Chapter 4: Measurement of Matter

Question 1. Fill in the blanks.
(1) Atomic radius is expressed in **um**
(2) The unit of atomic mass is called **Dalton**
(3) Positively charged ions are called **cation**
(4) The sum of the number of **protons** and **neutrons** in the nucleus of the atom is called the atomic mass number.
(5) Protons and neutrons are together called **nucleons**.
(6) There is no **rise** or **drop** in the weight of the matter during a chemical reaction.
(7) The proportion by **weight** of the constituent elements in the various samples of a compound is fixed.
(8) The capacity of an element to combine is called **valency**.

Question 2. True or False
(1) Matter is neither gained nor lost during a chemical reaction. **True**
(2) In a compound, the elements are always present in different proportions by weight. **False**
(3) The proportion of carbon and oxygen by weight in carbon dioxide is 3: 6. **False**
(4) The molecular mass of a substance is the sum of the atomic masses of all the atoms in its molecule. **True**
(5) The number 6.022 x 10 is called Avogadro's number. **False**
(6) The mass of an atom of hydrogen is the average relative mass of the atom as compared to 1/12th the mass of one carbon atom. **True**

Question 3. Write symbol, atomic number and valency of the element

Element	Symbol	Atomic Number	Valency
Hydrogen	H	1	1
Helium	He	2	0 (inert)
Lithium	Li	3	1
Beryllium	Be	4	2
Boron	B	5	3
Carbon	C	6	4
Nitrogen	N	7	3
Oxygen	O	8	2
Fluorine	F	9	1
Neon	Ne	10	0 (inert)
Sodium	Na	11	1
Magnesium	Mg	12	2
Aluminum	Al	13	3
Silicon	Si	14	4
Phosphorus	P	15	3, 5
Sulfur	S	16	2
Chlorine	Cl	17	1
Argon	Ar	18	0 (inert)
Potassium	K	19	1
Calcium	Ca	20	2

Question 4. Answer in one sentence
(1) Define valency

Answer: Valency is the combining capacity of an atom, determined by the number of electrons it can lose, gain, or share to form a stable compound.

(2) What is anion.

Answer: An anion is a negatively charged ion formed when an atom gains one or more electrons.

(3) What is cation

Answer: A cation is a positively charged ion formed when an atom loses one or more electrons.

(4) What is one mole.

Answer: One mole is the amount of substance that contains 6.022×10^{23} particles (atoms, molecules, ions, etc.), known as Avogadro's number.

(5) Define Atomic Number.

Answer: The atomic number is the number of protons in the nucleus of an atom, which determines its chemical properties and position in the periodic table.

(6) Define atomic mass number.

Answer: The atomic mass number is the total number of protons and neutrons (nucleons) in an atom's nucleus.

(7) Define nucleons.

Answer: Protons and neutrons are together called nucleons.

(8) What is dalton

Answer: A dalton (Da) is a unit of mass used to express atomic and molecular masses, approximately equal to the mass of a hydrogen atom or 1/12 the mass of a carbon-12 atom.

Question 5. Answer the following questions.

(1) What is Law of chemical combination. Explain with simple example.

Answer: The Law of Chemical Combination refers to two key laws—the Law of Conservation of Mass and the Law of Constant Proportion. It states that when substances combine to form compounds, they do so in fixed ratios by mass. For example, in the formation of water (H_2O), 2 grams of hydrogen combine with 16 grams of oxygen in a fixed ratio of 1:8 by mass.

(2) What is Law of conservation of matter. Explain with simple example.

Answer: The Law of Conservation of Matter states that matter cannot be created or destroyed in a chemical reaction, only transformed from one form to another. For instance, when carbon burns in oxygen to form carbon dioxide, the mass of carbon and oxygen before the reaction is equal to the mass of carbon dioxide after the reaction.

(3) What is Law of constant proportion. Explain with simple example.

Answer: The Law of Constant Proportion, also called the Law of Definite Proportions, states that a chemical compound always contains its component elements in a fixed ratio by mass. For example, water (H_2O) always consists of hydrogen and oxygen in a 1:8 mass ratio, regardless of the amount of water or its source.

(4) Write a short note on Avagadro number.

Answer: Avogadro's Number, 6.022×10^{23}, is the number of atoms, molecules, or particles present in one mole of a substance. It provides a link between the microscopic world of atoms and the macroscopic world of grams and moles, allowing chemists to count atoms and molecules by weighing substances.

(5) Write a note on valency, also explain variable valency.

Answer: Valency is the capacity of an element to combine with other elements, determined by the number of electrons an atom can lose, gain, or share. Some elements exhibit variable valency, meaning they can combine in different proportions depending on the chemical environment. For example, iron (Fe) can have a valency of 2 or 3, forming Fe^{2+} or Fe^{3+} ions in compounds like $FeCl_2$ (iron (II) chloride) or $FeCl_3$ (iron (III) chloride).

(6) 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:

a. Positive Radicals (Cations):
- Sodium ion (Na^+)
- Potassium ion (K^+)
- Calcium ion (Ca^{2+})

b. Basic Radicals (Cations):
- Ammonium ion (NH_4^+)
- Magnesium ion (Mg^{2+})
- Barium ion (Ba^{2+})

c. Composite Radicals (Polyatomic Ions):
- Sulfate ion (SO_4^{2-})
- Nitrate ion (NO_3^-)
- Carbonate ion (CO_3^{2-})

d. Metals with Variable Valency
- Examples:Iron (Fe^{2+}, Fe^{3+})
- Copper (Cu^+, Cu^{2+})
- Tin (Sn^{2+}, Sn^{4+})

e. Bivalent Acidic Radicals (Anions with Valency 2):
- Sulfate ion (SO_4^{2-})
- Carbonate ion (CO_3^{2-})
- Oxide ion (O^{2-})

f. Trivalent Basic Radicals (Cations with Valency 3):
- Aluminum ion (Al^{3+})
- Ferric ion (Fe^{3+})
- Chromium ion (Cr^{3+})

Question 6: Calculate molecular mass of:

(1) H_2O

Molecule	Constituent elements	Atomic mass u	Number of atoms in the molecule	Atomic mass x number of atoms	Mass of the constituents u
H_2O	Hydrogen	1	2	1 x 2	2
	Oxygen	16	1	16 x 1	16
Molecular mass = sum of constituent atomic masses (Molecular mass of H_2O) = (Atomic mass of H) x 2 + (Atomic mass of O) x 1					Molecular mass 18

(2) H_2O_2

Molecule	Constituent elements	Atomic mass u	Number of atoms in the molecule	Atomic mass x number of atoms	Mass of the constituents u
H_2O_2	Hydrogen	1	2	1 x 2	2
	Oxygen	16	2	16 x 2	32
Molecular mass = sum of constituent atomic masses (Molecular mass of H_2O_2) = (Atomic mass of H) x 2 + (Atomic mass of O) x 2					Molecular mass 34

(3) MgO

Molecule	Constituent elements	Atomic mass u	Number of atoms in the molecule	Atomic mass x number of atoms	Mass of the constituents u
MgO	Magnesium	24	1	24 x 1	24
	Oxygen	16	1	16 x 1	16
Molecular mass = sum of constituent atomic masses (Molecular mass of MgO) = (Atomic mass of Mg) x 1 + (Atomic mass of O) x 1					Molecular mass 40

(4) NaCl

Molecule	Constituent elements	Atomic mass u	Number of atoms in the molecule	Atomic mass x number of atoms	Mass of the constituents u
NaCl	Sodium	23	1	23 x 1	23
	Chlorine	35	1	35 x 1	35
Molecular mass = sum of constituent atomic masses (Molecular mass of NaCl) = (Atomic mass of Na) x 1 + (Atomic mass of Cl) x 1					Molecular mass 58

(5) H_2SO_4

Molecule	Constituent elements	Atomic mass u	Number of atoms in the molecule	Atomic mass x number of atoms	Mass of the constituents u
H_2SO_4	Hydrogen	1	2	1 x 2	2
	Sodium	23	1	23 x 1	23
	Oxygen	16	4	16 x 4	64
Molecular mass = sum of constituent atomic masses (Molecular mass of H_2SO_4) = (Atomic mass of H) x 2 + (Atomic mass of S) x 1 + (Atomic mass of O) x 4					Molecular mass 89