

# Assignments in Science Class IX (Term II)

## 3

## Atoms and Molecules

### IMPORTANT NOTES

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| <ol style="list-style-type: none"><li><b>1. Law of Conservation of Mass :</b> Mass can neither be created nor can it be destroyed in a chemical reaction.</li><li><b>2. Law of Constant Proportions :</b> In a pure substance same elements are always present in a definite proportion by weight.</li><li><b>3. Atom :</b> Smallest unit of an element, which may or may not exist independently, but always takes part in a chemical reaction.</li><li><b>4. Molecule :</b> Smallest unit of an element or a compound which always exists independently and retains the complete physical and chemical properties of the element or the compound.</li><li><b>5. Atomicity of a molecule of an element :</b> It is the number of atoms which constitute one molecule of an element.</li><li><b>6. Molecular formula :</b> The symbolic representation of the kind and the actual number of atoms in one molecule of a pure substance, may be an element or a compound.</li></ol> | <ol style="list-style-type: none"><li><b>7. Atomic mass unit :</b> The mass of <math>1/12</math> part of C-12 (isotope of carbon) is equivalent to one atomic mass unit.</li><li><b>8. Gram-atomic mass :</b> The atomic mass of an element expressed in terms of grams.</li><li><b>9. Atomic mass :</b> The number of times an atom of an element is heavier than <math>1/12</math> part of C-12 (isotope of carbon).</li><li><b>10. Molecular mass :</b> The number of times a molecule of a pure substance is heavier than <math>1/12</math> part of C-12 (isotope of carbon).</li><li><b>11. Gram-molecular mass :</b> The molecular mass of a pure substance expressed in grams.</li><li><b>12. Mole :</b> A group of <math>6.022 \times 10^{23}</math> particles (atoms, molecules, ions, electrons, protons, neutrons, etc.) of a substance is called mole.</li><li><b>13. Mole number :</b> It is a number which states, how many times one molecular mass comes in certain mass of a substance in grams.</li></ol> |
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### ASSIGNMENTS FOR SUMMATIVE ASSESSMENT

#### I. VERY SHORT ANSWER QUESTIONS

(1 Mark)

#### PREVIOUS YEARS' QUESTIONS

1. State the postulate of Dalton's Atomic Theory which can explain the law of definite proportions?

[2011 (T-II)]

#### OTHER IMPORTANT QUESTIONS

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| <ol style="list-style-type: none"><li>1. Find the ratio by mass of the combining elements in the compound – <math>C_2H_5OH</math>.</li><li>2. Give the formula of the compound formed by the elements calcium and fluorine.</li><li>3. What is the acid radical present in sodium peroxide?</li><li>4. Carbon and silicon have the same valency. What is the formula of sodium silicate?</li><li>5. What is the ratio by number of atoms in mercurous chloride?</li></ol> | <ol style="list-style-type: none"><li>6. Name the element whose Latin name is Stibium.</li><li>7. What is the valency of a sulphide ion?</li><li>8. How many atoms of oxygen are present in 50g of <math>CaCO_3</math>?</li><li>9. Calculate the number of molecules of water present in 1 ml of water vapour at STP.</li><li>10. What is the unit of measurement of atomic radius?</li><li>11. Why is potassium denoted by the symbol K?</li></ol> |
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12. Define relative atomic mass of an element.
13. State the Law of Conservation of Mass.
14. A substance is made of only one kind of atom. Name the general term applied to the substance.
15. Define the term atom.

16. What is the formula of ferric nitrate?
17. Name the compound represented by the formula  $\text{Ca}_3(\text{PO}_4)_2$ .
18. Name the acid radical present in  $\text{NaClO}_3$ .
19. What is the concentration of hydrogen ions in  $1 \text{ mol/dm}^3$  of sulphuric acid?

## II. SHORT ANSWER QUESTIONS - I

(2 Marks)

### PREVIOUS YEARS' QUESTIONS

1. 5 g of calcium combine with 2 g of oxygen to form a compound. Find the molecular formula of the compound. (Atomic mass of Ca = 40 u; O = 16 u) [2011 (T-II)]
2. (i) Name the body which approves the nomenclature of elements and compounds.  
(ii) The symbol of sodium is written as Na and not as S. Give reason.  
(iii) Name one element which form diatomic and one which form tetra atomic molecules. [2011 (T-II)]
3. (i) State the law of constant proportions.  
(ii) Show that water illustrates the law of constant proportions. [2011 (T-II)]
4. An element 'Z' forms the following compound when it reacts with hydrogen, chlorine, oxygen and phosphorus. [2011 (T-II)]  
 $\text{ZH}_3$ ,  $\text{ZCl}_3$ ,  $\text{Z}_2\text{O}_3$  and  $\text{ZP}$   
(a) What is the valency of element Z?  
(b) Element 'Z' is metal or non-metal?
5. (a) Calculate the number of molecules in 8 g of  $\text{O}_2$ .  
(b) Calculate the number of moles in 52 grams of He (Helium).  
[At. mass : O = 16 u  
He = 4 u] [2011 (T-II)]
6. 2.8 g of nitrogen gas was allowed to react with 0.6 g of hydrogen gas to produce 3.4 g of ammonia. Show that these observations are in agreement with the law of Conservation of mass. State the law of conservation of mass. [2011 (T-II)]
7. State law of conservation of mass? If 12 g of carbon is burnt in the presence of 32 g of oxygen, how much carbon dioxide will be formed? [2011 (T-II)]
8. Potassium chlorate decomposes, on heating, to form potassium chloride and oxygen. When

24.5 g of potassium chlorate is decomposed completely, then 14.9 g of potassium chloride is formed. Calculate the mass of oxygen formed. State the law of chemical combination which you have used in solving this problem.

[2011 (T-II)]

9. (a) Write chemical formulae of sodium sulphate.  
(b) Name one element each which forms diatomic and tetra atomic molecule. [2011 (T-II)]
10. State the law of constant proportion. Magnesium and oxygen combine in the ratio of 3 : 2 by mass to form magnesium oxide. How much oxygen is required to react completely with 12 g of magnesium? [2011 (T-II)]
11. (a) Write chemical formula of potassium sulphate.  
(b) Calculate the molar mass of :  
(i) Ethyne ( $\text{C}_2\text{H}_2$ ) and  
(ii) Phosphorus molecule ( $\text{P}_4$ ) (Atomic mass of C = 12u, H = 1u and P = 31u). [2011 (T-II)]
12. Calculate mass of  $3.011 \times 10^{23}$  number of nitrogen atoms ( Atomic mass of N = 14 u)? [2011 (T-II)]
13. (a) Write a chemical formula of a compound using zinc ion and phosphate ion.  
(b) Calculate the ratio by mass of atoms present in a molecule of carbon dioxide. (Given C = 12, O = 16) [2011 (T-II)]
14. Write the name of the compound represented by the following formulae : [2011 (T-II)]  
(a)  $\text{Al}_2(\text{SO}_4)_3$  (b)  $\text{CaCl}_2$   
(c)  $\text{KNO}_3$  (d)  $\text{Mg}_3\text{N}_2$
15. Write the chemical formula of : [2011 (T-II)]  
(a) Aluminium phosphate  
(b) Sodium sulphide

16. Mention the two postulates of Dalton's Atomic Theory that explain : [2011 (T-II)]
- Law of Conservation of Mass
  - Law of Constant Proportions.
17. (a) What is molar mass?  
(b) Calculate the molar mass of carbon dioxide gas.
18. Write the chemical formula for : [2011 (T-II)]
- Zinc phosphate
  - Lead carbonate [2011 (T-II)]
19. (a) The ratio of hydrogen and oxygen in water is 1:8 by mass, find out their ratio by number of atoms, in one molecule of water. (At mass H=1 u ; O=16 u)  
(b) Write the formulae of the following compounds :
- Ammonium sulphate
  - Magnesium chloride [2011 (T-II)]
- (Given Ammonium =  $\text{NH}_4^+$ , Sulphate =  $\text{SO}_4^{2-}$   
Magnesium =  $\text{Mg}^{2+}$ , chloride =  $\text{Cl}^-$ .)
20. (a) What is a Cation? Give one example.  
(b) Name the compounds represented by the following formulae
- $\text{KNO}_3$
  - $\text{H}_2\text{S}$  [2011 (T-II)]
21. Calculate number of moles in 34 g of  $\text{NH}_3$   
(Given atomic mass of N = 14 u; H = 1 u). [2011 (T-II)]
22. Write chemical formula of :
- Sodium carbonate
  - Ammonium chloride [2011 (T-II)]
23. (i) Define polyatomic ions and give an example.  
(ii) Write the chemical formula of zinc nitrate. [2011 (T-II)]
24. Write the names of compounds represented by the following formulae : [2011 (T-II)]
- $\text{KNO}_3$
  - $\text{Al}_2(\text{SO}_4)_3$
  - $\text{MgCl}_2$
  - $(\text{NH}_4)_2\text{SO}_4$
25. (a) Write down the names of compounds represented by the following formulae.
- $\text{Ca}(\text{OH})_2$
  - $\text{K}_2\text{SO}_4$
- (b) Give two examples of bivalent cations. [2011 (T-II)]
26. Give one word for the following :
- Positively charged atom
  - A group of atoms carrying a charge. [2011 (T-II)]
27. (a) Define atomicity.  
(b) Give an example for an element, monoatomic and a polyatomic molecule. [2011 (T-II)]
28. Calculate the number of moles in 17g of  $\text{H}_2\text{O}_2$ .  
(Atomic weight of H=1, O=16u) [2011 (T-II)]
29. Calculate the number of moles in 5.75 g of sodium (atomic mass of sodium = 23). [2011 (T-II)]

### OTHER IMPORTANT QUESTIONS

- In photosynthesis, 6 molecules of carbon dioxide combine with an equal number of water molecules through a complex series of reactions to give a molecule of glucose having a molecular formula,  $\text{C}_6\text{H}_{12}\text{O}_6$ . How many grams of water would be required to produce 18 g of glucose? Compute the volume of water so consumed, assuming the density of water to be  $1 \text{ g cm}^{-3}$ .
- Raunak took 5 moles of carbon atoms in a container and Krish also took 5 moles of sodium atoms in another container of the same weight.  
(a) Whose container is heavier? (b) Whose container has more number of atoms?
- Compute the number of ions present in 5.85 g of sodium chloride.
- A gold sample contains 90% of gold and the rest copper. How many atoms of gold are present in one gram of this sample of gold?
- What are ionic and molecular compounds? Give examples.
- How many molecules are present in 1 ml of water?
- What fraction of the mass of water is constituted by the neutrons?
- Classify the following on the basis of their atomicity :  
  - Chlorine
  - Phosphorus
  - Helium
  - Ozone
- State the number of atoms present in each of the following chemical species.  
  - $\text{CO}_3^{2-}$
  - $\text{PO}_4^{3-}$
  - $\text{P}_2\text{O}_5$
  - CO

### III. SHORT ANSWER QUESTIONS - II

(3 Marks)

#### PREVIOUS YEARS' QUESTIONS

1. (i) State and explain the law of constant proportion taking an example of ammonia.  
(ii) Write the symbol of an element A with atomic number thirteen and mass number 27 respectively.  
(iii) Give definition of ion in your own words.  
[2011 (T-II)]
2. (i) Mention the formula of sodium nitride.  
(ii) Calculate the formula unit mass of  $\text{CaCO}_3$ .  
(Given, Ca=40 u, C=12 u and O=16 u)  
(iii) Calculate the mass of 10 moles of carbon dioxide.  
[2011 (T-II)]
3. (i) Define the term 'atomic mass unit'. How is it linked with relative atomic mass?  
(ii) How do we know the presence of atoms if they do not exist independently for most of the elements?  
[2011 (T-II)]
4. (i) Define Avogadro's number. Why is it also known as Avogadro constant?  
(ii) Calculate the molar mass of  $\text{Na}_2\text{O}$ . (Given, Na = 23 u; O = 16 u)  
(iii) Find the mass of 10 moles of carbon dioxide (Given, C = 12 u; O = 16 u) [2011 (T-II)]
5. (a) Write the formula of the compounds  
(1) Calcium sulphate  
(2) Aluminium chloride  
(b) The average atomic mass of a sample of an element X is 16.2 u. What is the % of isotopes  $^{16}_8\text{X}$  and  $^{18}_8\text{X}$  in the sample?  
[2011 (T-II)]
6. (a) What are polyatomic ions? [2011 (T-II)]  
(b) Write the formulae and names of the compounds formed by combination of  
(i)  $\text{Fe}^{3+}$  and  $\text{SO}_4^{2-}$  (ii)  $\text{NH}_4^{1+}$  and  $\text{CO}_3^{2-}$
7. Ravi prepared a solution of sodium chloride by mixing 5.85 g of salt in 1 litre of water. Find  
(a) Molar mass of sodium chloride  
(b) Number of moles of sodium chloride dissolved. (Atomic masses of sodium and chlorine are 23 u and 35.5 u respectively).  
(c) Concentration of the sodium chloride solution. [2011 (T-II)]
8. Write the chemical formulae of the following.  
(a) Potassium chloride  
(b) Magnesium hydroxide  
(c) Ammonium sulphate [2011 (T-II)]
9. Calculate the following : [2011 (T-II)]  
(i) The mass of  $1.0505 \times 10^{23}$  molecules of carbon dioxide ( $\text{CO}_2$ )  
(ii) The number of molecules of 0.25 moles of ammonia ( $\text{NH}_3$ )  
(iii) The formula unit mass of sodium sulphite ( $\text{Na}_2\text{SO}_3$ )  
(Atomic mass : Na = 23 u ; S = 32 u ; O=16 u ; H =1u) ( $N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$ )
10. (a) Mention the postulate of Dalton's Atomic Theory that explains the law of constant proportions. Explain the law by giving example of water.  
(b) Write the chemical formulae for the following compounds : [2011 (T-II)]  
(i) Calcium hydroxide  $\text{Ca}^{2+} \text{ OH}^-$   
(ii) Ammonium sulphate  $\text{NH}_4^+ \text{ SO}_4^{2-}$
11. (a) Define molar mass. What are its units?  
(b) Write the names of compounds represented by the following formulas :  
(i)  $\text{K}_2\text{CO}_3$  (ii)  $\text{Na}_2\text{SO}_4$   
(iii)  $\text{Ca}(\text{HCO}_3)_2$  (iv)  $\text{H}_2\text{S}$  [2011 (T-II)]
12. If the number of molecules in a given sample of sulphur dioxide ( $\text{SO}_2$ ) is  $3.011 \times 10^{23}$ , calculate the following : [2011 (T-II)]  
(i) the number of moles in the given sample.  
(ii) mass of sulphur dioxide in the given sample.  
(iii) number of oxygen atoms in the given sample. (Atomic mass of S = 32u ; O=16u)
13. Name the two laws of chemicals combinations and write the statement of each one of them.  
[2011 (T-II)]

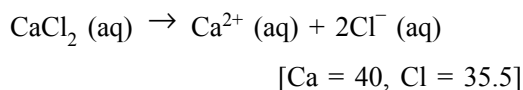
14. (a) Calculate the formula unit mass of  $\text{Na}_2\text{CO}_3$ . [2011 (T-II)]  
 (b) What is the mass of one mol of oxygen atoms?  
 (c) Convert 12g of oxygen gas into mole.
15. Calculate the molar mass of the following compounds : [2011 (T-II)]  
 (a) Lead sulphate  
 (b) Calcium phosphate  
 [Given atomic masses of various elements  
 Ca - 40, S - 32, O - 16, Pb - 207, P - 31]
16. (a) What do the following abbreviations stand for?  
 (i) 2O (ii)  $3\text{O}_2$   
 (b) Which amongst the following has more number of atoms 11.5 g of sodium or 15 g of calcium? How? [2011 (T-II)]  
 [Given atomic mass of Na = 23, Ca = 40]
17. (a) Define law of constant proportion.  
 (b) Give one example of each.  
 (i) Positively charged ion.  
 (ii) A group of atoms carrying a charge. [2011 (T-II)]
18. Calculate :  
 (a) (i) number of molecules in 90gm of  $\text{H}_2\text{O}$ .  
 (ii) number of moles in 19gm of  $\text{H}_2\text{O}_2$ .  
 (b) Define the term mole. [2011 (T-II)]
19. Calculate : [2011 (T-II)]  
 (1) number of molecules in 90g of  $\text{H}_2$ ?  
 (2) number of moles in 19g of  $\text{H}_2\text{O}_2$ ?
20. Using criss cross method, write the chemical formula of copper chloride, calcium sulphate, sodium phosphate. [2011 (T-II)]
21. (a) State the law of Definite proportion with an example.  
 (b) Give any two limitations of Dalton's Atomic Theory. [2011 (T-II)]
22. A gas jar contains 1.7 g of ammonia gas. Calculate the following :  
 (i) Molar mass of ammonia.  
 (ii) How many moles of ammonia are present in the gas jar?
- (iii) How many molecules of ammonia are present in the sample? [2011 (T-II)]
23. Calculate the number of moles of 4g of methane ( $\text{CH}_4$ ) and 11g of  $\text{CO}_2$ , Which has more molecules? [Atomic mass : H = 1u, C = 12u, O = 16u] [2011 (T-II)]
24. (a) How many atoms are present in (i)  $\text{PCl}_5$  molecule and (ii)  $\text{PO}_4^{3-}$  ion? [2011 (T-II)]  
 (b) Hydrogen and oxygen combine in the ratio of 1 : 8 by mass to form water. Calculate the mass of oxygen gas that would be required to react with 3 g of hydrogen gas.  
 (c) Which postulate of Dalton's Atomic Theory is the basis of law of conservation of mass ?
25. (a) If one mole of carbon weighs 12 grams, calculate the mass (in gram) of one atom of carbon.  
 (b) Show by calculation that :  
 9 moles of  $\text{CO}_2$  and 22 moles of  $\text{H}_2\text{O}$  have the same mass in grams. [2011 (T-II)]
26. (a) What is the mass of 0.5 mole of  $\text{NH}_3$ ? Given atomic mass of N = 14u, atomic mass of H = 1u.  
 (b) Calculate the number of particles in 31 g of  $\text{P}_4$  molecules. Atomic mass of P = 31 u.  
 (c) Find the number of moles in 87 g of  $\text{K}_2\text{SO}_4$ .  
 Atomic masses of -K = 39 u, S = 32 u, O = 16 u [2011 (T-II)]
27. (a) Define the atomic mass unit.  
 (b) Write the chemical formulae of :  
 (i) Ammonium carbonate  
 (ii) Sodium oxide  
 (c) Name the compound  $\text{Al}_2(\text{SO}_4)_3$  and mention the ions present in it. [2011 (T-II)]
28. (a) Define atomicity.  
 (b) Calculate the number of atoms in the following compounds :  
 (i) Ozone (ii) Sodium chloride  
 (c) Give an example of polyatomic molecule of an element. [2011 (T-II)]
29. Write any four postulates of Dalton's Atomic Theory. Why are Dalton's symbol not used in chemistry? [2011 (T-II)]



30. Define the term mole. Calculate the number of molecules of sulphur ( $S_8$ ) in 16g of solid sulphur. [2011 (T-II)]
31. (a) Calculate the molar mass of nitric acid ( $HNO_3$ ) (atomic masses of  $H=1u$ ,  $O=16u$  and  $N=14u$ )
- (b) Calculate the no. of moles in 22 grams of carbon dioxide ( $CO_2$ ) (atomic masses of  $C=12u$ ,  $O=16u$ )
- (c) Calculate the number of molecules of oxygen in 6.4 grams of oxygen. [Given  $N=6.02 \times 10^{23}$  mole.] [2011 (T-II)]
32. (a) Distinguish between an atom and a molecule. [2011 (T-II)]
- (b) Carbon dioxide ( $CO_2$ ) contains carbon and oxygen in a fixed ratio 3 : 8 by mass. Name the law of chemical combination which governs this statement. Also state the law.
33. (a) Calculate the mass of 0.5 mole of oxygen atoms.
- (b) Calculate the number of molecules of glucose present in its 90 grams (molecular mass of glucose is 180u) ( $6.02 \times 10^{23} \text{ mol}^{-1}$ )
- (c) Calculate the number of moles of water in 2 grams of water. (atomic mass of  $H = 1u$ ;  $O=16u$ ) [2011 (T-II)]
34. With a labelled diagram describe an activity to demonstrate the law of conservation of mass. [2011 (T-II)]
35. Calculate number of atoms in 120 g of Ca : (atomic mass of Ca = 40 u) [2011 (T-II)]
36. Calculate number of atoms in 120 g of calcium and 120 g of iron. Which one has more number of atoms and how much is the difference? (Given atomic mass of calcium = 40 u and iron = 56 u) [2011 (T-II)]
37. (a) An element "M" forms the compound  $MH_3$  when it reacts with hydrogen,
- (i) Find the valency of element M.
- (ii) Is element "M" is metal or a non-metal?
- (b) How many moles are present in 4g of potassium hydroxide KOH? (Atomic mass of  $K = 39 u$ ,  $H = 1 u$ ,  $O = 16 u$ ) [2011 (T-II)]
38. Calculate the number of particles in each of the following.
- (a) 48 g of Mg (b) 8 g  $O_2$
- (c) 0.1 mole of carbon (Atomic mass  $Mg = 24 u$ ,  $O = 16 u$ ,  $C = 12 u$ , Avogadro Constant  $N_A = 6.022 \times 10^{23}$ ). [2011 (T-II)]
39. (a) State the law of conservation of mass.
- (b) What mass of silver nitrate will react with 5.85g of sodium chloride to produce 14.35 g of silver chloride and 8.5 g of sodium nitrate if the law of conservation of mass is true? [2011 (T-II)]
40. Calculate the following quantities in 5.6 g of nitrogen [ Atomic mass of  $N = 14 u$ ]
- (a) Number of moles of  $N_2$
- (b) Number of molecules of  $N_2$
- (c) Number of atoms of nitrogen. [2011 (T-II)]
41. (a) State the law of constant proportion.
- (b) While searching for various atomic mass units, scientists initially took 1/16 of the mass an atom of naturally occurring oxygen as one unit. State two reasons for this. [2011 (T-II)]
42. (a) 2 gm of hydrogen combines with 16 gm of oxygen to form water. How many grams of water will be formed? State the law of chemical combination which you have used in this calculation.
- (b) Which group of elements form cations and anions? [2011 (T-II)]
43. (a) How many atoms are there in one mole of  $N_2$  molecule?
- (b) Sample A contains one gram molecule of oxygen molecule and sample B contains one mole of oxygen molecule. What is the ratio of the number of molecules in both the samples? [2011 (T-II)]
44. (a) What does 1 mole of a substance represent?
- (b) Which has more number of molecules. 100g of  $N_2$  or 100 g  $NH_3$ ? [2011 (T-II)]
45. (a) What is the law of constant proportions? Explain with the help of an example.
- (b) Which postulate of Dalton's Atomic Theory is in agreement with this law? [2011 (T-II)]

### OTHER IMPORTANT QUESTIONS

1. Calcium chloride when dissolved in water dissociated into its ions according to the following equation.



Calculate the number of ions obtained from  $\text{CaCl}_2$  when 222 g of it is dissolved in water.

2. Name all the elements present in the following compounds.
- Lead nitrate
  - Ammonium phosphate
  - Magnesium hydrogen carbonate
3. Cinnabar ( $\text{HgS}$ ) is a prominent ore of mercury. How many grams of mercury are present in 225 g of pure  $\text{HgS}$ ? Molar mass of Hg and S are  $200.6 \text{ g mol}^{-1}$  and  $32 \text{ g mol}^{-1}$  respectively.
4. A sample of vitamin C is known to contain  $2.58 \times 10^{24}$  oxygen atoms. How many moles of oxygen atoms are present in the sample?
5. Fill the missing data in the table.

Species	$\text{H}_2\text{O}$	Na atom
Property		
No. of moles	2	—
No. of particles	—	—
Mass	36 g	115 g

6. (i) Define one mole of an element.
- (ii) What is the relation between mole and gram atomic mass of an element.
- (iii) Gram atomic mass of an element X is 27 g. How many moles of X are in 54 g?
7. Calculate :
- The percentage of hydrogen in ammonium sulphate  $[(\text{NH}_4)_2\text{SO}_4]$ .  
[N = 14 u, H = 1 u, S = 32 u, O = 16 u]
  - The percentage composition of water present in washing soda  $[\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}]$ .
  - The mass of oxygen contained in 72 g of pure water.
8. What is the qualitative meaning of the symbol of chlorine (Cl) of atomic mass 35.5 u?

### IV. LONG ANSWER QUESTIONS

(5 Marks)

#### PREVIOUS YEARS' QUESTIONS

- When 3.0 g of carbon is burnt in 8.0 g of oxygen, 11.0 g of carbon dioxide is produced. What mass of carbon dioxide will be formed when 3.0 g of carbon is burnt in 50.00 g of oxygen? Which law of chemical combination will govern your answer? State the law. [2011 (T-II)]
- Define the following terms with example.
  - Atomicity
  - Anion
  - Molecular Mass
  - Relative Formula Mass
  - Cation [2011 (T-II)]
- Calculate the molecular mass of  $\text{CaCO}_3$ . (At mass Ca=40 u, C=12 u, O=16 u) [2011 (T-II)]
  - Verify by calculating that
    - 5 moles of  $\text{CO}_2$  and 5 moles of  $\text{H}_2\text{O}$  do not have the same mass
    - 240g of calcium and 240 g of magnesium elements have a mole ratio of 5 : 3  
(At mass H=1u, Ca= 40u, Mg=24u )
- Write the formula of the compounds formed by the following ions
    - $\text{Cr}^{3+}$  and  $\text{SO}_4^{2-}$  (ii)  $\text{Pb}^{2+}$  and  $\text{NO}_3^{-1}$
  - State the significance of one mole.
  - Which has more number of atoms 100g of sodium or 100g of iron?  
(At mass Na=23u, Fe=56u) [2011 (T-II)]

## OTHER IMPORTANT QUESTIONS

1. Compute the difference in masses of one mole each of aluminium atoms and one mole of its ions. (Mass of an electron is  $9.1 \times 10^{-28}$ g). Which one is heavier?
2. A silver ornament of mass 'm' gram is polished with gold equivalent to 1% of the mass of silver. Compute the ratio of the number of atoms of gold and silver in the ornament.  
[Molar mass of gold = 197 g/mol, silver = 107.9 g/mol]
3. A sample of ethane ( $C_2H_6$ ) gas has the same mass as  $1.5 \times 10^{20}$  molecules of methane ( $CH_4$ ). How many  $C_2H_6$  molecules does the sample of the gas contain?
4. Write the formulae for the following and calculate the molecular mass for each one of them.  
(a) Caustic potash      (b) Baking powder  
(c) Limestone      (d) Caustic soda  
(e) Ethanol  
[K=39, O=16, H=1, Na=23, Ca=40, C=12]

## ASSIGNMENTS FOR FORMATIVE ASSESSMENT

### A. Science Quiz

- (i) If 2 g of hydrogen is equal to 1 mole, how many grams of hydrogen are present in 0.01 moles.
- (ii) 1 mole of oxygen weighs as much as 4 moles of helium. What is the ratio of atoms of oxygen to the atoms of helium?
- (iii) 24 g of magnesium has as many atoms as 12g of carbon. How many moles of carbon will weigh as much as 24 g of magnesium?
- (iv) Name two non-metals that have lustre.
- (v) Name a non-metal which occurs as liquid at room temperature.
- (vi) What is the difference between molecular mass and g-molecular mass of an element?
- (vii) 1.70g of silver nitrate in solution form reacts with 0.585 g of sodium chloride in solution form. If the mass of sodium nitrate formed is 0.85 g, what is the mass of silver chloride formed?

### B. Group Activity

**Objective :** To prepare playing cards for making formulae from symbol.

1. Take a fresh pack of playing cards. On each of the cards paste white paper and allow it to dry.
2. Cut the excess paper with the help of scissors, so as to make it the exact size of the playing card.
3. Take three cards and write over them  $Na^+$ .

4. Similarly, on a set of three cards write  $NH_4^+$ ,  $Ca^{2+}$ ,  $Zn^{2+}$ ,  $Cu^{2+}$ ,  $Al^{3+}$ ,  $Fe^{3+}$ ,  $Cl^-$ ,  $O^{2-}$ ,  $OH^-$ ,  $CO_3^{2-}$ ,  $PO_4^{3-}$ ,  $NO_3^{1-}$  and  $S^{2-}$ .
5. Your playing card of 52 pieces is ready for playing.
6. Distribute the cards equally among four players. Start making a set of compounds, such as  $Na_2S$ ,  $Al_2O_3$ ,  $ZnSO_4$ , etc.  
The card or cards which do not fit can be discarded as you play the game of Rummy.
7. The player who makes the maximum number of formulae first is the winner.

### C. Charts

1. Prepare a chart of all the elements in the order of their increasing atomic mass. Clearly show the metals, metalloids and non-metals.

### D. Collections

Collect five samples of metallic elements and two samples of non-metallic elements.

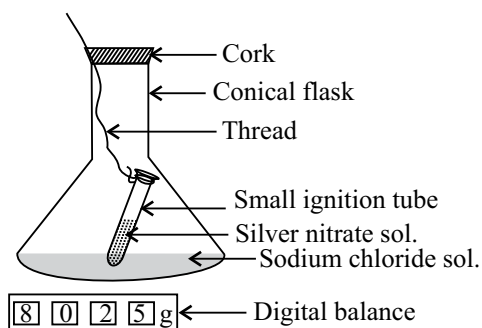
### E. Demonstration

**Objective :** To prove the law of conservation of mass experimentally.

#### Materials Required :

- (i) Sodium chloride solution, (ii) Silver nitrate solution, (iii) Conical flask, (iv) Small ignition tube, (v) A thin and long cotton thread, (vi) Rubber cork, (vii) Digital balance.





**Procedure :**

1. Pour about 20 ml of sodium chloride in the conical flask.
2. Take the small ignition tube and tie a thread along its neck.

3. Fill 3/4 of ignition tube with silver nitrate solution.
4. Lower the ignition tube gently in the flask, such that it rests against the side of the conical flask.
5. Holding the thread tightly fix the rubber cork, such that the ignition tube does not slide.
6. Place the set up on the digital balance. Read and record the weight.
7. Lift the conical flask from the digital balance and invert it, so that the contents of the ignition tube mix with sodium chloride. You will notice a white ppt. is formed.
8. Again weigh the flask on the digital balance. You will notice that the weight does not change. The demonstration proves the law of conservation of mass.

## Class IX Chapter 3 – Atoms and Molecules Science

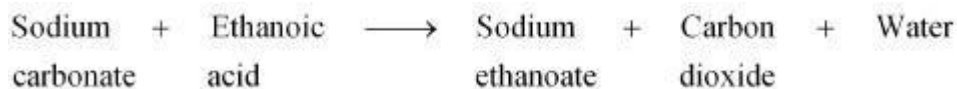
Question 1:

In a reaction, 5.3 g of sodium carbonate reacted with 6 g of ethanoic acid. The products were 2.2 g of carbon dioxide, 0.9 g water and 8.2 g of sodium ethanoate. Show that these observations are in agreement with the law of conservation of mass.

Sodium carbonate + ethanoic acid  $\rightarrow$  sodium ethanoate + carbon dioxide + water

Answer:

In the given reaction, sodium carbonate reacts with ethanoic acid to produce sodium ethanoate, carbon dioxide, and water.



Mass of sodium carbonate = 5.3 g (Given)

Mass of ethanoic acid = 6 g (Given)

Mass of sodium ethanoate = 8.2 g (Given)

Mass of carbon dioxide = 2.2 g (Given)

Mass of water = 0.9 g (Given)

Now, total mass before the reaction = (5.3 + 6) g

= 11.3 g

And, total mass after the reaction = (8.2 + 2.2 + 0.9) g

= 11.3 g

$\therefore$  Total mass before the reaction = Total mass after the reaction

Hence, the given observations are in agreement with the law of conservation of mass.

Question 2:

Hydrogen and oxygen combine in the ratio of 1:8 by mass to form water. What mass of oxygen gas would be required to react completely with 3 g of hydrogen gas?

Answer:

It is given that the ratio of hydrogen and oxygen by mass to form water is 1:8. Then, the mass of oxygen gas required to react completely with 1 g of hydrogen gas is 8 g. Therefore, the mass of oxygen gas required to react completely with 3 g of hydrogen gas is  $8 \times 3 \text{ g} = 24 \text{ g}$ .

Question 3:

Which postulate of Dalton's atomic theory is the result of the law of conservation of mass?

Answer:

The postulate of Dalton's atomic theory which is a result of the law of conservation of mass is:

Atoms are indivisible particles, which can neither be created nor destroyed in a chemical reaction.

Question 4:

Which postulate of Dalton's atomic theory can explain the law of definite proportions?

Answer:

The postulate of Dalton's atomic theory which can explain the law of definite proportion is:

The relative number and kind of atoms in a given compound remains constant.

Question 1:

Define atomic mass unit.

Answer:

Mass unit equal to exactly one-twelfth  $\left(\frac{1}{12^{\text{th}}}\right)$  the mass of one atom of carbon-12 is called one atomic mass unit. It is written as 'u'.

Question 2:

Why is it not possible to see an atom with naked eyes?

Answer:

The size of an atom is so small that it is not possible to see it with naked eyes. Also, the atom of an element does not exist independently.

Write down the formulae of

(i) sodium oxide

(ii) aluminium chloride

(iii) sodium sulphide (iv) magnesium hydroxide Answer:

(i) Sodium oxide  $\rightarrow \text{Na}_2\text{O}$

(ii) Aluminium chloride  $\rightarrow \text{AlCl}_3$



(iii) Sodium sulphide  $\rightarrow \text{Na}_2\text{S}$

(iv) Magnesium hydroxide  $\rightarrow \text{Mg}(\text{OH})_2$

Question 2:

Write down the names of compounds represented by the following formulae:

(i)  $\text{Al}_2(\text{SO}_4)_3$

(ii)  $\text{CaCl}_2$

(iii)  $\text{K}_2\text{SO}_4$

(iv)  $\text{KNO}_3$

(v)  $\text{CaCO}_3$  Answer:

(i)  $\text{Al}_2(\text{SO}_4)_3 \rightarrow$  Aluminium sulphate

(ii)  $\text{CaCl}_2 \rightarrow$  Calcium chloride

(iii)  $\text{K}_2\text{SO}_4 \rightarrow$  Potassium sulphate

(iv)  $\text{KNO}_3 \rightarrow$  Potassium nitrate

(v)  $\text{CaCO}_3 \rightarrow$  Calcium carbonate

Question 3:

What is meant by the term chemical formula?

Answer:

The chemical formula of a compound means the symbolic representation of the composition of a compound. From the chemical formula of a compound, we can know the number and kinds of atoms of different elements that constitute the compound. For example, from the chemical formula  $\text{CO}_2$  of carbon dioxide, we come to know that one carbon atom and two oxygen atoms are chemically bonded together to form one molecule of the compound, carbon dioxide.

Question 4:

How many atoms are present in a

(i)  $\text{H}_2\text{S}$  molecule and (ii)  $\text{PO}_4^{3-}$  ion?

Answer:

(i) In an  $\text{H}_2\text{S}$  molecule, three atoms are present; two of hydrogen and one of sulphur.

(ii) In a  $\text{PO}_4^{3-}$  ion, five atoms are present; one of phosphorus and four of oxygen.

Calculate the molecular masses of  $\text{H}_2$ ,  $\text{O}_2$ ,  $\text{Cl}_2$ ,  $\text{CO}_2$ ,  $\text{CH}_4$ ,  $\text{C}_2\text{H}_6$ ,  $\text{C}_2\text{H}_4$ ,  $\text{NH}_3$ ,  $\text{CH}_3\text{OH}$ .

Answer:

Molecular mass of  $\text{H}_2 = 2 \times \text{Atomic mass of H}$

$$= 2 \times 1$$

$$= 2 \text{ u}$$

Molecular mass of  $\text{O}_2 = 2 \times \text{Atomic mass of O}$

$$= 2 \times 16$$

$$= 32 \text{ u}$$

Molecular mass of  $\text{Cl}_2 = 2 \times \text{Atomic mass of Cl}$

$$= 2 \times 35.5$$

$$= 71 \text{ u}$$

Molecular mass of  $\text{CO}_2 = \text{Atomic mass of C} + 2 \times \text{Atomic mass of O}$

$$= 12 + 2 \times 16$$

$$= 44 \text{ u}$$

Molecular mass of  $\text{CH}_4 = \text{Atomic mass of C} + 4 \times \text{Atomic mass of H}$

$$= 12 + 4 \times 1$$

$$= 16 \text{ u}$$

Molecular mass of  $\text{C}_2\text{H}_6 = 2 \times \text{Atomic mass of C} + 6 \times \text{Atomic mass of H}$

$$= 2 \times 12 + 6 \times 1$$

$$= 30 \text{ u}$$

Molecular mass of  $\text{C}_2\text{H}_4 = 2 \times \text{Atomic mass of C} + 4 \times \text{Atomic mass of H}$

$$= 2 \times 12 + 4 \times 1$$

$$= 28 \text{ u}$$

Molecular mass of  $\text{NH}_3 = \text{Atomic mass of N} + 3 \times \text{Atomic mass of H}$

$$= 14 + 3 \times 1$$

$$= 17 \text{ u}$$

Molecular mass of  $\text{CH}_3\text{OH} = \text{Atomic mass of C} + 4 \times \text{Atomic mass of H} + \text{Atomic mass of O}$

$$= 12 + 4 \times 1 + 16 = 32 \text{ u}$$

Question 2:

Calculate the formula unit masses of  $\text{ZnO}$ ,  $\text{Na}_2\text{O}$ ,  $\text{K}_2\text{CO}_3$ , given atomic masses of  $\text{Zn} = 65 \text{ u}$ ,  $\text{Na} = 23 \text{ u}$ ,  $\text{K} = 39 \text{ u}$ ,  $\text{C} = 12 \text{ u}$ , and  $\text{O} = 16 \text{ u}$ .

Answer:

Formula unit mass of  $\text{ZnO} = \text{Atomic mass of Zn} + \text{Atomic mass of O}$

$$= 65 + 16$$

$$= 81 \text{ u}$$

Formula unit mass of  $\text{Na}_2\text{O} = 2 \times \text{Atomic mass of Na} + \text{Atomic mass of O}$

$$= 2 \times 23 + 16$$

$$= 62 \text{ u}$$

Formula unit mass of  $\text{K}_2\text{CO}_3 = 2 \times \text{Atomic mass of K} + \text{Atomic mass of C} + 3 \times$

Atomic mass of O

$$= 2 \times 39 + 12 + 3 \times 16$$

$$= 138 \text{ u}$$

If one mole of carbon atoms weighs 12 gram, what is the mass (in gram) of 1 atom of carbon?

Answer:

One mole of carbon atoms weighs 12 g (Given)

i.e., mass of 1 mole of carbon atoms = 12 g

Then, mass of  $6.022 \times 10^{23}$  number of carbon atoms = 12 g

Therefore, mass of 1 atom of carbon  $= \frac{12}{6.022 \times 10^{23}} \text{ g}$

$$= 1.9926 \times 10^{-23} \text{ g}$$

Question 2:



Which has more number of atoms, 100 grams of sodium or 100 grams of iron (given, atomic mass of Na = 23 u, Fe = 56 u)?

Answer:

Atomic mass of Na = 23 u (Given)

Then, gram atomic mass of Na = 23 g

$$6.022 \times 10^{23}$$

$$= \frac{6.022 \times 10^{23}}{23} \times 100$$

Now, 23 g of Na contains = number of atoms

Thus, 100 g of Na contains number of atoms

$$= 2.6182 \times 10^{24} \text{ number of atoms}$$

Again, atomic mass of Fe = 56 u (Given)

Then, gram atomic mass of Fe = 56 g

$$6.022 \times 10^{23}$$

$$= \frac{6.022 \times 10^{23}}{56} \times 100$$

Now, 56 g of Fe contains = number of atoms

Thus, 100 g of Fe contains number of atoms

$$= 1.0753 \times 10^{24} \text{ number of atoms}$$

Therefore, 100 grams of sodium contain more number of atoms than 100 grams of iron.

A 0.24 g sample of compound of oxygen and boron was found by analysis to contain 0.096 g of boron and 0.144 g of oxygen. Calculate the percentage composition of the compound by weight.

Answer:

Mass of boron = 0.096 g (Given)

Mass of oxygen = 0.144 g (Given)

Mass of sample = 0.24 g (Given)

Thus, percentage of boron by weight in the compound =  
= 40%

And, percentage of oxygen by weight in the compound =

$$\frac{0.096}{0.24} \times 100\%$$

Question 2:

When 3.0 g of carbon is burnt in 8.00 g oxygen,  
11.00 g of carbon dioxide is produced. What mass of  
carbon dioxide will be formed when 3.00 g of carbon is burnt in  
50.00 g of oxygen? Which law of chemical combinations will govern your answer?  
Answer:

$$\frac{0.144}{0.24} \times 100\%$$

Carbon + Oxygen  $\longrightarrow$  Carbon dioxide

3 g of carbon reacts with 8 g of oxygen to produce 11 g of carbon dioxide.

If 3 g of carbon is burnt in 50 g of oxygen, then 3 g of carbon will react with 8 g of oxygen. The remaining 42 g of oxygen will be left un-reactive.

In this case also, only 11 g of carbon dioxide will be formed.

The above answer is governed by the law of constant proportions.

Question 3:

What are polyatomic ions? Give examples?

Answer:

A polyatomic ion is a group of atoms carrying a charge (positive or negative). For

example, ammonium ion  $(\text{NH}_4^+)$

sulphate ion  $(\text{SO}_4^{2-})$ , hydroxide ion  $(\text{OH}^-)$ , carbonate ion  $(\text{CO}_3^{2-})$ ,

Question 4:

Write the chemical formulae of the following:

(a) Magnesium chloride

(b) Calcium oxide

(c) Copper nitrate

(d) Aluminium chloride

(e) Calcium carbonate Answer:

- (a) Magnesium chloride  $\rightarrow \text{MgCl}_2$
- (b) Calcium oxide  $\rightarrow \text{CaO}$
- (c) Copper nitrate  $\rightarrow \text{Cu}(\text{NO}_3)_2$
- (d) Aluminium chloride  $\rightarrow \text{AlCl}_3$  (e) Calcium carbonate  $\rightarrow \text{CaCO}_3$  Question 5:

Give the names of the elements present in the following compounds:

- (a) Quick lime
- (b) Hydrogen bromide
- (c) Baking powder
- (d) Potassium sulphate

Answer:

Compound	Chemical formula	Elements present
Quick lime	CaO	Calcium, oxygen
Hydrogen bromide	HBr	Hydrogen, bromine
Baking powder	NaHCO <sub>3</sub>	Sodium, hydrogen, carbon, oxygen
Potassium sulphate	K <sub>2</sub> SO <sub>4</sub>	Potassium, sulphur, oxygen

Question 6:

Calculate the molar mass of the following substances:

(a) Ethyne, C<sub>2</sub>H<sub>2</sub>

(b) Sulphur molecule, S<sub>8</sub>

(c) Phosphorus molecule, P<sub>4</sub> (atomic mass of phosphorus = 31)

(d) Hydrochloric acid, HCl

(e) Nitric acid, HNO<sub>3</sub> Answer:

(a) Molar mass of ethyne, C<sub>2</sub>H<sub>2</sub> =  $2 \times 12 + 2 \times 1 = 28$  g

(b) Molar mass of sulphur molecule, S<sub>8</sub> =  $8 \times 32 = 256$  g

(c) Molar mass of phosphorus molecule, P<sub>4</sub> =  $4 \times 31 = 124$  g (d) Molar mass of hydrochloric acid, HCl =  $1 + 35.5 = 36.5$  g

(e) Molar mass of nitric acid, HNO<sub>3</sub> =  $1 + 14 + 3 \times 16 = 63$  g



Question 7:

What is the mass of— (a) 1 mole of nitrogen atoms?

(b) 4 moles of aluminium atoms (Atomic mass of aluminium = 27)?

(c) 10 moles of sodium sulphite ( $\text{Na}_2\text{SO}_3$ )?

Answer:

(a) The mass of 1 mole of nitrogen atoms is 14 g.

(b) The mass of 4 moles of aluminium atoms is  $(4 \times 27) \text{ g} = 108 \text{ g}$

(c) The mass of 10 moles of sodium sulphite ( $\text{Na}_2\text{SO}_3$ ) is

$10 \times [2 \times 23 + 32 + 3 \times 16] \text{ g} = 10 \times 126 \text{ g} = 1260 \text{ g}$  Question 8:

Convert into mole.

(a) 12 g of oxygen gas

(b) 20 g of water (c) 22 g  
of carbon dioxide

Answer:

(a) 32 g of oxygen gas = 1 mole

Then, 12 g of oxygen gas =  $\frac{12}{32} \text{ mole} = 0.375 \text{ mole}$

(b) 18 g of water = 1 mole

Then, 20 g of water =  $\frac{20}{18} \text{ mole} = 1.11 \text{ moles (approx)}$

$\frac{22}{44} \text{ mole}$

(c) 44 g of carbon dioxide = 1 mole

Then, 22 g of carbon dioxide =        = 0.5 mole

Question 9:

What is the mass of:

(a) 0.2 mole of oxygen atoms?

(b) 0.5 mole of water molecules?

Answer:

(a) Mass of one mole of oxygen atoms = 16 g

Then, mass of 0.2 mole of oxygen atoms =  $0.2 \times 16\text{g} = 3.2\text{ g}$

(b) Mass of one mole of water molecule = 18 g

Then, mass of 0.5 mole of water molecules =  $0.5 \times 18\text{ g} = 9\text{ g}$

Question 10:

Calculate the number of molecules of sulphur ( $\text{S}_8$ ) present in 16 g of solid sulphur.

Answer:

1 mole of solid sulphur ( $\text{S}_8$ ) =  $8 \times 32\text{ g} = 256\text{ g}$

i.e., 256 g of solid sulphur contains =  $6.022 \times 10^{23}$  molecules

Then, 16 g of solid sulphur contains =  $\frac{6.022 \times 10^{23}}{256} \times 16$  molecules

=  $3.76 \times 10^{22}$  molecules (approx) Question 11:

Calculate the number of aluminium ions present in 0.051 g of aluminium oxide.

(Hint: The mass of an ion is the same as that of an atom of the same element. Atomic mass of Al = 27 u) Answer:

$$1 \text{ mole of aluminium oxide (Al}_2\text{O}_3) = 2 \times 27 + 3 \times 16$$

$$= 102 \text{ g}$$

$$\text{i.e., } 102 \text{ g of Al}_2\text{O}_3 = 6.022 \times 10^{23} \text{ molecules of Al}_2\text{O}_3$$

$$\text{Then, } 0.051 \text{ g of Al}_2\text{O}_3 \text{ contains } = \frac{6.022 \times 10^{23}}{102} \times 0.051 \text{ molecules}$$

$$= 3.011 \times 10^{20} \text{ molecules of Al}_2\text{O}_3$$

The number of aluminium ions ( $\text{Al}^{3+}$ ) present in one molecule of aluminium oxide is 2.

Therefore, the number of aluminium ions ( $\text{Al}^{3+}$ ) present in  $3.011 \times 10^{20}$  molecules

$$(0.051 \text{ g}) \text{ of aluminium oxide (Al}_2\text{O}_3) = 2 \times 3.011 \times 10^{20}$$

$$= 6.022 \times 10^{20}$$