio".

for e.g: In sample m, the ratio of proportion of elements (calcium:oxygen) is 5:2
Ca:O =5:2
for e.g: In sample n, the ratio of proportion of elements (calcium:oxygen) is 1.0:0.4
Ca:O =1.0:0.4
=10:4
=5:2
On simplifying the ratio proportion by mass, we get the same values which verifies "The Law Of Constant Proportion".

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Question 7:

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

32g oxygen, 90g water, 8.8g carbon dioxide, 7.1g chlorine.

ANSWER:

a. 32 g of oxygen

$$\text{Number of moles in } O_2 = \frac{\text{Mass of } O_2 \text{ in grams}}{\text{Molecular mass of } O_2}$$

$$= \frac{32}{32} = 1\text{mol}$$

1 mole of O_2 contains-----6.022 x 10^{23} molecules

b. 90 g of water

$$\text{Number of moles in } water = \frac{\text{Mass of } water \text{ in grams}}{\text{Molecular mass of } water}$$

$$= \frac{90}{18} = 5\text{moles}$$

5 moles of H_2O contains-----5 x 6.022 x 10^{23} molecules = 30.11 x 10^{23} molecules

c. 8.8 g of CO_2

$$\text{Number of moles in } CO_2 = \frac{\text{Mass of } CO_2 \text{ in grams}}{\text{Molecular mass of } CO_2}$$

$$= \frac{8.8}{44} = 0.2mol$$

0.2 moles of CO_2 contains-----0.2 x 6.022 x 10^{23} molecules = 1.2044 x 10^{23} molecules

d. 7.1 g of chlorine

$$\text{No. of moles in chlorine} = \frac{\text{Mass of chlorine in grams}}{\text{Molecular mass of chlorine}}$$

$$= \frac{7.1}{71} = 0.1\,\text{mol}$$

0.1 moles of Cl_2 contains-----0.1 x 6.022 x 10^{23} molecules = 0.6022 x 10^{23} molecules

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Question 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

ANSWER:

a. We know that,

$$\text{Number of moles of a substance} = \frac{\text{Mass of the substance in grams}}{\text{Molecular mass of the substance}}$$

Molar mass= sum of constituent atomic masses

Molar mass of NaCl= 23 + 35.5 = 58.5 g/mol

$$\text{Number of moles of a substance} = \frac{\text{Mass of the substance in grams}}{\text{Molecular mass of the substance}}$$

$$0.2 = \frac{x}{58.5} = 11.7\text{g}$$

We need, 11.7 g of NaCl for obtaining 0.2 moles of NaCl.

b. Molar mass of MgO= 24 + 16 = 40 g/mol

$$\text{Number of moles of a substance} = \frac{\text{Mass of the substance in grams}}{\text{Molecular mass of the substance}}$$

$$0.2 = \frac{x}{40} = 8\text{g}$$

We need, 8 g of MgO for obtaining 0.2 moles of MgO.

c. Molar mass of $CaCO_3$= 40 + 12 + 3 (16) = 100 g/mol

$$\text{Number of moles of a substance} = \frac{\text{Mass of the substance in grams}}{\text{Molecular mass of the substance}}$$

$$0.2 = \frac{x}{100} = 20\text{ g}$$

We need, 20 g of $CaCO_3$ for obtaining 0.2 moles of $CaCO_3$.