

Chapter = 01

Fundamental Chemistry

Q1) Define Chemistry. Name different branches of chemistry

CHEMISTRY

Chemistry is the branch of science which deals with the properties, composition and structure of matter. Chemistry also deals with the changes involved in the matter



Q2) Define different branches of chemistry

PHYSICAL CHEMISTRY

Physical chemistry is the branch of chemistry which deals with relationship between composition and physical properties of matter with the changes in them.

ORGANIC CHEMISTRY

Organic chemistry is the branch of chemistry which deals with hydrocarbons and their derivatives. Organic chemistry is the study of structure, properties, which include hydrocarbons except oxides, carbonates, bicarbonates and cyanides.

INORGANIC CHEMISTRY

Inorganic chemistry is the branch of Chemistry which deals with the study of all elements and their compound except hydrocarbons. These compounds are generally obtained from nonliving organisms.

BIOCHEMISTRY

Biochemistry is the branch of Chemistry which deals with the compounds of living organisms. Plants and animals and their metabolism and synthesis in the living body such as carbohydrates, proteins and fats.

NUCLEAR CHEMISTRY

Nuclear chemistry is the branch of chemistry which deals with the radioactivity, nuclear processes and properties. Radioactive elements are widely used in medicine as diagnostic tools.

ENVIRONMENTAL CHEMISTRY

It is the branch of Chemistry which deals with the study of the interaction of chemical materials and their effect on the environment of animals and plants. Personal hygiene, pollution, health hazards are the important areas of environmental chemistry.

ANALYTICAL CHEMISTRY

Analytical chemistry is the branch of chemistry which deals with separation and analysis of kind, quality and quantity of various components in given substance, It used in chromatography, electrophoresis and spectroscopy.

MEDICINAL CHEMISTRY



The branch of Chemistry which deals with synthetic organic chemistry, pharmacology and various biological specialties. The medicinal chemistry is used in synthesis of chemicals, bioactive molecules (Drugs) and pharmaceutical agents.

QUANTUM CHEMISTRY

The branch of Chemistry which deals with application, mechanics and experiments of physical models in chemical system. It is also called molecular quantum mechanics.

GREEN CHEMISTRY

The branch of chemistry which deals with study of processes and designing products, which are composed of less hazardous substances. It is also known as sustainable chemistry.

Q3) Give importance of chemistry in daily life.

IMPORTANCE OF CHEMISTRY IN DAILY LIFE

1. Cooking, eating and digestion of food are purely chemical processes. Construction, cleaning and washing of our homes are dependable on chemistry.
2. The production of fertilizers, glass, plastic synthetic fiber, polymer, ceramics, petroleum products, soaps, and detergents are based on chemistry.
3. The diseases transmitted through impure drinking water as cholera, typhoid, dysentery, skin and eye infections can be controlled with the help of chlorine treatment to kill the pathogenic organism to obtain pure water.
4. The chlorine is most important chemical which used commercially to produce more than one thousand compounds which are used in chemical industry.

Q4) Give one contribution of Following Scientists

- 1) **Jabir ibne Haiyan:** Invented experimental methods of nitric acid, hydrochloric acid and white lead.
- 2) **Al Razi:** Prepared ethyl alcohol by fermentation process.
- 3) **Al Beruni:** Determined densities of different substances.
- 4) **Ibne-Sina:** Contributed in medicines, philosophy and astronomy.
- 5) **J.Black:** Study of carbon dioxide
- 6) **j.Priesly:** Discovered oxygen, Sulphur dioxide and hydrogen chloride.

- 7) **Cavendish:** Discovered hydrogen
- 8) **Lavoisier:** Discovered that oxygen is one fifth of air
- 9) **Mendeleve:** Discovered periodic arrangement of elements.
- 10) **Neil bohr:** Proposed a theory for the hydrogen atom based on quantum theory
- 11) **Rutherford:** Postulated the nuclear structure of the atom.
- 12) **Elbert Einstein:** Proposed fourth state of matter

Q5) Define matter. What is atom?



MATTER

Matter is any substance that has mass and takes up space by having volume.

ATOM

An atom is the smallest unit of ordinary matter that forms a chemical element.

Q6) What is molecule. Give examples of mono, di, tri atomic elements

MOLECULE

A molecule is the smallest particle in a chemical element or Compound that has the chemical properties of that element or Compound.

MONO ATOMIC

Helium (He)

Argon (Ar)

Krypton (Kr)

DI ATOMIC

Nitrogen (N₂)

Oxygen (O₂)

Iodine (I₂)

POLYATOMIC

Ozone (O₃)

Sulphur (S₈)

Phosphorus (P₄)

Q7) Define substance with example

SUBSTANCE:

A substance is a matter that has definite properties and composition. Every pure compound and element are a substance.

EXAMPLE:

Baking soda (sodium bicarbonate)

Table salt (sodium chloride)

Pure sugar (sucrose)

Q8) What is an element. List 10 elements with their symbol and name

ELEMENT

An element is a pure substance consisting only of atoms that all have the same numbers of protons in their atomic nuclei.

Hydrogen (H)

Lithium (Li)

Carbon (C)

Oxygen (O)

Magnesium (Mg)

Sulphur (S)

Calcium (Ca)

Sodium (Na)

Chlorine (Cl)

Nitrogen (N)

Q9) What is valence? Also give valence of some elements

VALENCE:



The Combining power of an element with other element is called valency. Valency is the number of electrons an atom/element can gain, lose or share.

Hydrogen	H	+1, -1
Lithium	Li	+1
Oxygen	O	-2
Chlorine	Cl	-1
Aragon	Ar	0

Q10) What is a chemical formula? Also give example of it

CHEMICAL FORMULA

The chemical formula represents the symbol of elements and ratios of elements to one another in a compound. Chemical formula tells us number of atoms of each element in a compound with symbols

FOR EXAMPLE:

- Chemical formula of water is H_2O which indicates that 2 atoms of hydrogen combine with 1 atom of oxygen.
- Chemical formula of ammonia NH_3 shows that one nitrogen atom combines with 3 atoms of hydrogen.

Q11) What is compound. Give six examples of compound

COMPOUND

The Compound is a substance formed when two or more elements are chemically bonded together in a fixed ratio by mass, As a result a new entirely different properties possessing substance formed.

EXAMPLE

Water (H_2O) Silicon dioxide (SiO_2) Sugar ($C_{12}H_{22}O_{11}$)
Ammonia (NH_3) Sulphuric Acid (H_2SO_4)

Q12) Differentiate between elements and compound

<u>Elements</u>	<u>Compound</u>
Element is a substance made up of same atoms, and discovered naturally	Compound is formed by a chemical combination of atoms of the elements.

Element shows unique properties due to similarity of atoms.	Constituent of compound lose their identity and form a new substance with new properties.
Element cannot decompose in to simple substances by ordinary means	Components cannot be separated by physical means.
Element represented by symbols	Every compound represented by chemical formula.



Q13) Differentiate between mixture and compound

<u>Mixture</u>	<u>Compound</u>
Mixture formed by the simple mixing of the substances.	Compound is formed by a chemical combination of atoms of the elements.
Constituents of mixture retain their properties in mixture.	Constituent of compound lose their identity and form a new substance with new properties.
The components can be separated by physical means.	Components cannot be separated by physical means.
It consists of two or more components and does not show any chemical formula	Every compound represented by chemical formula.

Q14) Differentiate between empirical formula and molecular formula

<u>Empirical Formula</u>	<u>Empirical Formula</u>
The formula showing minimum relative numbers of each type of atoms in a molecule is called Empirical Formula	The Molecular formula is the formula which shows actual number of atoms of each element present in a molecule
Empirical Formula shows simplest ratio of each atoms present in a molecule.	Molecular formula of a compound may be same or multiple of empirical formula
Empirical Formula does not show the actual number of atoms in the molecule	Molecular Formula show the actual number of atoms in the molecule
E.F of benzene CH	M.F of benzene C ₆ H ₆
E.F of benzene CH ₂ O	M.F of benzene C ₆ H ₁₂ O ₆

Q15) Define atomic number and atomic mass

ATOMIC NUMBER

The Atomic Number is number of protons present in the nucleus of atom of any Element. it represented by symbol Z .

FOR EXAMPLE



All oxygen atoms have 8 number of protons due to this atomic number is 8 ($Z = 8$).

ATOMIC MASS

The Atomic Mass is sum of number of protons and neutrons present in the nucleus of atom of any element. it represented by symbol A and calculated by $A = Z + n$ where n is number of neutrons.

FOR EXAMPLE

Nitrogen atom have 7 number of protons and 7 number of electrons then Atomic mass of nitrogen is 14 ($A = 7 + 7 = 14$).

Q16) What is an ion? Also define cation, anion, molecular ion and free radical

ION Ion is an atom or group of atoms having a charge on it. The charge may be positive or negative.

CATION The cations are formed when an atom loses electrons from its outer most shell.

FOR EXAMPLE: Na^+ , K^+ are cations

ANION An atom or group of atom that has a negative charge on it is called anion.

FOR EXAMPLE: O^{2-} , Cl^- are anions

MOLECULAR ION when a molecule loses or gains electrons called molecular ions. Molecular ions also possess positive or negative charge like any ion.

FOR EXAMPLE CH_4^+

FREE RADICAL Free radicals are atoms and group of atoms having number of unpaired electrons. It is represented by putting a dot over the symbol of an element.

FOR EXAMPLE: H^\bullet , Cl^\bullet , $\text{H}_3\text{C}^\bullet$

Q17) Differentiate between molecules and molecular ion

<u>Molecules</u>	<u>Molecular Ion</u>
Molecule is the smallest particle in a chemical element or compound that has chemical properties of that element or compound	Molecular ion formed by gain and lose of electrons by a molecule.

Molecule is always neutral.	Molecular ion have positive or negative charge
Molecule is formed by the combination of atoms	Molecular ion formed by the ionization of a molecule
Molecule is stable unit	Molecular ion is reactive species.

Q18) Give some examples of

- 1) **MONO ATOMIC MOLECULE:** Molecule consist of one atom.

E.g. helium (He), neon(Ne), argon(Ar)

- 2) **DI ATOMIC MOLECULE:** Molecule consist of two atoms.

E.g. Hydrogen (H₂) Oxygen (O₂), Chlorine (Cl₂)

- 3) **TRI ATOMIC MOLECULE:** Molecule consist of three atoms.

E.g. H₂O, CO₂

- 4) **POLY ATOMIC MOLECULE:** Molecule consist of many atoms.

E.g. CH₄, H₂SO₄, C₆H₁₂O₆

- 5) **HOMO ATOMIC MOLECULE:** Molecule consist of same type of atoms

E.g. H₂, O₃, P₄, S₈

- 6) **METRO ATOMIC MOLECULE:** Molecule consist of different type of atoms

E.g. NH₃, H₂O, CO₂



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Numerical Problems

Q1. Complete the table

Elements	Name of elements	Atomic Number	Mass Number
H			
Mg			
Ca			
B			
C			
N			
O			
Li			
F			
Al			
P			
S			
Cl			
Cu			
Na			
Ag			
I			
Pt			
Hg			
Au			
K			
Be			

ELECTRON, PROTON AND NEUTRON

Mass Number Z Gain/Loss of Electron
Atomic Number

Q2. How many Proton, Neutrons and Electron are present in the following atoms?

1. $^{23}_{11}\text{Na}$
2. $^{16}_8\text{O}$
3. $^{12}_6\text{C}$
4. ^1_1H
5. $^{131}_{53}\text{I}$
6. $^{16}_8\text{O}^{-2}$
7. $^{23}_{11}\text{Na}$
8. $^{39}_{19}\text{K}$
9. $^{19}_9\text{F}^{-1}$
10. $^{23}_{11}\text{Na}^{+1}$
11. $^{32}_{16}\text{S}^{-2}$
12. $^{14}_7\text{N}^{-3}$



MOLECULAR MASS

Q. Calculate the molar mass of the following.

Example:



Solution

$$\text{Molecular mass of Ca}(\text{HCO}_3)_2 = 40 \times 1 + 2(1 \times 1 + 12 \times 1 + 16 \times 3)$$

$$\text{Molecular mass of Ca}(\text{HCO}_3)_2 = 40 + 2(1 + 12 + 48)$$

$$\text{Molecular mass of Ca}(\text{HCO}_3)_2 = 40 + 2(61)$$

$$\text{Molecular mass of Ca}(\text{HCO}_3)_2 = 40 + 122$$

$$\text{Molecular mass of Ca}(\text{HCO}_3)_2 = 162 \text{ a.m.u Ans.}$$

1. KOH Ans. 56 a.m.u

2. CH₃COOH Ans. 60 a.m.u

3. C₆H₁₂O₆ Ans. 180 a.m.u

4. H₂SO₄ Ans. 98 a.m.u

5. H₂SO₇ Ans. 146 a.m.u

6. Al(OH)₃ Ans. 78 a.m.u

7. Mg(OH)₂ Ans. 58 a.m.u

8. Al₂O₃ Ans. 73 a.m.u

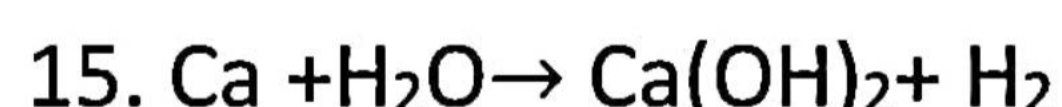
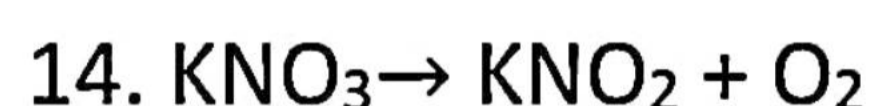
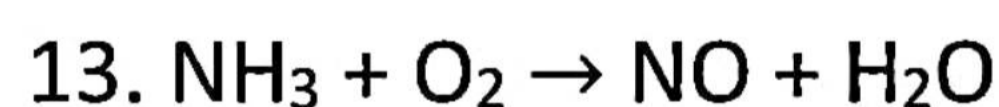
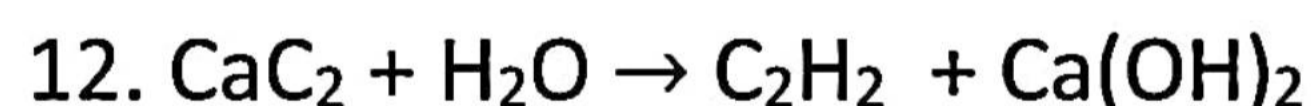
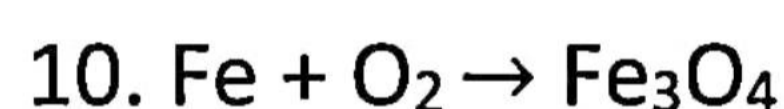
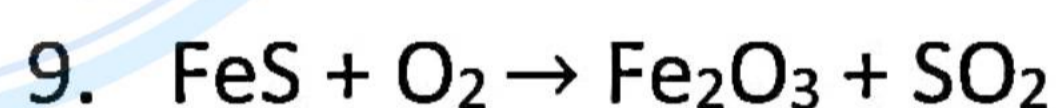
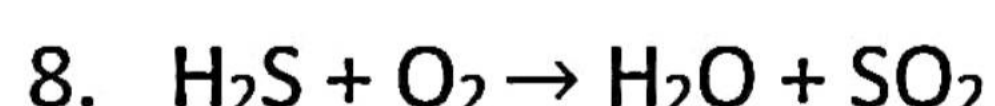
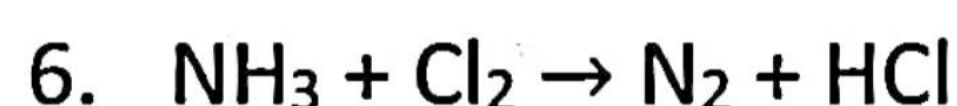
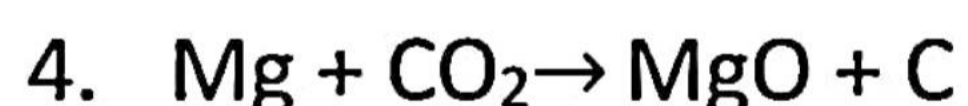
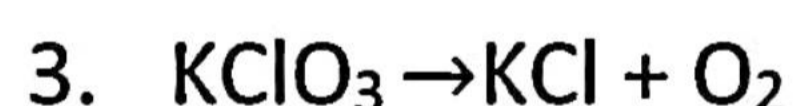
9. MgCl₂ Ans. 95 a.m.u

10. NaCl Ans. 58.5 a.m.u

11. KNO₃ Ans. 101 a.m.u

BALANCE THE CHEMICAL EQUATION

Q. Balance the following chemical reaction.



NUMBER OF MOLES

1. 20 gram of Be Ans. 2.222 mole

2. 15 gram of Ne Ans. 0.75 mole

3. 25 gram of K Ans. 0.641 mole

4. 130 gram of HNO₃ Ans. 2.063 mole

5. 50 gram of C₆H₁₂O₆ Ans. 0.278 mole

6. 35 gram of CaSO₄ Ans. 0.257 mole

MASS OF SUBSTANCE

Q. Calculate the mass of following.

- | | | | |
|--------------------|--------------|---------------------------------|----------------|
| 1. 2 moles of Mg | Ans. 48 gm | 5. 1.75 moles of S | Ans. 56 gm |
| 2. 3.5 moles of Al | Ans. 94.5 gm | 6. 0.36 mole of MgSO_4 | Ans. 43.2 gm |
| 3. 0.5 moles of Ca | Ans. 20 gm | 7. 2.23 moles of HCl | Ans. 81.395 gm |
| 4. 7.5 moles of N | Ans. 105 gm | 8. 1.25 moles of KOH | Ans. 70 gm |

NUMBER OF ATOMS

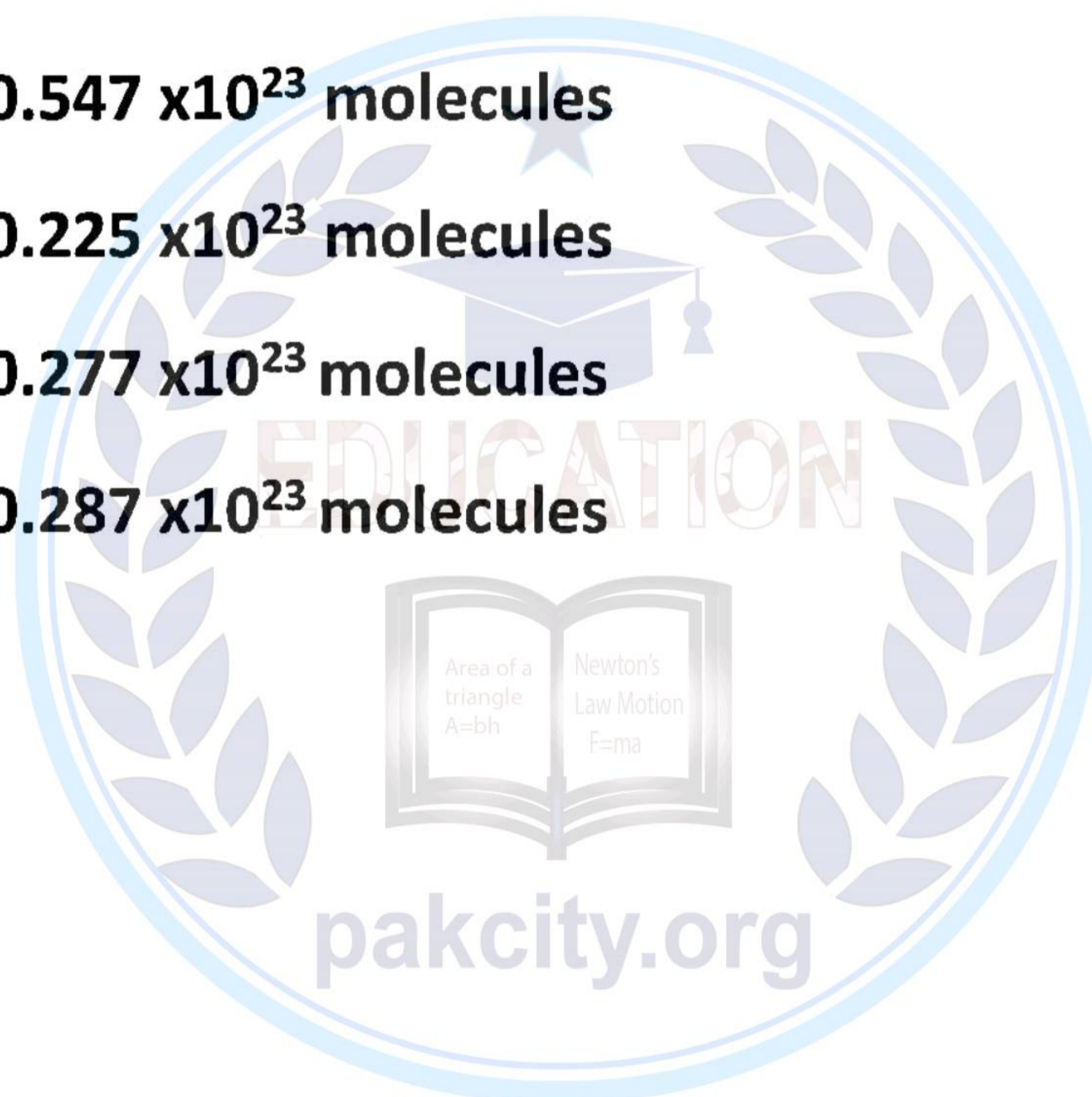
Q. Calculate the number of atoms in following:

- | | | | |
|-----------------|-----------------------------------|-------------------|-----------------------------------|
| 1. 1 gram of He | Ans. 2.007×10^{23} atoms | 3. 5 gram of Ca | Ans. 0.753×10^{23} atoms |
| 2. 3 gram of Al | Ans. 0.669×10^{23} atoms | 4. 1.75 gram of S | Ans. 0.329×10^{23} atoms |

NUMBER OF MOLECULES

Q. Calculate the number of molecules in following:

- | | |
|--|---------------------------------------|
| 1. 4 gram of CO_2 | Ans. 0.547×10^{23} molecules |
| 2. 3 gram of SO_3 | Ans. 0.225×10^{23} molecules |
| 3. 4.5 gram of H_2SO_4 | Ans. 0.277×10^{23} molecules |
| 4. 3 gram of HNO_3 | Ans. 0.287×10^{23} molecules |



MULTIPLE CHOICE QUESTIONS

1. The branch of Chemistry which deals with hydrocarbons:
(a) Industrial chemistry (b) Inorganic chemistry
(c) Organic chemistry (d) Physical chemistry
2. The atomic mass of an element expressed in gram is:
(a) Gram molecular mass (b) Gram atomic mass
(c) Gram formula mass (d) Mole
3. Which of the following can be separated by physical means?
(a) Mixture (b) Element
(c) Compound (d) Substance
4. The molar mass of H_2SO_4 is:
(a) 98 a.m.u (b) 9.8gm (c) 98gm (d) 9.8 a.m.u
5. The Molecule consist of two atoms is:
(a) Monoatomic molecule (b) Polyatomic molecule
(c) Hetero atomic molecule (d) Di atomic molecule
6. A formula that indicates actual number and type of atoms in a molecule is called:
(a) Chemical formula (b) Empirical formula
(c) Molecular formula (d) Formula mass
7. Ethyl alcohol was prepared by:
(a) Ibne-Sina (b) Al-Razi (c) Al-Beruni (d) Jaber bin-Hayan
8. which of the following is Not a homo atomic:
(a) H_2 (b) NH_3 (c) H_2O (d) CO_2
9. The Empirical formula of hydrogen peroxide is:
(a) H_2O_2 (b) HO (c) OH (d) O_2H_2
10. A piece of matter in pure form is termed as:
(a) Radical (b) Mixture (c) Compound (d) Substance