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UNIT 01

# States of Matter and Phase Changes

## Descriptive Questions

**Q.1 (Ex. Q.4 (i)) Mention the name of the branch of Chemistry in which you will study each of the following topics.**

09201001

**Ans.** Chemistry is the branch of Science which deals with the properties, composition and the structure of matter. It also studies the physical and chemical changes in matter and the laws or principles which govern these changes.

**(a) Rate of reaction**

**Ans.** Rate of reaction is studied in physical chemistry.

**(b) Digestion of food in human body**

**Ans.** Digestion of food in human body is studied in biochemistry.

**(c) Properties of Plasma**

**Ans.** Properties of plasma are studied in physical chemistry.

**(d) Ecosystem**

**Ans.** Ecosystem is studied in environmental chemistry.

**(e) Reactions taking place during fire works**

**Ans.** Inorganic chemistry deals with the study of reactions taking place during fireworks.

**(f) Measurement of the absorption of wavelength with the help of ultraviolet spectrometer.**

**Ans:** Analytical chemistry deals with the measurement of the absorption of wavelength with the help of ultraviolet spectrometer.

**Q.2 (Ex. Q.4 (ii)) What are allotropic forms? Explain the allotropic forms of carbon and sulphur. How does coal differ from diamond?**

09201002

**Ans. Definition**

Elements may exist in more than one structural forms which can exhibit quite different physical and chemical properties. These forms are called allotropic forms and phenomenon is called allotropy.

**For example:-**

**(i) Allotropic forms of oxygen:**

Oxygen exists in two allotropic forms namely oxygen ($O_2$) and ozone ($O_3$).

**(ii)Allotropic forms of carbon:**

Carbon exists in three allotropic forms diamond, graphite and Buckminster fullerene.

**a. Diamond**

Diamond has a giant macromolecular structure.

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**b. Graphite**

Graphite has a layered structure of hexagonal rings of carbon.

**c. Buckminster fullerene**

Buckminster fullerene ($C_{60}$) consists of spheres made of atoms arranged in pentagons and hexagons. Fullerenes are stable at high temperatures and high pressures. Being covalent in nature, they are soluble in organic solvents. The fullerene structure is unique in that the molecule is not charged, has no boundaries and has no unpaired electrons. They have a cage like structure. Fullerene $C_{60}$ has a low melting point. It is soft and cannot conduct electricity.

**(iii) Allotropic forms of sulphur**

Sulphur also exists in two crystalline allotropic forms i.e. rhombic and monoclinic;

1. **Rhombic:** It contains $S_8$ molecules arranged in a rhombic crystal lattice. It is more stable allotropes under standard condition
2. **Monoclinic:** It contains $S_8$ molecule arranged in a monoclinic crystal lattice.

| Coal | Diamond |
|---|---|
| • Coal is a combustible black or brownish-black sedimentary rock composed primarily of carbon along with hydrogen, sulphur, oxygen and nitrogen. | • Diamond is a form of carbon with a rigid three dimensional crystal lattice structure. |
| • Coal is used as a source of energy for heating and electricity generation due to its high carbon content. | • Diamond is known for its hardness, transparency and high refractive index. Due to which, it is use in jewelry and industrial applications. |

**Q.3 (Ex. Q.4 (iii)) What are supercritical fluids? How are they different from ordinary liquids?**

09201003

**Ans.** Supercritical fluids are highly compressed state of matter which shows both properties of gases and liquids.

**Difference between supercritical fluids and ordinary liquids:**

| Supercritical fluids | Ordinary liquids |
|---|---|
| • They diffuse quickly. | • They diffuse slowly. |
| • They have higher solvating power which means they can dissolve a wide range of substances. | • They have low solvating power which means they can dissolve a fewer substance. |
| • They have lower viscosity allowing them to flow more easily. | • They have high viscosity. |
| • They are more compressible than ordinary liquids. | • They are less compressible than supercritical fluids. |

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**Q.4 (Ex. Q.4 (iv)) Define solubility of a solute. How does the solubility of solutes change with the increase in temperature?** 09201004

**Definition**

The solubility of a solute is the amount of solute which can dissolve in 100g of a solvent at a particular temperature.

**Solubility change with change in temperature**

Change in temperature has different effects on the solubility of different compounds.

**i) Solubility increase with increase in temperature:**

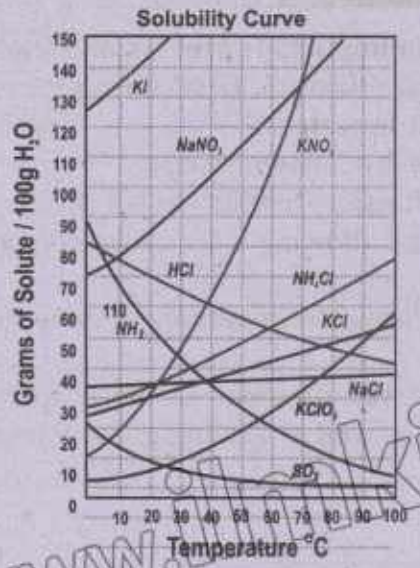
Usually the solubility increases with the increase in temperature but it cannot be taken as a general rule. There are a large number of compounds whose solubility in $H_2O$ increases with the increase in temperature e.g. potassium nitrate ($KNO_3$), silver nitrate ($AgNO_3$) and potassium chloride (KCl) etc. Similarly, the solubility of copper sulphate and sodium nitrate also increase with increase in the temperature. On dissolving a solute in a solvent if heat is absorbed, it means that solutes- solutes forces are stronger and heat is required to break these forces. For such solutes, solubility increase with the increase in temperature.

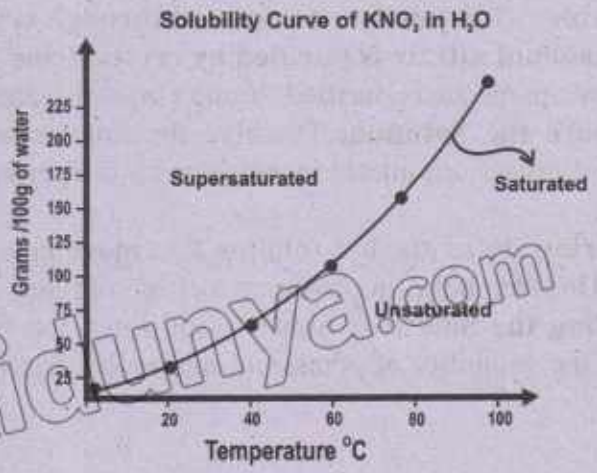
**ii) Solubility decrease with increase in temperature:**

The solubility of compounds like Lithium carbonate ($Li_2CO_3$) and calcium chromate ($CaCrO_4$) decrease with the increase in temperature. The solubility of gases in water also decreases with the increase in temperature. On dissolving solute in a solvent if heat is released, it means that solute solvent interactions are stronger then solute-solute forces. For such solids solubility decrease with the increase of temperate. Similarly, the solubility of calcium hydroxide decreases with the increase in temperature.

**iii) Temperature has no effect on solubility**

The solubility of sodium chloride in $H_2O$ does not increase appreciably with the increase in temperature. On adding a solute in a solvent, if neither heat is absorbed nor released, temperature has minimum effect on solubility.




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**Q.5 (Ex. ,Q.4 (v)) What types of movements are present in gaseous and liquid molecules?** 09201005

**Ans.**

**i. Gaseous Molecules:**

In gaseous molecules, the molecules have rapid and random movements. They move freely and quickly, colliding with each other and the walls of the container. Due to this free movement, gases expand to fill their container. They have weak intermolecular forces and make gases easily compressible. Their densities are very low.

**ii. Liquid Molecules:**

In liquid molecules, the molecules are also in continous state of motion but the movement is more restricted as compared to gases. Liquid molecules have significant intermolecular forces between them allowing them to flow and take the shape of the container. But they do not expand to fill the entire volume like gases. Liquids are therefore not easily compressible and their densities have high values.

**Q.6 (Ex. Q.4 (vi)) Differentiate between the areas which are studied under inorganic and organic chemistry.** 09201006

| Organic chemistry | Inorganic chemistry |
|---|---|
| **i) Definition** It is the branch of chemistry that deals with the compounds of carbons and hydrogen (hydrocarbons) and their derivatives other than its simple salts like carbonates, bicarbonates, oxides and carbides. | **i) Definition** It is the study of the synthesis composition, properties and structure of elements and compounds that contain little or no carbon. hydrogen (hydrocarbons) |
| **ii) Application** In this branch, we study the structure, formation, properties, composition and reactions of carbon containing compounds. Organic compounds are found in all forms of life and are also essential for life. | **ii) Application** Inorganic compounds are used as medicines, fertilizers, catalysts, pigments, coatings and much more. |

## Investigative Questions

**Q.1. (Ex. Q.5 (i)) Preparation of solutions leads to an important process in chemistry which enables us to purify a compound through crystallization. Describe a process in which potassium nitrate is purified by crystallizing it in water.** 09201007

**Ans.** Potassium nitrate is purified through crystallization by following steps:

**i) Prepare the Solution:** Dissolve the impure potassium nitrate in hot water. The solubility of potassium nitrate increases with temperature allowing more of the compound to dissolve.

**ii) Filtering:** Filter the hot solution to remove any insoluble impurities or undissolved particles. This step helps in obtaining a clear solution.

**iii) Cooling the Solution:** Slowly cool down the filtered solution. As the temperature decreases, the solubility of potassium nitrate decreases as well as leading to the formation of crystals.

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iv) **Crystallization:** Crystals of potassium nitrate will start to form as the solution cools. These crystals are purer than the original compound since impurities are less likely to be incorporated the crystal lattice.

v) **Isolation of Crystals:** Once a sufficient amount of crystals has formed, separate them from the remaining liquid using techniques like filtration or decantation.

vi) **Drying:** Finally, dry the purified potassium nitrate crystals to remove any remaining water resulting in a pure crystalline compound. Put solids commonly appear as beautifully shaped crystals.

This process of crystallization helps in purifying potassium nitrate by separating it from impurities present in the initial sample.

**Q.2. (Ex. Q.5 (ii)) Graphene is called a miracle material and it is the material of the future. Which of its many properties makes it very useful in electronics?** 09201008

**Ans.** Graphene is highly valuable in the field of electronics and it is often called a "miracle material" because of its unique characteristics. It is useful in electronics like:

- It is a single layer of carbon atoms arranged in a hexagonal lattice, making it incredibly strong.
- It is a light weight.
- It is a good conductor of electricity and heat.
- It is a transparent material.
- It is highly flexible material.

Graphene is exceptionally strong about 200 times stronger than steel. This strength combined with its light weight nature make it highly desirable for various applications.

**Examples:**

Graphene-based transistors, sensors and flexible electronic devices are just a few examples of how this material is revolutionizing the electronics industry.

**Uses:**

Due to its transparency, it is use in touch-screen, solar cells and other optoelectronic devices.

## SLO Based Additional Long Questions

**Q.1 What is Chemistry? Explain its Branches.** 09201009

**Ans.** Chemistry is the science which deals with the properties, composition and the structure of matter. It also studies the physical and chemical changes in matter and the laws or principles which govern these changes.

**Need of Branches of Chemistry**

Chemistry is divided into many distinct branches. These branches have distinct areas of study for the scientists to focus on and to achieve breakthroughs and advancements.

**1. Physical Chemistry**

This branch investigates how substances behave at atomic or molecular levels. It provides clear explanation as to how fundamental physical laws governing our world cause atoms and molecules to show specific characteristics and in turn react to give huge structures related to life.

**Uses:** Physical chemistry is also used to predict and change the rates of reaction and thus optimize the conditions to carry out the reaction on industrial scale.

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**2. Inorganic Chemistry**

It is the study of the synthesis, composition, properties and structure of elements and compounds that contain little & no carbon.

**Uses:** Inorganic compounds are used as fertilizers, medicines, catalysts, pigments, coatings and much more.

**3. Organic Chemistry**

It is the branch of chemistry that deals with the carbon compounds (hydrocarbons and their derivatives) other than its simple salts like carbonates, bicarbonates, oxides and carbides. In this branch, we study the structure, formation, properties, composition and reactions of carbon containing compounds.

**Uses:** Organic compounds are found in all forms of life and are also essential for life.

**4. Environmental Chemistry**

It is the scientific study of the chemical and biochemical phenomena that occur in this planet. In this we study the sources, reactions, effects and fates of chemical species in the air, soil and water environments.

**Uses:** Without this, it would be impossible to study the effects that humans have on the environment through the release of chemicals. It helps in understanding the causes, effects and solutions of different types of pollution.

**5. Analytical Chemistry**

This branch of chemistry deals with the analysis of different substances. It involves separation, identification and determination of the concentration of the material things.

**Uses:** Nowadays the field of analytical chemistry generally involves the use of modern instruments to analyze the matter.

**6. Biochemistry**

It is the branch of chemistry in which we understand life through chemical processes. It is the study of chemical substances and vital processes occurring in living organisms.

**Uses:** Biochemistry provides insights into the structure and function of molecules such as proteins, carbohydrates, lipids and nucleic acids.

**7. Nuclear Chemistry**

Nuclear chemistry deals with the reactions taking place in the nucleus of an atom. It deals with radioactivity, nuclear processes and transformation in the nuclei of atoms.

**8. Polymer Chemistry**

Polymer chemistry focuses on the properties, structure and synthesis of polymers and macromolecules.

**Uses:** Many materials present in the living organisms including proteins, cellulose and nucleic acids are naturally occurring polymers.

**9. Geochemistry**

The study of chemical composition of Earth and its sources and minerals is called geochemistry.

**Uses:** It is used in minerals exploration, geochemistry mapping today has application in environmental monitoring, forestry and medical research.

**10. Medicinal Chemistry**

In this branch of chemistry, the chemist tries to design and synthesize a medicine or drugs which is beneficial for mankind.

**Uses:** It includes the discovery, delivery, absorption and metabolism of drugs in human body.

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**11. Astrochemistry**

It is the study of molecules and ions recurring in space and interstellar space.

**Uses:** In this discipline we study the abundance and reactions of molecules and ions in the universe and interaction of these species with radiation.

**Q.2 Explain differences between Elements, Compounds and Mixtures.** 09201010

**Ans.**

| Elements | Compounds | Mixtures |
|---|---|---|
| An element is the simplest form of matter. It is a pure substance containing the same kind of atoms. | A compound is a pure substance. It is formed by the chemical combination of two or more atoms of different elements. | Mixture is an impure compound. A sample of matter having more than one type of elements or compounds mixed together in any ratio, is called a mixture. |
| It is not possible to break down an element into simpler particles by ordinary chemical reactions. | In a compound, the atoms of elements must combine together by a fixed ratio by weight. For example, in water ($H_2O$) hydrogen and oxygen are present in a fixed ratio of 1:8 by weight. | Each component of a mixture retains its identity and specific properties. |
| When an element exists in the form of aggregate of atoms, it is represented by a symbol. For example, sodium and calcium are represented by their symbols Na and Ca. | It is possible to break a compound into its constituent elements by a chemical reaction. For example, ammonia can be converted back to nitrogen and hydrogen by a suitable chemical reaction. | A mixture may be homogenous or heterogeneous. For example, the solution of common salt in water is a homogeneous mixture while a sample of rock is a heterogeneous mixture. |
| Gaseous elements exist in the form of independent molecules, for example nitrogen ($N_2$), oxygen ($O_2$) and chlorine ($Cl_2$). Noble gases however, exist as monoatomic molecules. | The properties of a compound are always different from the elements from which it is formed. For example, the properties of water are different from those of hydrogen and oxygen. | The components of a mixture are not chemically bound together and they can be separated by physical method. |
| For example, Helium (He) and Argon(Ar) | Compounds exist in the form of molecules, for example hydrogen chloride (HCl), ammonia ($NH_3$) and water ($H_2O$). Compounds may also exist as network arrangement of their atoms. For example ionic compounds like NaCl and covalent compounds like sand ($SiO_2$) | The properties of a mixture are the sum of those of its components. |

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## Exercise Short Question

**Q.1 Why is there a need to divide Chemistry into many branches. Give three reasons.** 09201011

**Ans.** To understand the widely spread complex subject of chemistry and to concentrate on its specific aspects, chemistry is divided into many distinct branches. The purposes of this division is

- It helps in understanding the fundamental principles of chemical reactions and bonding.
- It allows scientists to develop new materials and technologies, improving everything products.
- These branches have distinct areas of study for the scientists to focus on and to achieve breakthroughs and advancements.

**Q.2 Reactions may take place due to electrons present outside the nucleus or they may take place inside the nucleus. Which branches of Chemistry cover these two types of reactions?** 09201012

**Ans.** Reactions that involve electrons outside the nucleus are studied in physical chemistry and reactions that take place inside the nucleus are part of nuclear chemistry.

**Q.3 What types of problems are solved in analytical chemistry?** 09201013

**Ans.** In analytical chemistry, problems related to the identification, composition, and quantification of substances are solved. This branch of chemistry deals with of the analysis of different substances by use of instruments to analyze the matter.

**Q.4 Both graphite and graphene have hexagonal layered structures. What is the difference?** 09201014

**Ans.**

| Graphite | Graphene |
|---|---|
| i. It is a three-dimensional layered structure of hexagonal rings of carbon. | i. It is a two dimensional single layer of carbon atoms arranged in a hexagonal pattern. |
| ii. **Example:** The pencil is made up of a mixture of graphite and clay. | ii. **Example:** It is used in development of flexible, light weight touch screens |

**Q.5 Why are supercritical fluids important?** 09201015

**Ans.** Supercritical fluids are important because they exhibit properties of both liquids and gases when they are at a specific temperature and pressure. These fluids are used in various processes such as extraction, chromatography and chemical reactions due to their unique properties like high diffusion, low viscosity and high solvating power.

**Q.6 In which state does matter exist in the Sun?** 09201016

**Ans.** In the sun, matter primarily exists in the plasma state. Plasma is not so generally seen form of matter. It is composed of particles with very high kinetic energy. It exists in fluorescent tubes, lightning and welding arcs. Plasma can be considered as a partially ionized gas containing electrons, ions, photons, etc.

**Q.7 What is the importance of graphene?** 09201017

**Ans.** Graphene is important because it is a single layer of carbon atoms arranged in a hexagonal pattern. Graphene has many applications in electronics, energy storage devices, and sensors and even in medical devices. Because, graphene has exceptional properties such as tough, flexible and light material with a high resistance.

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**Q.8 Which form of matter do most of the material things in this world belong to?** 09201018

**Ans.** Most of the material things in this world belong to the state of matter known as solids. Solids have a fixed shape and volume and their particles are closely packed together in an ordered form.

## Practice Exercise Questions

**Q.9 . A lunar mission has recently brought samples from the Moon. The following experiments were then carried out on it. Point the branch of chemistry these experiments are related to.** 09201019

**Ans.**

| Experiment | Branch of Chemistry |
|---|---|
| **1. Determing its composition.** | **Ans.** Analytical chemistry |
| **2. Studying the physical properties of materials it contains.** | **Ans.** Physical chemistry |
| **3. Carrying out chemicals reactions with usual inorganic reagents.** | **Ans.** Inorganic chemistry |

**Q.10 Which elements are found in pure state on Earth?** 09201020

**Ans.** Gold (Au), Silver (Ag), Copper (Cu), Platinum (Pt), Sulphur (S) are found in pure state on Earth.

**Q.11 Which elements are present in very small amounts of Earth?** 09201021

**Ans.** Astatine(At),Radium(Ra),Iodine (I),Uranium (U) and Beryllium (Be) are present in very small amounts of Earth.

**Q.12 How variation of solubility at different temperatures can be useful for us?** 09201022

**Ans.** i) The increase in the solubility of solids in liquids with increase in temperature may be used to purify crystal of potassium nitrate. Pure solids commonly appear as beautifully shaped crystals.

ii) Generally the solubility of gases decreases with increase in temperature. Carbon dioxide gas is also more soluble in water at low temperature. Soda water bottles are thus stored in the refrigerator to keep carbon dioxide gas dissolved in water for a longer period of time.

## SLO Based Additional Short Question

### What is Chemistry

**Q.13 Define Chemistry?** 09201023

**Ans.** Chemistry is the science which deals with the properties composition and the structure of matter. It also studies the physical and chemical changes in matter and the laws or principles which govern these changes.

**Q.14 What is physical chemistry?** 09201024

**Ans.** This branch investigates how substances behave at atomic or molecular levels. It provides clear explanation as to how fundamental physical laws governing our world cause atoms and molecules to show specific characteristics and it turn react to give huge structures related to life.

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**Scope:** Physical chemistry is also used to predict and change the rates of reaction and thus optimize the conditions to carry out the reaction on industrial scale.

**Q.15 Difference between organic & inorganic chemistry.** 09201025

**Ans. Organic chemistry:** It is the branch of chemistry that deals with the carbon compounds (hydrocarbons and their derivatives) other than its simple salts like carbonates, oxides and carbides.

**Inorganic chemistry:** It is the study of the synthesis, composition, properties and structure of elements and compounds that contain little or no carbon.

**Q.16 Difference between Environmental & Analytical chemistry.** 09201026

**Ans. Environment chemistry**: It is the scientific study of the chemical and biochemical phenomena that occur in this planet. In this subject, we study the sources, reactions, effects and fates of chemical species in the air, soil and water environments. Without this, it would be impossible to study the effects humans have on the environment through the release of chemicals.

**Analytical chemistry**: This branch of chemistry deals with the analysis of different substances. It involves separation, identification and determination of the concentration of the material things.

**Q.17 Difference between Biochemistry & Nuclear chemistry.** 09201027

**Ans. Biochemistry:** It is the branch of chemistry in which we understand life through chemical processes. It is the study of chemical substances and vital processes occurring in living organisms.

**Nuclear chemistry:** Nuclear chemistry deals with the reactions taking place in the nucleus of an atom. It deals with radioactivity, nuclear processes and transformation in the nuclei of atoms.

**Q.18 Difference b/w polymer & geochemistry.** 09201032

**Ans. Polymer Chemistry:** Polymers are large molecules made by linking together a series of building blocks. (Polymer chemistry focuses on the properties, structure and synthesis of polymers and macromolecules. Many materials present in the living organisms including proteins, cellulose and nucleic acids are naturally occurring polymers.

**Geochemistry:** The study of chemical composition of Earth and its sources and minerals is called geochemistry. Apart from its use in minerals exploration, geochemical mapping today has applications in environmental monitoring, forestry and medical research.

**Q.19 Difference between medicinal & Astrochemistry.** 09201029

**Ans. Medicinal Chemistry:** In this branch of chemistry, the chemist tries to design and synthesize a medicine or a drug which is beneficial for mankind.

**Astrochemistry:** It is the study of molecules and ions recurring in space and interstellar space. In this discipline we study the abundance and reactions of molecules and ions in the universe and interaction of these species with radiation.

**Q.20 What is meant by Nuclear Process?** 09201030

**Ans.** Nuclear process refer to any process that occurs within the nucleus of an atom. Such as Radioactive decay, Nuclear fission, Nuclear fusion.

**Q.21 For what purpose geothermal heat pump used?** 09201031

**Ans.** Geothermal heat pump uses a pump to transfer underground water into the buildings during the winter to heat them and in the summer to cool them.

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## States of Matter

**Q.22 Define matter. Give examples.** 09201033

**Ans.** Anything that has mass and occupies space is called matter. This makes air, water, rocks and even people examples of matter.

**Q.23 Why gases do not have a definite shape and volume?** 09201034

**Ans.** Gases do not have a definite shape & volume because gas molecules are widely apart with no order and have weak intermolecular forces.

**Q.24 Why solid have a definite shape & volume?** 09201035

**Ans.** Solid have definite shape/volume because their molecules are closely attached and have significant intermolecular forces.

**Q.25 Why gases show the property of compressibility?** 09201036

**Ans.** Because molecule widely apart with no order and weak intermolecular forces. This makes gases easily compressibility.

**Q.26 Describe gaseous state of matter.** 09201037

**Ans.** Matter in gaseous state does not have definite shape and volume. Therefore, gases occupy all the available space. Gases have very weak intermolecular forces.

**Q.27 What is meant by solid?** 09201038

**Ans.** Matter that has a definite shape and volume is called solid. **For example,** wood, coal, plastic etc.

**Q.28 What are the physical states of matter?** 09201039

**Ans.** There are four states of matter.

i) Gas ii) Liquid
iii) Solid iv) Plasma

**Q.29 How can matter change its state?** 09201040

**Ans.** Energy can change matter into different states. **For example,** solids become liquids or gases when heated. At very high temperatures or when subjected to a strong electric field, the gas transforms into plasma. Under normal condition, most substances remain in one distinct state: solid, liquid or gas. Temperatures and energy levels on the earth are not sufficient to ionize atoms and create plasma.

**Q.30 What is plasma? Write its uses.** 09201041

**Ans.** Plasma is not so generally seen form of matter. It is composed of particles with very high kinetic energy. It exists in fluorescent tubes, lightning and welding arcs. Plasma can be considered as a partially ionized gas containing electrons, ions, photons, etc.

**Q.31 What is liquid crystal?** 09201042

**Ans.** Liquid crystal is state of matter whose properties are between those of conventional liquids and those of crystalline solids. Liquid crystals are used in display devices including computer monitors, clocks, watches and navigation systems.

**Q.32 What are classification of matter?** 09201043

**Ans.** Matter can be classified as:

i. Substance (Pure matter)
ii. Mixture (Impure matter)

**1. Substance can be classified as:**

a) Element b) Compound

**2. Mixtures can be classified as:**

a) Homogeneous mixture
b) Heterogeneous mixture

## Element, Compound and Mixture

**Q.33 How rocks are formed?** 09201044

**Ans.** Rocks are composed of different types of minerals such as granite, mica and limestone.

**Q.34 Which was the first element created in the laboratory?** 09201045

**Ans.** Technetium was first element created by scientists in the laboratory.

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**Q.35 Write the method the remove the impurities in a mixture?** 09201046

**Ans.** We can removed the impurities in a mixture by Filtration, Evaporation and crystallization.

**Q.36 Why compound show a chemical formula?** 09201047

**Ans.** Compound show chemical formula because they have a fixed ratio by mass and they are formed by chemical combination of elements.

**Q.37 Define element.** 09201048

**Ans.** The simplest form of matter made up the same type of atoms, having same atomic numbers and cannot be broken down into simpler substance by ordinary chemical means.

**Q.38 Define compound.** 09201049

**Ans.** When two or more elements chemically combine, meaning undergo a chemical reaction to form a new substance, this is called a compound.

**Q.39 Define mixture. Give example.** 09201050

**Ans.** Mixtures are the physical combination of substances. A mixture that does not contain the same types of particles. It is a substance formed when two or more substances physically combine without any fixed ratio by mass.

## Allotropic Forms of Substances

**Q.40 Define the term allotropy with examples.** 09201051

Elements may exist in more than one structural forms which can exhibit quite different physical and chemical properties. These forms are called allotropic forms and phenomenon is called allotropy.

**For example:-**

**Allotropic forms of oxygen:**

Oxygen exists in two allotropic forms namely oxygen ($O_2$) and ozone ($O_3$).

**Q.41 What is the difference between diamond and graphite?** 09201052

**Ans.**

| Diamond | Graphite |
|---|---|
| i. Diamond has a giant macromolecular structure. | i. Graphite has a layered structure of hexagonal rings of carbon. |
| ii. Carbon is covalently bonded to four other carbon atoms forming rigid network tetrahedral in shape. | ii. Graphite is composed of flat two dimensional layers of hexagonally arranged carbon atoms. |
| iii. Diamond is non-conductor of electricity. | iii. Graphite is a good conductor of electricity. |

**Q.42 What do you know about Buckminster fullerene ($C_{60}$)? / Why fullerene, are stable at high temperature and pressures?** 09201053

**Ans.** Buckminster fullerene ($C_{60}$) consists of spheres made of atoms arranged in pentagons and hexagons. Fullerenes are stable at high temperatures and high pressures. Being covalent in nature, they are soluble in organic solvents. The fullerene structure is unique in that the molecule is not charged, has no boundaries and has no unpaired electrons. They have a cage like structure. Fullerene $C_{60}$ has a low melting point. It is soft and cannot conduct electricity.

**Q.43 How bucky balls are made?** 09201054

**Ans.** Buckyballs, also known as fullerenes, have a football like fused hollow ring structure made up of twenty hexagons and twelve pentagons. Each of its 60 carbon atoms are bonded to 3 carbon atoms.

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## Solution, colloidal solution and Suspension

**Q.44 Define solution. Give few characteristics of true solution.** 09201055

**Ans.** A solution is such a mixture in which solute particles are completely homogenized in the solvent **e.g.** dissolution of sodium chloride or copper sulphate in water.

**Characteristics:** The solute particles in such a solution cannot be seen by the naked eye. If solution is filtered, these particles pass through the pores of filter paper leaving no precipitate, Such a solution is called a true solution.

**Q.45 Define suspension. Give few characteristics of suspension.** 09201056

**Ans.** A suspension is a mixture in which solute particles do not dissolve in the solvent.

**Characteristics:-**

We can actually see these particles. If a suspension is kept for some time, these particles settle down. Again, if this suspension is filtered, the particles in it cannot pass through the pores of filter paper like the particles of a true solution.

**Q.46 Define colloidal solution. Give few characteristics of colloidal solution.** 09201057

**Ans.** In colloidal solution the solute particles do not homogenize with solvent.

**Characteristics:-**

These particles are a little bit bigger than the solute particles present in the true solution but not big enough to be seen with a naked eye like the particles present in a suspension. If kept for some time, the particles of a colloidal solution do not settle down. On filtration, these particles pass through the filter paper like particles of true solution. Starch solution and white of an egg are the common examples of colloidal solutions.

**Q.47 How formation of Mixtures can be useful in daily life?** 09201058

**Ans.** Mixtures are closely related to our everyday lives. The air we breathe, the foods we consume, the fluids in our body, the solids like steel we use, are all either homogenous or heterogeneous mixture.

## Saturated & Unsaturated Solution

**Q.48 Define a saturated solution and give example.** 09201059

**Ans.** A solution containing maximum amount of solute at a given temperature is called a saturated solution.

**For example:** The saturated solutions of table sugar and sodium chloride are prepared, it is found that the concentration of sodium chloride saturated solution is 5.3 molar at room temperature while that of sugar solution is 3.8 molar at room temperature.

**Q.49 How unsaturated Solution is formed?** 09201060

**Ans.** A solution which can dissolve more amount of a solute at a particular temperature is called an unsaturated solution.

**For example:** Take about 100g of water in a beaker add to it 5g of table sugar and stir it. The sugar will dissolve in water. Then add another 5g of sugar and stir. This will also dissolve it.

## Effect of temperature on the Solubility of Solutes

**Q.50 Justify with example that solubility of a salt increases with increase in temperature.** 09201061

**Ans.** When a salt like $KNO_3$, is dissolved in water, heat is absorbed. It means heat is required to break the attractive forces between ions of solute. Therefore, solubility of such salt increases with increase of temperature.

**Q.51 Define solubility.** 09201062

**Ans.** Solubility is defined as the number of grams of the solute dissolved in 100g of solvent at a particular temperature.

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**Q.52 Why does solubility of $Li_2CO_3$ and $CaCrO_4$ decrease with increase of temperature?** 09201063

**Ans.** $Li_2CO_3$ and $CaCrO_4$ dissolve in water with the evolution of heat, therefore solubility of such salts decrease with the increase of temperature. In such cases attractive forces among the solute particles are weaker and solute-solvent interaction are stronger. As a result, there is release of energy.

## Constructed Response Questions

**Q.1 (Ex. Q.3 (i)) How does a supercritical state look like?** 09201066

**Ans.** In a supercritical state, a substance looks like a dense fluid that show properties of both gases and a liquid. It doesn't have a distinct boundary between liquid and gas. So, it can fill a container like a gas while still being dense like a liquid. Supercritical fluids are often clear and can flow easily.

**Q.2 (Ex. Q.3 (ii)) In what way is plasma created in a fluorescent tube?** 09201067

**Ans.** In a fluorescent tube, plasma is created by applying a high voltage current at low pressure to the tube which ionizes the gas inside. This ionization process causes the gas to convert into a plasma state, emitting light as the excited electrons return to their ground state. This is how the fluorescent tube produces light

**Q.3 (Ex. Q.3 (iii)) Most of the molecules we study in biochemistry are organic in nature. Where does the difference exist in organic and biochemistry branches of Chemistry?** 09201068

**Ans.**

| Biochemistry | Organic Chemistry |
|---|---|
| **i.** In this branch, we specifically study the chemical processes and substances that occur in living organisms. | **i. Organic chemistry:** It is the branch of chemistry that deals with the carbon compounds (hydrocarbons and their derivatives) other than its simple salts like carbonates, oxides and carbides. |
| **ii.** It focus on biological molecules like proteins, nucleic acids, carbohydates, lipids. | **ii.** It deals with the study of substances both in living organisms and non-living matter. |

**Q.4 (Ex. Q.3 (iv)) Give the reason of brilliance shown by diamond. Can you improve it?** 09201069

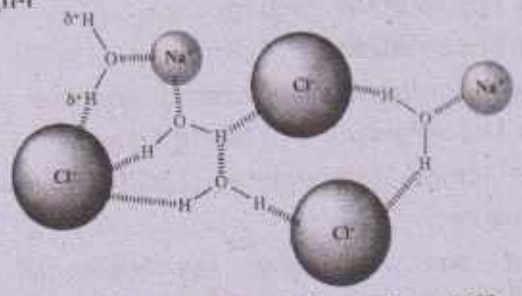
**Ans.** To enhance the brilliance of diamond, they can be cut and polished in specific ways to optimize the reflection and refraction of light within the stone. The cut of a diamond such as the proportions and angles greatly influences how light interacts with the diamond affecting its brilliance and sparkle.

**Q.5 (Ex. Q.3 (v)) Explain the dissolution of NaCl in water.** 09201070

**Ans.** The dissolution of NaCl occurs when the ions of the NaCl separate in water due to

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the polar nature of water molecules. The partially charged ends of water molecules attract and surround the positive and negative ions of NaCl. Due to this, the attraction between sodium ions and chloride ions break apart and thus NaCl dissolve in water




**Q.6 (Ex. Q.3 (vi)) Why do different compounds have different solubilities in water at a particular temperature?** 09201071

**Ans.** Different solutes have different solubilities in a water.

**For example,** If the solutions of table sugar and sodium chloride are prepared, it is found that 36 g of sodium chloride can dissolve in 100 g of water at 20°C to give a saturated solution. Against this 203.9 g of table sugar can dissolve in water at 20°C to give its saturated solution. In other words, the solubility of table sugar in water is far greater than that of sodium chloride at 20°C. This is due to the fact that sugar molecules are larger than salt ions, so more water molecules can surround a single sugar molecule, causing it to dissolve in larger amounts.

**Q.7 (Ex. Q.3 (vii)) Why NaCl cannot be crystallized from water just like $KNO_3$?** 09201072

**Ans.** The solubility of potassium nitrate increase significantly with the increase in temperature and on cooling excess potassium nitrate crystallizes out from water. On the other hand, in case of sodium chloride, the solubility does not increase with increase in temperature so the NaCl does not crystallizes out on cooling. That's why, NaCl cannot by crystallized from water like $KNO_3$.

**Q.8 (Ex. Q.3 (viii)) Why graphite is slippery to touch? Which property of graphite enables it to be used as lubricant?** 09201073

**Ans.** Graphite is slippery to touch because of its layered structure. The layers in graphite are held together by weak forces allowing them to slide over each other easily. This property of graphite enables it to be used as a lubricant.

## Multiple Choice Questions (Exercise)

**Tick (✓) the correct answer.**

**1. Matter is present in neon signs in the state of:** 09201074
(a) supercritical fluid
(b) plasma
(c) Gas
(d) Liquid crystal

**2. Hazardous effects of shopping bags are studied in:** 09201075
(a) Geochemistry
(b) Inorganic chemistry
(c) analytical chemistry
(d) environmental chemistry

**3. The man-made polymer is:** 09201076
(a) starch (b) polystyrene
(c) protein (d) Cellulose

**4. The crystals of which substance has rhombic shape?** 09201077
(a) Brass (b) Sulphur
(c) Graphite (d) Bronze

**5. Which liquid among the following is a colloidal solution?** 09201078
(a) Milk
(b) Slaked lime used for white wash
(c) Vinegar solution
(d) Mixture of AgCl in water

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6. **Which of the following is a heterogeneous mixture?** 09201079
   (a) A solution of calcium hydroxide in water
   (b) A solution of potassium nitrate in water
   (c) Hot chocolate
   (d) Concrete mixture
7. **A state of matter whose properties are between those of liquids and crystalline solids.** 09201080
   (a) Liquid crystal
   (b) Supercritical fluid
   (c) Plasma
   (d) Dark matter
8. **When the tiny particles of a substance are dispersed through a medium, the mixture is named as:** 09201081
   (a) True solution
   (b) Colloid
   (c) Suspension
   (d) Heterogeneous mixture
9. **A solution of $KClO_3$ has a solubility of about 13.2g per 100 $cm^3$ at 40°C. How its solubility will be affected, if you decrease the temperature?** 09201082
   (a) The solubility will increase
   (b) The solubility will decrease
   (c) The solubility will remain the same
   (d) The solubility will first increase with temperature and then it will decrease
10. **You are studying the rate of hydrolysis of organic compound starch under different conditions of temperature. In which branch of chemistry this topic will fall?** 09201083
    (a) Organic Chemistry
    (b) Analytical Chemistry
    (c) Biochemistry
    (d) Physical Chemistry

## SLO Based Additional MCQ's

### What is Chemistry

11. **Which branch of chemistry is the study elements and their compounds except for organic compounds?** 09201084
    a) physical chemistry
    b) organic chemistry
    c) inorganic chemistry
    d) geochemistry chemistry
12. **Which branch of chemistry helps to protect water that has been poisoned by soil?** 09201085
    a) environmental chemistry
    b) organic chemistry
    c) inorganic chemistry
    d) geochemistry chemistry
13. **Which area of chemistry improves to gauge the behavior of pollutants and develop techniques for pollution control?** 09201086
    a) analytical chemistry
    b) organic chemistry
    c) environmental
    d) geochemistry chemistry
14. **The branch of chemistry that helps to treat diseases and synthesize new medicines:** 09201087
    a) physical chemistry b) organic chemistry
    c) inorganic chemistry d) environmental chemistry
15. **The branch of science helps to understand chemical products and processes that reduce the use of hazardous substances:** 09201088
    a) analytical chemistry
    b) physical chemistry
    c) green chemistry
    d) astrochemistry

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16. **To identify the concentration of a particular solution through titration is and application of:** 09201089
a) astrochemistry
b) analytical chemistry
c) geochemistry
d) organic chemistry

17. **The batteries in our vehicles are built on the principle of electrochemistry. It is the application of:** 09201090
a) astrochemistry
b) analytical chemistry
c) organic chemistry
d) physical chemistry

18. **The branch of chemistry that is concerned with the large-scale production of chemical substances is:** 09201091
a) industrial chemistry
b) physical chemistry
c) inorganic chemistry
d) environmental chemistry

19. **The branch of chemistry that focuses on the study of polymers, their types, properties, uses is called:** 09201092
a) industrial chemistry
b) polymer chemistry
c)organic chemistry
d) astrochemistry

20. **The study of the interaction between drugs and biological targets, as well as the development of new medicinal agents.** 09201093
a) organic chemistry
b) medicinal chemistry
c)inorganic chemistry
d) environmental chemistry

21. **Which is deal with composition, structure, properties, behavior and changes of matter & energy?** 09201094
a) technology
b) engineering
c) chemistry
d) sciencee

22. **Which branch of chemistry deals with the changes that occur in atomic nuclei?** 09201095
a) environmental chemistry
b) astrochemistry
c) biochemistry
d) nuclear chemistry

23. **Which branch of chemistry deals with elements and compounds in earth's crust?** 09201096
a) polymer chemistry
b) geochemistry
c) organic chemistry
d) physical chemistry

24. **Which branch of chemistry deals with the study of stars, planets, comets and interstellar space?** 09201097
a) medicinal chemistry
b) geochemistry
c) astrochemistry
d) physical chemistry

25. **Which branch of chemistry tells us sulphuric acid is extremely corrosive to skin?** 09201098
a) organic chemistry
b) physical chemistry
c)biochemistry
d) inorganic chemistry

26. **Which branch of chemistry give information about starch synthesis in plants?** 09201099
a) organic chemistry
b) biochemistry
c) environmental chemistry
d) inorganic chemistry

27. **Polymers are sometimes called:** 09201100
a) monomers
b) micromolecules
c) macromolecules
d) none of these

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## States of Matter

**28. Anything that has mass and occupies space is called:** 09201101
(a) liquid (b) gas
(c) solid (d) matter

**29. Following are states of matter** 09201102
(a) gas (b) liquid
(c) solid (d) All of these

**30. Macroscopic properties are properties that can be visualized by:** 09201103
(a) the naked eye
(b) microscope
(c) electron microscope (d) telescope

**31. Matter can be described by both its:** 09201104
(a) physical properties and chemical properties
(b) physical properties
(c) chemical properties
(d) none of these

**32. A substance formed when two or more different elements combine chemically.** 09201105
(a) atom (b) compound
(c) element (d) solution

**33. How many states of matter exist?** 09201106
(a) One (b) Two
(c) Three (d) Four

**34. In which state matter does not have definite shape and volume?** 09201107
(a) Solid (b) Liquid
(c) Gas (d)All of these

**35. Pressure is a significant property of:** 09201108
(a) Solid
(b) Liquid
(c) Gas
(d) None of these

**36. Which state of matter has fixed shape and volume?** 09201109
(a) Solid (b) Liquid
(c) Gas (d) All of these

**37. The simplest form of matter is:** 09201110
(a) Gas
(b) Liquid
(c) Solid
(d) Both 'b'and 'c'

**38. Building block of all matter is:** 09201111
(a) element (b) compound
(c) atom (d) mixture

**39. Fourth state of matter is:** 09201112
(a) Solid (b) Liquid
(c) Gas (d) Plasma

## Element, Compound and Mixture

**40. Mixture can be separated by means of:** 09201113
(a) Nuclear method
(b) Chemical method
(c) Physical method
(d) All of these

**41. Example of heterogeneous mixture is:** 09201114
(a) Air (b) Gasoline
(c) Ice cream (d) Soil

**42. A good example of homogeneous mixture is:** 09201115
(a) Soil (b) Rock
(c) Wood (d) Ice-cream

## Allotropic Forms of Substances

**43. Allotropes of oxygen are:** 09201116
(a) 2 (b) 4
(c) 3 (d) 5

**44. Graphite is _____ conductor of electricity.** 09201117
(a) good
(b) bad
(c) moderate
(d) None of these

**45. In diamond, each C-atom is covalently bonded with _____ C-atoms.** 09201118
(a) two (b) three
(c) four (d) five

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46. **Diamond is _____.** 09201119
(a) conductor
(b) non-conductor
(c) both a and b
(d) none of these

47. **The structure of C-atom in diamond is _____.** 09201120
(a) pentagonal
(b)tetrahedral
(c) triangle
(d)hexahedral

48. **Buckyballs also known as _____.** 09201121
(a) graphite
(b) fullerenes
(c) both a and b
(d) none of these

## Solution, Colloidal Solution and Suspension

49. **Which one of the following will show negligible effect of temperature on its solubility?** 09201122
(a) KCl (b) $KNO_3$
(c) $NaNO_3$ (d) NaCl

50. **Which one of the following is heterogeneous mixture?** 09201123
(a) Milk
(b) Ink
(c) Milk of magnesia
(d) Sugar solution

51. **Solubility of which salt increases with the increase of temperature:** 09201124
(a) $KNO_3$
(b) $NaNO_3$
(c) KCl
(d) All of these

52. **The solubility of which salt decreases with the increase of temperature?** 09201125
(a) $KNO_3$ (b) $NaNO_3$
(c) $Li_2SO_4$ (d) KCl

53. **Which one is example of colloid?** 09201126
(a) Jelly (b) Paints
(c) Milk of magnesia (d) None of these

54. **Which one is a suspension?** 09201127
(a) Blood
(b) Toothpaste
(c) Ink
(d) Chalk in water

## Answer Key

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1 | b | 2 | d | 3 | b | 4 | b | 5 | a |
| 6 | d | 7 | a | 8 | b | 9 | b | 10 | d |
| 11 | c | 12 | a | 13 | c | 14 | b | 15 | c |
| 16 | b | 17 | d | 18 | a | 19 | b | 20 | b |
| 21 | c | 22 | d | 23 | b | 24 | c | 25 | d |
| 26 | b | 27 | c | 28 | d | 29 | d | 30 | a |
| 31 | a | 32 | b | 33 | d | 34 | c | 35 | c |
| 36 | a | 37 | a | 38 | c | 39 | d | 40 | c |
| 41 | d | 42 | d | 43 | a | 44 | a | 45 | c |
| 46 | b | 47 | b | 48 | b | 49 | d | 50 | c |
| 51 | d | 52 | c | 53 | a | 54 | d | | |

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