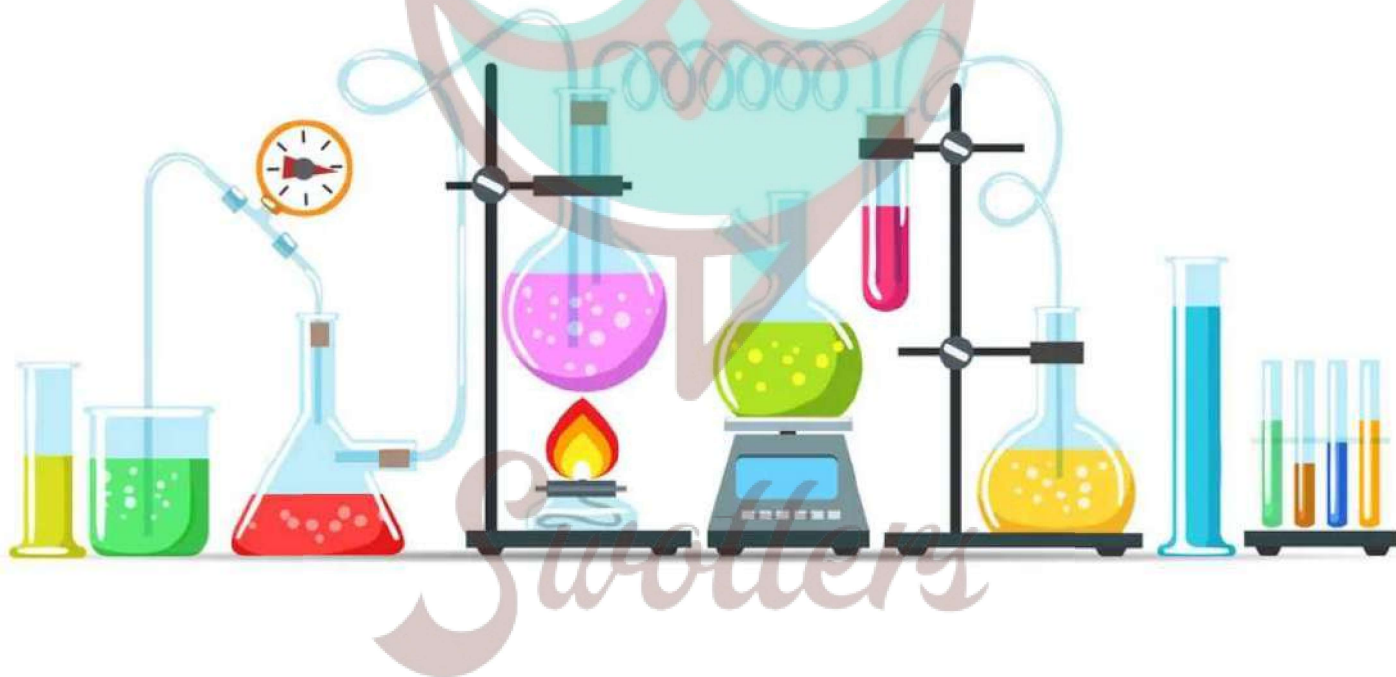


CHEMISTRY

Chapter 3: Atoms and Molecules



Important Questions

➤ Multiple Choice Questions:

1. Which of the following correctly represents 360g of water?

- (i) 2 moles of water
- (ii) 20 moles of water
- (iii) 6.022×10^{23} molecules of water
- (iv) 1.2044×10^{25} molecules of water

- (a) (i)
- (b) (i) and (iv)
- (c) (ii) and (iii)
- (d) (ii) and (iv)

2. Which of the following statements is not true about an atom?

- (a) Atoms are not able to exist independently.
- (b) Atoms are the basic units from which molecules and ions are formed.
- (c) Atoms are always neutral in nature.
- (d) Atoms aggregate in large numbers to form the matter that we can see, feel or touch.

3. 1 u or 1 amu means

- (a) 1/12th mass of C-12 atoms
- (b) Mass of C-12 atom
- (c) Mass of O-16 atom
- (d) Mass of Hydrogen molecule

4. Which of the following contains maximum number of molecules?

- (a) 19 CO₂
- (b) 1g N₂
- (c) 1g H₂
- (d) 1g CH₄

5. A sample of NH₃ molecule irrespective of source contains 82.35% Nitrogen and 17.65% of Hydrogen by mass. This data supports:

- (a) Law of Conservation of Mass

- (b) Law of Multiple Proportions
- (c) Law of Definite Proportions
- (d) Avogadro's Law

6. An element X is divalent and another element Y is tetravalent. The compound formed by these two elements will be:

- (a) XY
- (b) XY₂
- (c) X₂Y
- (d) XY₄

7. The molecular formula of potassium nitrate is _____.

- (a) KNO₃
- (b) KNO
- (c) KNO₂
- (d) KON

8. 3.42 g of sucrose are dissolved in 18 g of water in a beaker. The numbers of oxygen atoms in the solution are:

- (a) 6.68×10^{23}
- (b) 6.09×10^{22}
- (c) 6.022×10^{23}
- (d) 6.022×10^{21}

9. Molecular mass is defined as the:

- (a) Mass of one molecule of any substance compared with the mass of one atom of C – 12
- (b) Mass of one atom compared with the mass of one atom of hydrogen
- (c) Mass of one atom compared with the mass of one molecule
- (d) None of the above

10. A change in the physical state can be brought about

- (a) only when energy is given to the system
- (b) only when energy is taken out from the system
- (c) When energy is either given to, or taken out from the system
- (d) Without any energy change

11. The atomic mass of sodium is 23. The number of moles in 46g of sodium is _____.

- (a) 4
- (b) 2
- (c) 0
- (d) $\frac{1}{2}$

12. Which of the following represents a correct chemical formula?

- (a) CaCl
- (b) BiPO₄
- (c) NaSO₄
- (d) NaS

13. What is the formula mass unit of ZnO?

- (a) 18 u
- (b) 81 u
- (c) 88 u
- (d) 188 u

14. How many atoms of oxygen are present in 300 grams of CaCO₃?

- (a) 54.207×10^{23}
- (b) 6.207×10^{23}
- (c) 12.207×10^{23}
- (d) 22.2×10^{23}

15. Which of the following represents the correct relation between Avogadro's number (N_0), number of particles (N) and moles (n)?

- (a) $n = N / N_0$
- (b) $n = N_0 / N$
- (c) $n = N N_0$
- (d) all are correct

➤ **Very Short Question:**

1. Define law of conservation of mass.
2. Explain law of constant proportion.
3. Who coined the term atom?
4. Define atom.

5. Define molecule.
6. Define atomicity.
7. What is atomic mass unit?
8. How do atoms exist?
9. Give the atomicity of phosphorous and nitrogen.
10. What is an ion?

➤ Short Questions:

1. Give the unit to measure size of atom and give size of hydrogen atom.
2. What is IUPAC, give its one function?
3. Give the Latin name for sodium, potassium, gold and mercury.
4. What is the ratio by mass of combining elements in H_2O , CO_2 and NH_3 ?
5. Define valency and give the valency for the following elements:
6. What is polyatomic ion? Give one example.
7. Write down the formula for:
Copper nitrate, calcium sulphate and aluminium hydroxide.
8. What is formula unit mass? How is it different from molecular mass?

➤ Long Questions:

1. (a) How do atoms exist?
(b) What is atomicity?
(c) What are polyatomic ions?
2. Calculate
(a) the mass of one atom of oxygen
(b) the mass of one molecule of oxygen
(c) the mass of one mole of oxygen gas
(d) the mass of one ion of oxygen
(e) the number of atoms in 1 mole of oxygen molecule
3. What is meant by atomic mass, gram atomic mass of an element? Why is the mass have different expressions i.e., 'u' and 'g'?

➤ Assertion Reason Questions:

1. For two statements are given- one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below:
- Both Assertion and Reason are correct, and reason is the correct explanation for assertion.
 - Both Assertion and Reason are correct, and Reason is not the correct explanation for Assertion.
 - Assertion is true but Reason is false.
 - Both Assertion and Reason are false.

Assertion: Atom is the smallest unit of molecule

Reason: Atom is not seen by our naked eyes.

2. For two statements are given- one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below:
- Both Assertion and Reason are correct, and reason is the correct explanation for assertion.
 - Both Assertion and Reason are correct, and Reason is not the correct explanation for Assertion.
 - Assertion is true but Reason is false.
 - Both Assertion and Reason are false.

Assertion: Atom is the smallest unit of molecule

Reason: Atoms are combined with each other forming molecule.

Case Study Question:

1. Read the passage and answer any four questions:

The simplest compounds, which are made up of two different elements are called binary compounds. While writing the chemical formulae for compounds, the constituent elements and their valencies are written. Then crossover the valencies of the combining atoms. For the ionic compound, the symbol of cation written first followed by the symbol of the anion. Then their charges are criss-crossed to get the formula. The positive and negative charges must balance each other and the overall structure must be neutral. The molecular mass of a substance is the sum of the atomic masses of all the atoms in a molecule of the substance.

- Which of the following statement correctly justifies that crystallisation technique considered better than simple evaporation to purify solid?
 - Solid decompose or get charred on heating to dryness.

- b. Impurities may remain dissolved in the solution even after filtration.
- c. Both (a) and (b)
- d. Impurities are easily removed in solution.
- ii. In magnesium chloride, chloride ions for each magnesium ion.
- a. one
- b. two
- c. three
- d. four
- iii. The molecular mass of HNO_3 is
- a. 63u
- b. 7u
- c. 54u
- d. 45u
- iv. The formula unit mass of CaCl_2 is
- a. 111u
- b. 342u
- c. 213u
- d. 122u
- v. The formula unit mass of a substance is:
- a. the sum of the atomic masses of all atoms.
- b. the sum of the atomic mass of only one atom
- c. both (a) and (b)
- d. none of these
2. Atoms are too small, or they are smaller than anything that we can imagine or compare with. Our entire world is made up of atom. Dalton was the first scientist to use the symbols for elements in a very specific sense. When he used a symbol for an element he also meant a definite quantity of that element, that is, one atom of that element. In the beginning, the names of elements were derived from the name of the place where they were found for the first time. For example, the name copper was taken from Cyprus. Many of the symbols are the first one or two letters of the element's name in English. The first letter of a symbol is always written as a capital letter (uppercase) and the second letter as a small letter (lowercase)

- i. 1m is equal to nm
- 10¹⁰
 - 10⁹
 - 10⁸
 - 10⁶
- ii. is the symbol of
- sulphur
 - iron
 - silver
 - mercury
- iii. Who suggested the symbol of elements are made from one or two-letter of the atom?
- Proust
 - Berzelius
 - Boyle
 - Robert
- iv. Law of constant proportion is given by
- Proust
 - Lavoisier
 - Dalton
 - Berzelius
- v. Full form of IUPAC
- International Union of Pure and Applied Chemistry
 - International Unity of Pure and Applied Chemistry
 - Indian Union of Pure and Applied Chemistry
 - none of these

✓ **Answer Key-**

➤ **Multiple Choice Answers:**

- (d) (ii) and (iv)
- (d) Atoms aggregate in large numbers to form the matter that we can see, feel or touch.

3. (a) $1/12$ th mass of C-12 atoms
4. (c) 1g H₂
5. (c) Law of Definite Proportions
6. (b) XY₂
7. (a) KNO₃
8. (a) 6.68×10^{23}
9. (a) Mass of one molecule of any substance compared with the mass of one atom of C – 12
10. (c) When energy is either given to, or taken out from the system
11. (b) 2
12. (b) BiPO₄
13. (b) 81 u
14. (a) 54.207×10^{23}
15. (a) $n = N / N_0$

➤ Very Short Answers:

1. Answer: In a chemical reaction mass can neither be created nor destroyed.
E.g., $2\text{Na} + \text{Cl}_2 \rightarrow 2\text{NaCl}$
 $2 \times 23 + 2 \times 35.5 \rightarrow 2(23 + 35.5)$
2. Answer: In a chemical substance the elements are always present in definite proportions by mass.
E.g., In water, the ratio of the mass of hydrogen to the mass of oxygen H : O is always 1:8
3. Answer: John Dalton coined the term atom.
4. Answer: The smallest particle of matter, which can take part in a chemical reaction is called atom.
5. Answer: The smallest particle of an element or compound which can exist independently is called molecule.
6. Answer: The number of atoms constituting a molecule is known as its atomicity.
7. Answer: The sum of the atomic masses of all the atoms in a molecule of the substance is expressed in atomic mass unit. E.g., $\text{H}_2\text{O} = 1 \times 2 + 16 = 18 \text{ amu}$
8. Answer: Atoms exist in the form of atom, molecule or ions.
9. Answer. The atomicity of phosphorus is P₄ i.e., 4.
The atomicity of nitrogen is N₂ i.e., 2.

10. Answer: Charged atom is called as an ion. The ion can be positively charged called cation or negatively charged called anion.

➤ Short Answer:

1. Answer: The unit to measure size of atom, is nanometer, size of hydrogen atom is 10^{-10}m .
2. Answer: IUPAC is International Union for Pure and Applied Chemistry. It approves the names of elements.
3. Answer:
 - Sodium → Natrium, Gold → Aurum
 - Potassium → Kalium, Mercury → Hydrargyrum
4. Answer:
 - H_2O ratio by mass of combining elements $2 : 16 \rightarrow 1 : 8$ (H : O)
 - CO_2 ratio by mass of combining elements $12 : 32 \rightarrow 3 : 8$ (C : O)
 - NH_3 ratio by mass of combining elements $14 : 3 \rightarrow 14 : 3$ (N : H)
5. Answer: Valency: The combining capacity of an element is called its valency. Valency of the following elements:
Magnesium – 2
Aluminium – 3
Chlorine – 1
Copper – 2
6. Answer: A group of atoms carrying a charge is known as a polyatomic ion.
E.g., Ammonium – NH_4^+
Nitrate – NO_3^-
Copper nitrate, calcium sulphate and aluminium hydroxide.
7. Answer: Chemical formula:
Copper nitrate → $\text{Cu}(\text{NO}_3)$
Calcium sulphate → CaSO_4 Aluminium hydroxide $\text{Al}(\text{OH})_3$
8. Answer: The formula unit mass of a substance is a sum of the atomic masses of all atoms in a formula unit of a compound. The constituent particles of formula unit mass are ions and the constituent particles of molecular mass are atoms.

➤ Long Answer:

1. Answer: (a) Atoms of some elements are not able to exist independently. For such elements

atoms form molecules and ions. In case of metals and inert gases atoms can exist independently.

Atoms of metals and inert gases: *E.g.*, $\frac{\text{Na, Mg, Al}}{\text{Metals}}$ $\frac{\text{He, Ne, Ar}}{\text{Inert gases}}$

Non-metals: *E.g.*, H_2 , Cl_2 , P_4 , S_8

Exceptional non-metal C

(b) The number of atoms constituting a molecule is known as its atomicity.

E.g., $\text{O}_3 \rightarrow$ atomicity is 3

$\text{O}_2 \rightarrow$ atomicity is 2

(c) Polyatomic ions: When more than two atoms combine together and act like an atom with a charge on it is called polyatomic ion.

E.g., OH^- , NO_3^- , NH_4^+

2. Answer:

(a) Mass of one atom of oxygen

1 mole of oxygen atom = 16 gm = 6.022×10^{23} atoms.

$$\therefore \text{Mass of one atom of oxygen} = \frac{16}{6.022 \times 10^{23}} = 2.65 \times 10^{-23}$$

(b) Mass of one molecule of oxygen

$$\begin{aligned} 1 \text{ molecule of oxygen} &= \text{O}_2 \\ &= 2 \times 16 \\ &= 32 \text{ u} \end{aligned}$$

(c) Mass of one mole of oxygen gas

1 mole of oxygen gas is $\text{O}_2 = 32 \text{ u}$

(d) Mass of one ion of oxygen

One mole of oxygen = 6.022×10^{23} atoms = 16g.

$$\begin{aligned} \text{Mass of one ion of oxygen} &= \frac{16}{6.022 \times 10^{23}} \\ &= 2.65 \times 10^{-23} \end{aligned}$$

(e) Number of atoms in one mole of oxygen molecule

1 mole of oxygen molecule *i.e.*,

$$\text{O}_2 = 6.022 \times 10^{23} \text{ molecules.}$$

$$1 \text{ molecule of O}_2 = 2 \text{ atoms.}$$

3. Answer: The atoms are very tiny and their individual mass cannot be calculated as it is negligible. Hence the mass of atoms is expressed in units with respect to a fixed standard. Initially hydrogen atom with mass 1 was taken as standard unit by Dalton. Later, it was replaced by oxygen atom ($O=16$). But due to the isotopes the masses were found in fractions instead of whole number. Hence, carbon ($C=12$) isotope was taken as standard unit and was universally accepted.

The atomic mass unit is equal to one twelfth ($1/12$) the mass of an atom of carbon-12, its unit is u.

Gramatomic mass: When the atomic mass of an element is expressed in grams, it is called the gramatomic mass of the element.

The mass of atoms, molecules is expressed in 'u' and the mass of moles i.e., molar mass is expressed in g.

➤ **Assertion Reason Answer:**

- (b) Both Assertion and Reason are correct, and Reason is not the correct explanation for Assertion.
- (b) Both Assertion and Reason are correct, and Reason is not the correct explanation for Assertion.

➤ **Case Study Answer:**

1. Answer:

- Both (a) and (b)
- two
- a) 63u
- a) 111u
- a) sum of atomic masses of all element

2. Answer:

- 10^9
- a) sulphur
- b) Berzelius
- a) proust
- a) International Union of Pure and