

STATES OF MATTER & PHASE CHANGES

Complete Exercise & Answer Key

CHAPTER 1 | CLASS 9 | CHEMISTRY



1 Tick (✓) the Correct Answer

(i). Matter is present in neon signs in the state of:

• (a) Solid

✓ (b) Plasma

• (c) Liquid

• (d) Gas

Explanation

Neon signs work by passing high voltage electricity through neon gas. This electrical energy ionizes the gas, stripping electrons from atoms and creating a glowing state of matter called plasma.

(ii). Hazardous effects of shopping bags are studied in:

• (a) Organic Chemistry

• (b) Physical Chemistry

• (c) Analytical Chemistry

✓ (d) Environmental Chemistry

Explanation

Environmental chemistry deals with the study of chemical processes occurring in the environment, including the impact of human-made substances like non-biodegradable plastic shopping bags on ecosystems.

(iii). The man-made polymer is:

- (a) Starch

✓ (b) Polystyrene

- (c) Protein
- (d) Cellulose

Explanation

Starch, protein, and cellulose are natural biopolymers. Polystyrene is a synthetic (man-made) polymer produced from styrene monomers.

(iv). The crystals of which substance has rhombic shape?

- (a) Brass

✓ (b) Sulphur

- (c) Bronze
- (d) Graphite

Explanation

Sulphur crystallizes in an orthorhombic (rhombic) structure at room temperature. Brass and bronze are alloys (mixtures), and graphite has a hexagonal crystal structure.

(v). Which liquid among the following is a colloidal solution?

✓ (a) Milk

- (b) Slaked lime

- (c) Vinegar
- (d) AgCl in water

Explanation

Milk is an emulsion (a type of colloid) where liquid fat globules are dispersed in a liquid water medium. Slaked lime is a suspension, vinegar is a true solution, and AgCl in water forms a precipitate.

(vi). Which of the following is a heterogeneous mixture?

- (a) Sugar solution
- (b) Salt solution
- (c) Vinegar

✓ **(d) Concrete mixture**

Explanation

Concrete is a heterogeneous mixture because it consists of visibly different substances (cement, sand, gravel, and water) that do not blend into a single uniform phase. The other options form homogeneous true solutions.

(vii). A state of matter whose properties are between those of liquids and crystalline solids:

✓ **(a) Liquid crystal**

- (b) Plasma
- (c) Supercritical fluid

- (d) Amorphous solid

Explanation

Liquid crystals flow like liquids but retain some of the ordered molecular arrangement of crystalline solids, giving them unique optical properties.

(viii). When the tiny visible particles of a substance are dispersed through a medium, the mixture is named as:

- (a) True solution
- (b) Colloid

✓ **(c) Suspension**

- (d) Emulsion

Explanation

Suspensions contain particles large enough to be visible to the naked eye (or under a microscope) and will eventually settle out over time. Colloids have smaller particles that are not visible to the naked eye. True solutions have dissolved particles (atoms/molecules) that are invisible.

(ix). 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?

- (a) The solubility will increase

✓ **(b) The solubility will decrease**

- (c) The solubility will remain the same

- (d) Cannot be determined

Explanation

According to general solubility rules, the solubility of most solid solutes in liquid solvents increases as temperature rises and decreases as temperature drops.

(x). You are studying the rate of hydrolysis of starch under different conditions of temperature. In which branch of chemistry this topic will fall?

- (a) Organic Chemistry
- (b) Analytical Chemistry
- (c) Environmental Chemistry

✓ **(d) Physical Chemistry**

Explanation

Physical chemistry deals with the rates and mechanisms of chemical reactions (chemical kinetics), which includes studying how temperature affects reaction rates.

2 Questions for Short Answers

i. Why is there a need to divide Chemistry into many branches? Give three reasons.

Answer

Chemistry is divided into branches for the following reasons: **1. Vast Scope** — the subject is incredibly vast, covering millions of known substances and their interactions, making it impossible to study under one umbrella. **2. Diversity of Substances** — different types of matter require different specialized approaches (e.g., carbon-based compounds vs. minerals). **3. Focused Research** — dividing it allows scientists to specialize in specific fields (like environmental, analytical, or nuclear chemistry) to solve specific real-world problems efficiently.

ii. 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?

Answer

Reactions involving electrons outside the nucleus (chemical reactions) are covered by General, Physical, Organic, and Inorganic Chemistry. Reactions taking place inside the nucleus (nuclear reactions) are covered by Nuclear Chemistry.

iii. What types of problems are solved in analytical chemistry?

Answer

Analytical chemistry solves problems related to the qualitative analysis (identifying the presence of specific elements or compounds in a sample) and quantitative analysis (determining the exact amount or concentration of a substance in a sample).

iv. Both graphite and graphene have hexagonal layered structures. What is the difference?

Answer

The difference lies in their thickness. Graphite is made up of millions of stacked layers of hexagonal carbon rings. Graphene is a single, one-atom-thick layer of graphite.

v. Why are supercritical fluids important?

Answer

Supercritical fluids are important because they possess unique properties intermediate between gases and liquids. They have liquid-like density (great for dissolving substances) and gas-like diffusivity and low viscosity (great for penetrating materials). They are widely used as eco-friendly solvents in extraction processes (e.g., decaffeinating coffee).

vi. In which state does matter exist in the Sun?

Answer

Matter exists in the Plasma state in the Sun, where extreme temperatures and pressures strip electrons from atoms.

vii. What is the importance of graphene?

Answer

Graphene is incredibly strong, highly conductive (both electrically and thermally), transparent, and flexible. It is important for advancing electronics, creating faster computer chips, developing flexible touchscreens, and improving battery technology.

viii. Which form of matter do most of the material things in this world belong to?

Answer

Most materials in the world belong to the Solid state of matter.

3 Constructed Response Questions

i. How does a supercritical state look like?

Answer

A supercritical fluid looks like a dense, foggy gas or a very light, compressible liquid. It fills its container completely like a gas, but has the density of a liquid, making it look like a dense, swirling vapor. There is no distinct boundary between liquid and gas phases.

ii. In what way is plasma created in a fluorescent tube?

Answer

In a fluorescent tube, plasma is created by applying a high voltage across electrodes at either end of a sealed glass tube containing a low-pressure gas (like argon) and a small amount of mercury. The high voltage accelerates free electrons, which collide with the gas atoms, knocking off more electrons and ionizing the gas, creating a glowing plasma that emits ultraviolet light.

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?

Answer

Organic chemistry focuses on the study of the structure, properties, and reactions of all carbon-containing compounds, including synthetic ones (like plastics). Biochemistry is a sub-branch of both chemistry and biology that focuses specifically on the chemical processes and substances occurring within living organisms (like proteins, nucleic acids, and metabolism).

iv. Give the reason of brilliance shown by diamond. Can you improve it?

Answer

The brilliance of a diamond is due to its extremely high refractive index (2.42) and its ability to reflect light internally. Light entering the diamond undergoes total internal reflection off its many facets before exiting. Yes, this brilliance can be improved by cutting the diamond into specific shapes, such as the “brilliant cut,” which maximizes the reflection of light back through the top of the stone.

v. Explain the dissolution of sodium chloride in water.

Answer

When sodium chloride (NaCl) is added to water, the polar water molecules attract the Na^+ and Cl^- ions on the surface of the crystal. The negative oxygen end of water molecules surrounds the Na^+ ions, and the positive hydrogen ends surround the Cl^- ions. This ion-dipole interaction releases energy that overcomes the electrostatic forces holding the NaCl crystal lattice together, causing the ions to separate and become surrounded (hydrated) by water molecules, forming a solution.

vi. Why do different compounds have different solubilities in water at a particular temperature?

Answer

Solubility depends on the principle “like dissolves like.” Different compounds have different molecular structures, polarities, and intermolecular forces. Polar compounds (like salt or sugar) dissolve well in polar water because their attractive forces with water molecules are strong enough to overcome their own lattice energy. Non-polar compounds (like oil) do not dissolve in water because their intermolecular forces are not compatible with water's hydrogen bonding network.

vii. Why NaCl cannot be crystallized from water just like KNO_3 ?

Answer

The solubility of NaCl in water remains almost constant regardless of temperature changes. In contrast, the solubility of KNO_3 increases significantly as temperature increases. Therefore, cooling a saturated solution of KNO_3 causes it to crystallize out easily. Cooling a saturated NaCl solution does not cause crystallization because the solubility remains nearly the same.

viii. Why graphite is slippery to touch? Which property of graphite enables it to be used as lubricant?

Answer

Graphite is slippery to touch because it has a layered hexagonal structure. The covalent bonds between carbon atoms within a single layer are very strong, but the forces between the layers are very weak (van der Waals forces). These layers can easily slide over one another. This property of easy sliding between layers enables graphite to be used as a dry lubricant.

4 Descriptive Questions

i. Branch of Chemistry for Each Topic

(a) Rate of a reaction	Physical Chemistry
(b) Digestion of food in human body	Biochemistry
(c) Properties of plasma	Physical Chemistry
(d) Ecosystem	Environmental Chemistry
(e) Reactions taking place during fireworks	Inorganic Chemistry
(f) Measurement of absorption of wavelength with UV spectrometer	Analytical Chemistry

ii. Allotropic Forms

Allotropic forms (allotropes) are different physical forms of the same element in the same physical state, arising from different arrangements of atoms.

Carbon allotropes: Diamond (3D tetrahedral network, hardest natural substance), Graphite (layered hexagonal sheets, soft, conductive), and Fullerenes (spherical cage-like molecules).

Sulphur allotropes: Rhombic sulphur (stable below 95.6°C, yellow crystals) and Monoclinic sulphur (stable

above 95.6°C, needle-like crystals).

Coal vs. Diamond: Diamond is a pure, crystalline allotrope of carbon with a highly ordered 3D structure, making it transparent and the hardest known material. Coal is an impure, amorphous form of carbon containing hydrocarbons and other elements, making it opaque, relatively soft, and combustible.

iii.. What are supercritical fluids? How are they different from ordinary liquids?

Answer

Supercritical fluids are substances at temperatures and pressures above their critical point, where distinct liquid and gas phases do not exist. Supercritical fluids have much lower viscosity, much higher diffusivity (they spread out like a gas), and near-zero surface tension. Ordinary liquids have higher viscosity, lower diffusivity, and cannot be compressed easily, whereas supercritical fluids are highly compressible.

iv.. Define solubility of a solute. How does the solubility of solutes change with the increase in temperature?

Answer

Solubility is defined as the maximum amount of a solute that can be dissolved in a specific amount of solvent (usually 100g) at a given temperature to form a saturated solution. For most solid solutes (like KNO_3), solubility increases as temperature increases. However, for gases dissolved in liquids, solubility decreases as temperature increases.

v.. What types of movements are present in gaseous and liquid molecules?

Answer

Gaseous molecules: They possess rapid, random, straight-line translational motion, as well as rotational and vibrational motion. They move freely and collide frequently with each other and the container walls.

Liquid molecules: They possess translational motion (but much more restricted than gases), rotational motion, and vibrational motion. They are closely packed and slide past one another, allowing liquids to flow but maintaining a fixed volume.

vi.. Differentiate between the areas which are studied under inorganic and organic chemistry.

Answer

Inorganic Chemistry: Focuses on the study of all elements and their compounds except those containing carbon-hydrogen (C-H) bonds. This includes metals, minerals, salts, and coordination compounds. **Organic Chemistry:** Focuses specifically on the study of carbon-containing compounds, including their structure, properties, composition, reactions, and preparation. This includes hydrocarbons, polymers, and biomolecules.

5 Investigative Questions

i. Purification of Potassium Nitrate by Crystallization

Potassium nitrate (KNO_3) can be purified via crystallization because its solubility increases significantly with temperature. The process is carried out in the following steps:

1. Dissolving	A measured amount of impure KNO_3 is dissolved in a minimum volume of boiling distilled water to create a saturated solution.
2. Hot Filtration	The hot solution is filtered immediately to remove any insoluble impurities (like sand or dust).
3. Cooling	The clear filtrate is allowed to cool slowly. As the temperature drops, the solubility of KNO_3 decreases drastically, forcing it to crystallize out of the solution.
4. Separation	The pure KNO_3 crystals are separated from the remaining liquid (mother liquor, which contains soluble impurities) by filtration.
5. Drying	The purified crystals are washed with cold distilled water and dried.

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?

Answer

Graphene's usefulness in electronics is primarily due to its extraordinary electrical conductivity. It has zero bandgap and electrons can move through it at incredibly high speeds (near the speed of light) with very little resistance. Additionally, its exceptional mechanical strength, transparency, and flexibility make it ideal for creating faster transistors, flexible touchscreens, ultra-thin sensors, and advanced energy storage devices.

Well Done!

You have completed all exercise questions of
Chapter 1 — States of Matter and Phase Changes.

Keep practicing and keep exploring the world of Chemistry!

