According to Single National Curriculum

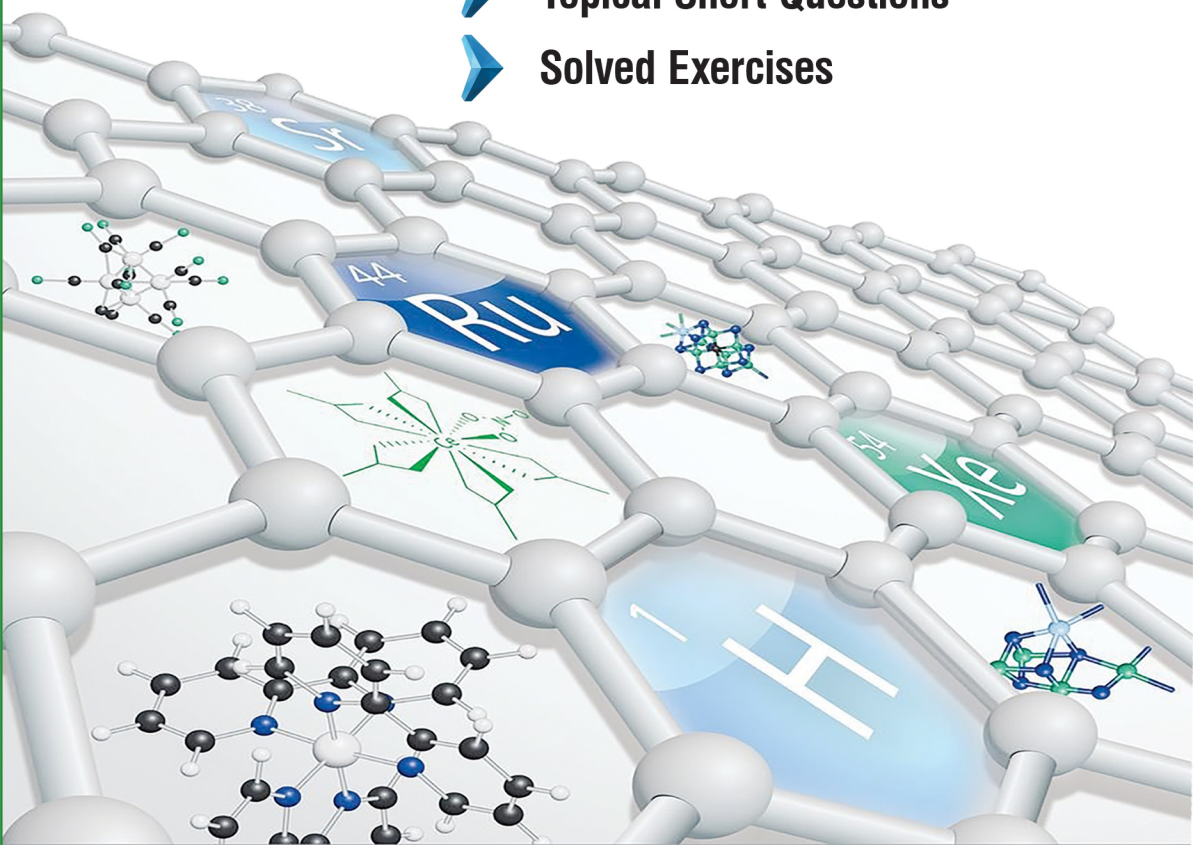
AL-RAZI ACADEMIC Notes

Chemistry

Grade 9

Promising

- Topical MCQs
- Topical Short Questions
- Solved Exercises



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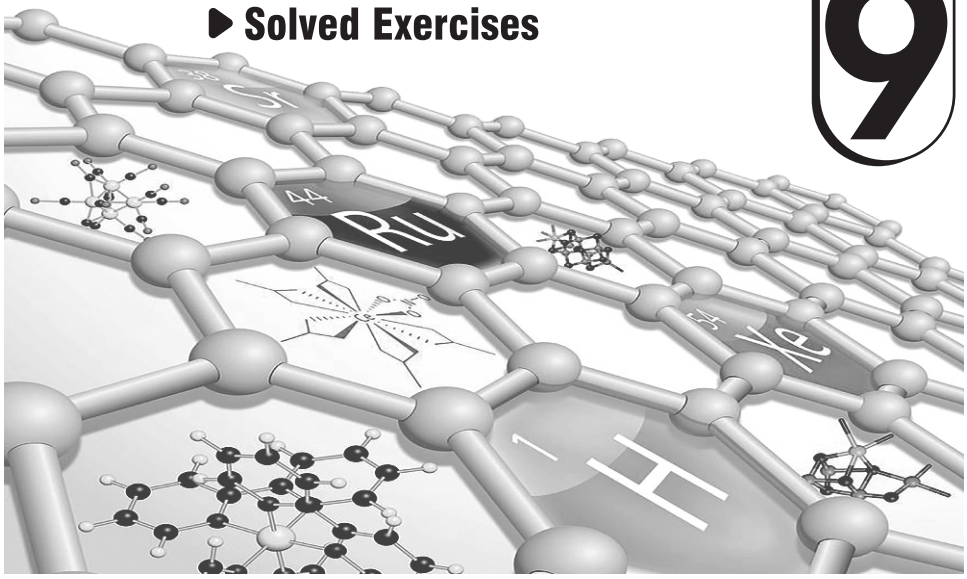

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Preface

Welcome to the "**Al-Razi Academic Notes** on **Chemistry**" *Grade* 9. This comprehensive solution book is designed to support students, teachers and parents in navigating the exciting world of Chemistry.

Crafted with clarity and precision, this book provides detailed solutions to the exercises along with Topical MCQ's, Topical Short Answer Questions and Topically solved exercises in the Grade 9 syllabus, accompanied by conceptual insights and visual aids. More than just a compilation of answers, it aims to foster curiosity, deepen understanding, and build confidence in young learners. By bridging the gap between theoretical knowledge and practical application, this book aspires to inspire students to appreciate the profound role Chemistry plays in shaping the world around us. My heartfelt gratitude goes to the educators and students whose valuable feedback has guided this endeavor, and I welcome suggestions for continual improvement. May this book serve as a trusted companion on your academic journey and spark a lifelong interest in the wonders of Chemistry!

Contents

Chapter 1 States of Matter and Phase Changes

1.1 What is Chemistry?

Multiple Choice Questions (MCQs)

1. Which branch of chemistry deals with the structure, composition, and properties of substances without carbon?

Ⓐ Organic Chemistry Ⓑ Inorganic Chemistry
Ⓒ Environmental Chemistry Ⓓ Physical Chemistry

2. The branch of chemistry that studies carbon compounds excluding carbonates, oxides, and carbides is called:

Ⓐ Nuclear Chemistry Ⓑ Physical Chemistry
Ⓒ Organic Chemistry Ⓓ Geochemistry

3. Which branch of chemistry helps in understanding life through chemical processes?

Ⓐ Biochemistry Ⓑ Medicinal Chemistry
Ⓒ Polymer Chemistry Ⓓ Analytical Chemistry

4. Radioactivity and reactions occurring in the nuclei of atoms are studied in:

Ⓐ Polymer Chemistry Ⓑ Medicinal Chemistry
Ⓒ Environmental Chemistry Ⓓ Nuclear Chemistry

5. Which branch of chemistry is primarily concerned with the analysis of substances?

Ⓐ Medicinal Chemistry Ⓑ Environmental Chemistry
Ⓒ Analytical Chemistry Ⓓ Astrochemistry

6. The study of chemical composition and processes occurring on Earth and its minerals is called:

Ⓐ Geochemistry Ⓑ Astrochemistry
Ⓒ Physical Chemistry Ⓓ Environmental Chemistry

7. What does physical chemistry primarily investigate?

Ⓐ Carbon compounds Ⓑ Chemical composition of Earth
Ⓒ Interaction of molecules in space
Ⓓ Behavior of substances at atomic and molecular levels

8. Medicinal Chemistry focuses on:

Ⓐ Studying nuclear processes Ⓑ Analyzing chemical substances
Ⓒ Designing and synthesizing drugs
Ⓓ Investigating environmental pollution

9. Which branch of chemistry studies the interaction of molecules in space?

Ⓐ Geochemistry Ⓑ Astrochemistry
Ⓒ Environmental Chemistry Ⓓ Nuclear Chemistry

10. Polymer Chemistry studies:

Ⓐ Properties and synthesis of large molecules
Ⓑ Properties of metals and nonmetals
Ⓒ Radioactive transformations
Ⓓ Chemical reactions in living organisms

11. The branch of chemistry that deals with environmental pollution and its solutions is:

Ⓐ Medicinal Chemistry Ⓑ Analytical Chemistry
Ⓒ Environmental Chemistry Ⓓ Nuclear Chemistry

12. In biochemistry, which molecules are studied?

Ⓐ Metals and nonmetals Ⓑ Hydrocarbons and salts
Ⓒ Radioactive elements
Ⓓ Proteins, carbohydrates, lipids, and nucleic acids

13. What is the focus of astrochemistry?

Ⓐ Study of Earth's minerals Ⓑ Molecules and ions in space
Ⓒ Polymer synthesis Ⓓ Environmental reactions

14. Which of the following does not fall under inorganic chemistry?

Ⓐ Salts Ⓑ Acids Ⓒ Bases Ⓓ Hydrocarbons

15. The branch of chemistry that uses sophisticated instruments to identify substances is:

Ⓐ Analytical Chemistry Ⓑ Biochemistry
Ⓒ Medicinal Chemistry Ⓓ Organic Chemistry

16. Which branch of chemistry is essential for studying fertilizers and pigments?

Ⓐ Physical Chemistry Ⓑ Polymer Chemistry
Ⓒ Inorganic Chemistry Ⓓ Geochemistry

Short Answered Questions

1. What is chemistry and what does it study?

Ans. Chemistry is the branch of science focused on the properties, composition, and structure of substances. It explores physical and chemical changes in matter and the principles that govern these changes.

2. Why are the branches of chemistry important?

Ans. The branches of chemistry allow scientists to specialize in distinct areas of study, making it easier to explore complex topics.

3. What is physical chemistry and its role?

Ans. Physical chemistry investigates the behavior of substances at atomic and molecular levels. It explains how physical laws affect atoms and molecules, enabling scientists to predict reaction rates and optimize industrial processes.

4. What is inorganic chemistry about?

Ans. Inorganic chemistry studies elements and compounds with little or no carbon, including metals, salts, acids, and bases. Its applications range from fertilizers to catalysts, making it vital in multiple industries.

5. What does organic chemistry study?

Ans. Organic chemistry focuses on carbon-containing compounds, including hydrocarbons and their derivatives. It examines their structure, properties, and reactions, which are essential for understanding life and creating various products.

6. How does environmental chemistry help?

Ans. Environmental chemistry studies chemical phenomena in air, water, and soil, analyzing human impacts on the environment. It helps identify pollution causes, effects, and solutions.

7. What is analytical chemistry used for?

Ans. Analytical chemistry involves identifying and quantifying substances in materials. Modern instruments are often used for precision, making it essential in quality control, research, and diagnostics.

8. What is biochemistry?

Ans. Biochemistry explores life at the molecular level by studying proteins, carbohydrates, lipids, and nucleic acids. It reveals vital processes in

organisms, bridging biology and chemistry for medical and scientific advancements.

9. What is nuclear chemistry?

Ans. Nuclear chemistry studies reactions in atomic nuclei, including radioactivity and nuclear processes. It has applications in energy production, medicine, agriculture, and research.

10. What is the significance of medicinal chemistry?

Ans. Medicinal chemistry focuses on designing and synthesizing drugs to improve health. It includes studying drug absorption, metabolism, and delivery to treat diseases effectively.

Interesting information!

☆ **How does a geothermal heat pump heat and cool buildings?**

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.

Exercise

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

Experiment	Branch of Chemistry
1. Determining its composition	This experiment falls under Analytical Chemistry, which involves identifying and quantifying the components in a sample, such as determining the elements and compounds in the lunar samples.
2. Studying the physical properties of materials, it contains	This relates to Physical Chemistry, which examines the physical properties and behavior of substances at atomic and molecular levels, such as studying the lunar materials' density, melting points, and conductivity.
3. Carrying out chemical reactions with usual inorganic reagents	This is related to Inorganic Chemistry, as it involves the study of the reactions, properties, and structures of inorganic compounds found in the lunar samples.

1.2 States of Matter

Multiple Choice Questions (MCQs)

17. Matter is:

Ⓐ Anything that has mass and occupies volume
Ⓑ Non-material entities Ⓒ Only gases and liquids
Ⓓ Anything that produces energy

18. The following is NOT a primary state of matter:

Ⓐ Solid Ⓑ Liquid Ⓒ Plasma Ⓓ Graphene

19. The state of matter has particles that are very widely apart:

Ⓐ Solid Ⓑ Liquid Ⓒ Gas Ⓓ Plasma

20. Gases easily compressible due to:

Ⓐ Strong intermolecular forces
Ⓑ High density Ⓒ Fixed shape and volume
Ⓓ Weak intermolecular forces and widely spaced particles

21. What distinguishes liquids from gases?

Ⓐ Significant intermolecular forces and higher density
Ⓑ Definite shape Ⓒ Weak intermolecular forces
Ⓓ Random arrangement of particles

22. The state of matter has particles fixed in position but able to oscillate is:

Ⓐ Gas Ⓑ Solid Ⓒ Plasma Ⓓ Liquid

23. The state of matter is most dense and incompressible is:

Ⓐ Liquid Ⓑ Gas Ⓒ Solid Ⓓ Plasma

24. A type of solid has particles perfectly arranged and strongly bonded is:

Ⓐ Crystalline solids Ⓑ Amorphous solids
Ⓒ Liquid crystals Ⓓ Supercritical fluids

25. Plasma is considered a partially ionized gas because it contains:

Ⓐ Only neutral atoms Ⓑ Fixed particles
Ⓒ Molecules with weak bonds Ⓓ Electrons, ions, and photons

26. Where can plasma be commonly observed?

Ⓐ Water bodies and oceans Ⓑ Solid surfaces
Ⓒ Lightning and fluorescent tubes Ⓓ Rocks and minerals

27. The state of matter does NOT require a container to hold its shape is:?
Ⓐ Liquid Ⓑ Solid Ⓒ Gas Ⓓ Plasma

28. The supercritical fluids are:
Ⓐ States with both solid and liquid properties
Ⓑ Partially ionized gases Ⓒ Crystalline solids
Ⓓ Highly compressed states with properties of gases and liquids

29. The state of matter composed of particles with very high kinetic energy is:
Ⓐ Plasma Ⓑ Gas Ⓒ Liquid Ⓓ Solid

30. The property common between gases and supercritical fluids is:
Ⓐ High density Ⓑ Fixed shape
Ⓒ Weak intermolecular forces Ⓓ Strong intermolecular forces

31. In which state of matter do particles move randomly but are closely attached?
Ⓐ Solid Ⓑ Liquid Ⓒ Gas Ⓓ Plasma

32. Why are solids incompressible?
Ⓐ Weak intermolecular forces
Ⓑ High kinetic energy Ⓒ Random movement of particles
Ⓓ Strong interatomic attractions and closely packed particles

33. The state of matter exists in fluorescent tubes is:
Ⓐ Gas Ⓑ Liquid Ⓒ Plasma Ⓓ Solid

Short Answered Questions

1. What is matter?

Ans. Matter is anything that carries weight and occupies space. Unlike energy, which is non-material, matter exists in various forms and surrounds us in everyday life.

2. What is a state of matter?

Ans. A state of matter refers to the distinct forms in which matter exists, such as solid, liquid, gas, and plasma. Beyond these, there are other states not commonly encountered in daily life.

3. How do solids differ from liquids and gases?

Ans. Solids have a fixed shape and volume, with particles closely packed and strongly bonded. Unlike gases and liquids, solids are incompressible and rigid due to their high density and strong intermolecular forces.

4. What are the characteristics of gases?

Ans. Gases have particles widely spaced apart with weak intermolecular forces, making them easily compressible. Their low density and random particle movement distinguish them from solids and liquids.

5. How are liquids unique among the states of matter?

Ans. Liquids have closely attached particles with significant intermolecular forces, allowing random movement. They are not easily compressible, have higher densities than gases, and take the shape of their container.

6. What are crystalline solids?

Ans. Crystalline solids have a perfectly arranged particle structure and strong bonding, making them incompressible. Their high density and rigid structure are characteristic of this form of solid.

7. What is plasma, and where is it found?

Ans. Plasma is a high-energy state of matter composed of electrons, ions, and photons. It exists in phenomena like fluorescent tubes, lightning, and welding arcs, representing a partially ionized gas.

8. What are supercritical fluids?

Ans. Supercritical fluids are intermediate states of matter that exhibit properties of both gases and liquids. They are highly compressed and used in chemical reactions where conventional solvents fail.

9. What are liquid crystals?

Ans. Liquid crystals represent an intermediate state where liquid meets solid. They have unique properties, such as molecular alignment, making them useful in display technologies like LCDs.

10. How does matter exist beyond the primary states?

Ans. Beyond solids, liquids, gases, and plasma, matter can exist in exotic forms like supercritical fluids, liquid crystals, and graphene. These states showcase unique properties valuable in scientific and industrial applications.

1.3 *Element, Compound and Mixture*

Multiple Choice Questions (MCQs)

34. What is the simplest form of matter?

Ⓐ Compound Ⓑ Element

Ⓒ Mixture Ⓓ Molecule

35. Is NOT a characteristic of an element:

Ⓐ Pure substance containing the same kind of atoms
Ⓑ Cannot be broken down by chemical reactions
Ⓒ Composed of two or more elements
Ⓓ Exists in solid, liquid, or gas form

36. The form of matter is the most abundant among elements:

Ⓐ Solid Ⓑ Liquid Ⓒ Gas Ⓓ Plasma

37. The type of substance made up of two or more different elements combined in a fixed ratio is:

Ⓐ Mixture Ⓑ Element Ⓒ Isotope Ⓓ Compound

38. An example of a homogeneous mixture:

Ⓐ Air Ⓑ Milk Ⓒ Saltwater solution Ⓓ Soil

39. An example of a heterogeneous mixture:

Ⓐ Tap water Ⓑ Rock Ⓒ Mineral acid Ⓓ Sugar solution

40. The following is a compound:

Ⓐ Potassium chloride Ⓒ Gold Ⓑ Oxygen Ⓓ Zinc

41. The two main types of mixtures are:

Ⓐ Solid and liquid Ⓑ Homogeneous and heterogeneous
Ⓒ Metallic and non-metallic Ⓓ Ionic and molecular

42. The type of element exists as a noble gas:

Ⓐ Sodium Ⓑ Silicon Ⓒ Iron Ⓓ Helium

43. The following is NOT a compound:

Ⓐ Water Ⓑ Carbon dioxide Ⓒ Mercury Ⓓ Ammonia

44. An example of a molecular compound is:

Ⓐ Water Ⓑ Sodium chloride Ⓒ Granite Ⓓ Copper

45. The following is a property of mixtures:

Ⓐ Fixed ratio of components Ⓑ Difficult to separate components
Ⓒ Difficult to separate components
Ⓓ Components retain their individual properties

46. An example of a metalloid is:

Ⓐ Oxygen Ⓑ Silicon Ⓒ Gold Ⓓ Potassium

47. What makes homogeneous mixtures different from heterogeneous mixtures?

Ⓐ Heterogeneous mixtures consist of only one component
Ⓑ Homogeneous mixtures are always solids
Ⓒ Homogeneous mixtures have uniform composition throughout
Ⓓ Heterogeneous mixtures are always liquids

48. The artificial element created in a laboratory was:

Ⓐ Technetium Ⓑ Iron

Ⓒ Copper Ⓓ Mercury

Short Answered Questions

1. What is an element?

Ans. An element is the simplest form of matter, made up of only one kind of atom. It is a pure substance that cannot be broken down further by ordinary chemical reactions. Elements exist in solid, liquid, and gaseous forms, with solids being the most common.

2. What are examples of elements?

Ans. Examples of elements include metals like iron and gold, non-metals like oxygen and chlorine, and noble gases like helium. Elements can exist as atoms, molecules, ions, or isotopes.

3. What is a compound?

Ans. A compound is a pure substance formed by the chemical combination of two or more different elements in a fixed ratio. Compounds have unique properties and strong chemical bonds, making them difficult to separate into their elements.

4. What are examples of compounds?

Ans. Examples of compounds include water (H_2O), carbon dioxide (CO_2), sodium chloride (NaCl), and ammonia (NH_3). These compounds may be organic, inorganic, molecular, or ionic.

5. What is a mixture?

Ans. A mixture consists of two or more elements or compounds combined in any ratio without chemical bonding. Mixtures can be homogeneous, like saltwater, or heterogeneous, like a sample of rock.

6. How do mixtures differ from compounds?

Ans. Mixtures differ from compounds in that their components are not chemically bonded and can be separated by physical means. In contrast, compounds have fixed compositions and chemical bonds between elements.

7. What are homogeneous mixtures?

Ans. Homogeneous mixtures have uniform composition and properties throughout. An example is a saltwater solution.

8. What are heterogeneous mixtures?

Ans. Heterogeneous mixtures have non-uniform composition, with different parts having varying concentrations. Examples include rocks and chocolate with visible inclusions.

9. What are artificial elements, and give an example?

Ans. Artificial elements are those created in laboratories rather than found in nature. An example is technetium, the first element synthesized by scientists.

10. How are elements classified?

Ans. Elements are classified as metals, non-metals, metalloids, or noble gases. Each group has distinct properties, with metals being conductive, non-metals non-conductive, metalloids having mixed properties, and noble gases being chemically inert.

Interesting information!

☆ **Which element was the first to be created by scientists in the laboratory?**

Ans. Many elements are found in nature but some are artificial. Technetium was first element created by scientists in the laboratory.

1.4 *Allotropic Forms of Substances*

Multiple Choice Questions (MCQs)

49. The phenomenon of elements existing in more than one structural form called:

Ⓐ Isomerism Ⓑ Allotropy
Ⓒ Crystallization Ⓓ Polymerization

50. The following are allotropic forms of oxygen:

Ⓐ Oxygen (O_2) and ozone (O_3) Ⓑ Oxygen (O_2) and water (H_2O)
Ⓒ Carbon dioxide (CO_2) and ozone (O_3)
Ⓓ Oxygen (O_2) and carbon monoxide (CO)

51. The element exists in diamond, graphite, and Buckminster fullerene forms is:

Ⓐ Sulphur Ⓑ Oxygen Ⓒ Carbon Ⓓ Nitrogen

52. The structure of diamond is:

Ⓐ Layered hexagonal rings Ⓑ Spherical arrangement
Ⓒ Monoclinic crystalline structure Ⓓ Giant macromolecular structure

53. The following is a characteristic of graphite:

Ⓐ High electrical conductivity Ⓑ Low melting point
Ⓒ Cage-like structure Ⓓ Insoluble in organic solvents

54. What makes Buckminster fullerene (C_{60}) unique?

Ⓐ Giant structure with strong covalent bonds
Ⓑ Spherical shape with no boundaries or unpaired electrons
Ⓒ Solubility in water Ⓓ High electrical conductivity

55. Is NOT a property of diamond:

Ⓐ Hardness Ⓑ High melting point
Ⓒ Electrical conductivity Ⓓ Covalent bonding

56. The allotrope of sulphur is more stable:

Ⓐ Monoclinic sulphur Ⓑ Amorphous sulphur
Ⓒ Liquid sulphur Ⓓ Rhombic sulphur

57. The structure of Buckminster fullerene (C_{60}) is:

Ⓐ Cage-like spheres made of pentagons and hexagons
Ⓑ Giant macromolecular structure
Ⓒ Hexagonal layers Ⓓ Rhombic crystalline structure

58. The allotrope of carbon is soft and cannot conduct electricity:

Ⓐ Diamond Ⓑ Buckminster fullerene
Ⓒ Graphite Ⓓ Graphene

59. The property common between diamond and graphite is:

Ⓐ Hardness Ⓑ Electrical conductivity
Ⓒ Covalent bonding Ⓓ Solubility in organic solvents

60. The primary structural difference between diamond and graphite is:

Ⓐ Diamond has a layered structure, and graphite has a giant macromolecular structure.
Ⓑ Diamond has a giant macromolecular structure, and graphite has a layered structure.
Ⓒ Both are layered structures. Ⓓ Both have a cage-like structure.

61. Which allotrope of sulphur has a monoclinic crystalline structure?

Ⓐ Rhombic sulphur Ⓑ Liquid sulphur
Ⓒ Amorphous sulphur Ⓓ Monoclinic sulphur

62. The allotrope of carbon stable at high temperatures and pressures is:

Ⓐ Buckminster fullerene Ⓑ Graphite
Ⓒ Diamond Ⓓ Amorphous carbon

Short Answered Questions

1. What is allotropy?

Ans. Allotropy is the phenomenon where elements exist in more than one structural form with distinct physical and chemical properties. Examples include oxygen existing as O_2 and O_3 (ozone).

2. What are the allotropic forms of oxygen?

Ans. Oxygen has two allotropic forms: oxygen (O_2) and ozone (O_3). O_2 is essential for respiration, while O_3 is a triatomic molecule found in the ozone layer, protecting us from harmful UV radiation.

3. What are the three main allotropic forms of carbon?

Ans. Carbon exists as diamond, graphite, and Buckminster fullerene. Diamond has a rigid macromolecular structure, graphite has a layered hexagonal structure, and fullerene forms spherical molecules.

4. What is unique about Buckminster fullerene?

Ans. Buckminster fullerene (C_{60}) has a cage-like structure made of carbon atoms arranged in pentagons and hexagons. It is stable at high temperatures, soluble in organic solvents, and has unique properties like low melting point and non-conductivity.

5. How does diamond differ from graphite?

Ans. Diamond has a giant macromolecular structure with strong covalent bonds, making it extremely hard. In contrast, graphite has a layered structure, allowing its layers to slide, making it soft and a good conductor of electricity.

6. What are the crystalline forms of sulphur?

Ans. Sulphur exists in two crystalline allotropic forms: rhombic and monoclinic. Rhombic sulphur is more stable, while monoclinic sulphur exists under specific temperature conditions.

7. What is the structure of graphene?

Ans. Graphene is a single layer of carbon atoms arranged in a hexagonal lattice. It has remarkable properties, including high strength, excellent electrical conductivity, and transparency.

8. Why is graphite a good conductor of electricity?

Ans. Graphite's layered structure contains delocalized electrons that move freely, allowing it to conduct electricity. This property is absent in diamond due to its rigid covalent bonding.

9. What are the uses of fullerenes?

Ans. Fullerenes are used in nanotechnology, medicine, and materials science due to their stability, unique structure, and ability to trap other molecules within their cage-like formation.

10. How do allotropes of the same element differ?

Ans. Allotropes differ in atomic arrangement and bonding, leading to distinct physical and chemical properties. For example, diamond is hard and non-conductive, while graphite is soft and conducts electricity.

1.5 *Differences between Elements, Compounds and Mixtures*

Multiple Choice Questions (MCQs)

63. An element is:

Ⓐ A mixture of compounds Ⓑ The simplest form of matter
Ⓒ A combination of molecules Ⓓ A homogeneous mixture

64. The elements exist as diatomic molecules in their gaseous state are:

Ⓐ Oxygen and nitrogen Ⓑ Sodium and potassium
Ⓒ Helium and argon Ⓓ Calcium and magnesium

65. A compound is:

Ⓐ A heterogeneous mixture Ⓑ An impure element
Ⓒ A suspension of particles
Ⓓ A pure substance with a fixed ratio of elements

66. The following is an example of a compound:

Ⓐ Sodium Ⓑ Air Ⓒ Water Ⓓ Iron

67. In a compound, the elements are combined in a:

Ⓐ Fixed ratio by weight Ⓑ Random ratio by volume
Ⓒ Variable ratio by weight Ⓓ Fixed ratio by volume

68. What distinguishes a mixture from a compound?

Ⓐ Mixtures are chemically bonded.
Ⓑ Mixtures can be separated by physical methods.
Ⓒ Mixtures have a fixed composition.
Ⓓ Mixtures have uniform properties.

69. An example of a homogeneous mixture:

Ⓐ Sand and iron filings Ⓑ Oil and water
Ⓒ Salt dissolved in water Ⓓ A sample of rock

9. What is the behavior of copper sulphate and sodium nitrate with temperature?

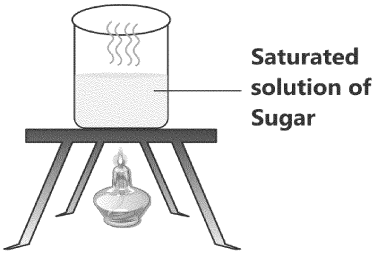
Ans. The solubilities of copper sulphate and sodium nitrate increase as temperature rises, making them examples of typical solubility behavior for many solids.

10. Why is calcium hydroxide an exception?

Ans. Calcium hydroxide shows decreased solubility with rising temperature. This behavior is unique and contrasts with the general trend of solids becoming more soluble as temperature increases.

Activity

☆ **Take 100 g of water in a beaker and prepare saturated solution of sugar at room temperature. Heat the beaker on a spirit lamp. Add a little more sugar in it and stir it. Will this sugar be dissolved in it? You will notice that by heating the solution the quantity of sugar dissolved in water has increased i.e. the solubility of sugar has increased.**



Ans. Activity (Effect of Temperature on Solubility): When sugar is added to water at room temperature, it dissolves until the solution becomes saturated. Upon heating the solution, the solubility of sugar increases, allowing more sugar to dissolve. This demonstrates how temperature can enhance the dissolving capacity of a solvent.

Exercise

☆ **How variation of solubility at different temperatures can be useful for us?**

Ans. Variation in solubility with temperature has practical applications in multiple areas:

1. **Purification of Solids:** Solids that increase in solubility with temperature can be purified through crystallization. Impurities remain dissolved when the solution is cooled, allowing pure crystals to form.
2. **Preservation of Gases in Liquids:** Solubility of gases decreases with increasing temperature. For example, soda bottles are kept in refrigerators to maintain the solubility of carbon dioxide, ensuring it stays dissolved for longer.
3. **Chemical Reactions Optimization:** Temperature-dependent solubility is crucial in industries to optimize reactions, especially for dissolving reactants or removing precipitates efficiently.

Intersting Information!

☆ **How does increasing temperature affect the solubility of solids in liquids?**

Ans. The increase in the solubility of solids in liquids with increase in temperature may be used to purify them. Pure solids commonly appear as beautifully shaped crystals.

☆ **Why are soda water bottles stored in the refrigerator?**

Ans. Generally the solubility of gases decreases with increase in temperature. Carbon dioxide gas is 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.

MCQs KEY

1	Ⓑ	2	Ⓒ	3	Ⓐ	4	Ⓓ	5	Ⓒ
6	Ⓐ	7	Ⓓ	8	Ⓒ	9	Ⓑ	10	Ⓐ
11	Ⓒ	12	Ⓓ	13	Ⓑ	14	Ⓓ	15	Ⓐ
16	Ⓒ	17	Ⓐ	18	Ⓓ	19	Ⓒ	20	Ⓓ
21	Ⓐ	22	Ⓑ	23	Ⓒ	24	Ⓐ	25	Ⓓ
26	Ⓒ	27	Ⓑ	28	Ⓓ	29	Ⓐ	30	Ⓒ
31	Ⓑ	32	Ⓓ	33	Ⓒ	34	Ⓑ	35	Ⓒ
36	Ⓐ	37	Ⓓ	38	Ⓒ	39	Ⓑ	40	Ⓐ
41	Ⓑ	42	Ⓓ	43	Ⓒ	44	Ⓐ	45	Ⓓ
46	Ⓑ	47	Ⓒ	48	Ⓐ	49	Ⓑ	50	Ⓐ
51	Ⓒ	52	Ⓓ	53	Ⓐ	54	Ⓑ	55	Ⓒ
56	Ⓓ	57	Ⓐ	58	Ⓑ	59	Ⓒ	60	Ⓑ
61	Ⓓ	62	Ⓐ	63	Ⓑ	64	Ⓐ	65	Ⓓ
66	Ⓒ	67	Ⓐ	68	Ⓑ	69	Ⓒ	70	Ⓓ
71	Ⓑ	72	Ⓐ	73	Ⓒ	74	Ⓓ	75	Ⓑ
76	Ⓐ	77	Ⓒ	78	Ⓓ	79	Ⓑ	80	Ⓒ
81	Ⓑ	82	Ⓓ	83	Ⓒ	84	Ⓓ	85	Ⓑ
86	Ⓓ	87	Ⓐ	88	Ⓑ	89	Ⓒ	90	Ⓓ
91	Ⓐ	92	Ⓑ	93	Ⓒ	94	Ⓓ	95	Ⓐ
96	Ⓒ	97	Ⓓ	98	Ⓐ	99	Ⓑ	100	Ⓒ
101	Ⓓ	102	Ⓑ	103	Ⓐ	104	Ⓒ	105	Ⓓ
106	Ⓑ	107	Ⓐ	108	Ⓑ	109	Ⓓ	110	Ⓒ

EXERCISE

1. Tick (✓) the correct answer.

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

Ⓐ Supercritical fluid Ⓑ Plasma
Ⓒ Gas Ⓓ Liquid crystal

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

Ⓐ Geochemistry Ⓑ Inorganic chemistry
Ⓒ Analytical Chemistry Ⓓ Environmental chemistry

(iii) The man-made polymer is:

Ⓐ Starch Ⓑ Polystyrene Ⓒ Protein Ⓓ Cellulose

(iv) The crystals of which substance have a rhombic shape?

Ⓐ Brass Ⓑ Sulphur Ⓒ Graphite Ⓓ Bronze

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

Ⓐ Milk Ⓑ Slaked lime used for white wash
Ⓒ Vinegar solution Ⓓ Mixture of AgCl in water

(vi) Which of the following is a heterogenous mixture?

Ⓐ A solution of calcium hydroxide in water
Ⓑ A solution of potassium nitrate in water
Ⓒ Hot chocolate Ⓓ Concrete mixture

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

Ⓐ Liquid crystal Ⓑ Supercritical fluid Ⓒ Plasma Ⓓ Dark matter

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

Ⓐ True solution Ⓑ Colloid Ⓒ Suspension Ⓓ Saturated solution

(ix) A solution of $KClO_3$ has a solubility of about 13.2g per 100cm³ at 40°C. How its solubility will be affected, if you decrease the temperature?

Ⓐ The solubility will increase Ⓑ The solubility will decrease
Ⓒ The solubility will remain the same
Ⓓ The solubility will first increase with temperature and then it will decrease

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

Ⓐ Organic Chemistry Ⓑ Analytical Chemistry
Ⓒ Biochemistry Ⓓ Physical Chemistry

MCQs KEY

i	Ⓑ	ii	Ⓓ	iii	Ⓑ	iv	Ⓑ	v	Ⓐ	vi	Ⓓ	vii	Ⓐ	viii	Ⓑ	ix	Ⓑ	x	Ⓒ

2. Questions for Short Answers

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

Ans. Chemistry is divided into branches to:

☆ Focus on specific aspects of its vast and complex field.

☆ Address interdisciplinary challenges like those in biochemistry or environmental chemistry.

☆ Enhance scientific advancements by specializing in areas like nuclear chemistry or analytical chemistry.

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.

Ans. ☆ Reactions involving electrons outside the nucleus are studied in Physical Chemistry and Inorganic Chemistry.

☆ Reactions involving changes inside the nucleus are studied in Nuclear Chemistry.

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

Ans. Analytical chemistry addresses problems like determining the composition of substances, identifying unknown compounds, and measuring the concentration of elements or compounds in mixtures using advanced techniques.

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

Ans.

Aspect	Graphite	Graphene
Structure	Made up of layers of hexagonal rings of carbon atoms.	Made up of a single layer of hexagonal rings of carbon atoms.
Thickness	Composed of multiple layers stacked together.	Composed of One single layer (monolayer).
Conductivity	Good conductor of electricity due to free electrons between layers.	Excellent conductor of electricity due to strong bonding and free electrons within the layer.

Strength	Relatively soft and slippery because of weak forces between layers.	Extremely strong due to strong covalent bonding between carbon atoms in the layer.
Flexibility	Not flexible as it consists of many layers.	Flexible and can be bent without breaking.
Use	Used in pencils, lubricants, and batteries.	Used in flexible electronics, supercapacitors, and advanced materials.

v. Why are supercritical fluids important?

Ans. Supercritical fluids, like supercritical carbon dioxide, combine the properties of gases and liquids. They are widely used in industrial processes like extraction, cleaning, and chemical reactions due to their efficiency and eco-friendliness.

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

Ans. Matter in the Sun exists in the Plasma state, a high-energy state where electrons are separated from nuclei, creating a soup of charged particles.

vii. What is the importance of graphene?

Ans. Graphene is incredibly strong, lightweight, and an excellent conductor of heat and electricity. Its properties make it highly valuable in electronics, material science, and energy storage applications.

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

Ans. Most material things in the world belong to the Solid state, characterized by fixed shapes, strong intermolecular forces, and high density.

3. Constructed Response Questions

i. How does a supercritical state look like?

Ans. In a supercritical state, a substance exists where the distinctions between liquid and gas disappear. It appears as a dense gas with liquid-like properties, filling a container uniformly without any phase separation.

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

Ans. Plasma in a fluorescent tube is created by ionizing a gas, such as argon or neon, using an electrical current. This ionization produces a mixture of charged particles (ions and electrons) that emit light when recombining.

iii. Most of the molecules we study in biochemistry are organic in nature. Where does the difference exists in organic and biochemistry branches of Chemistry.

Ans. Organic chemistry focuses on the structure, properties, and reactions of carbon-containing compounds. Biochemistry, however, specifically studies organic molecules and processes occurring within living organisms, such as proteins, enzymes, and DNA.

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

Ans. The brilliance of a diamond is due to its high refractive index and the way it disperses light. It can be enhanced by precise cutting techniques that maximize internal reflection and dispersion.

v. Explain the dissolution of sodium chloride in water.

Ans. Sodium chloride dissolves in water as its ions, Na^+ and Cl^-, separate due to the polar nature of water molecules. Water molecules surround and stabilize the ions, breaking the ionic lattice and forming a homogeneous solution.

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

Ans. Different compounds have different solubilities in water at a particular temperature due to variations in their chemical properties, including the strength of intermolecular forces between the solute and solvent molecules. Factors like polarity, hydrogen bonding, ionic nature, and molecular size affect how well a compound dissolves in water. For example, polar and ionic compounds dissolve well in water due to strong interactions with water's polar molecules, while nonpolar compounds do not.

vii. Why NaCl can be crystallized from water just like KNO_3?

Ans. NaCl can be crystallized from water just like KNO_3 because both salts dissolve in water and form a saturated solution at a certain temperature. When the temperature of the solution is lowered or water is evaporated, the solubility of the salt decreases, causing the ions to recombine and form solid crystals.

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

Ans. Graphite is slippery to touch because its structure consists of layers of carbon atoms arranged in a hexagonal lattice. These layers are held

together by weak van der Waals forces, which allow them to slide over each other easily. This property makes graphite an excellent lubricant, as it reduces friction between surfaces.

4. Descriptive Questions

i. Mention the name of the branch of Chemistry in which you will study each of the following topics.

(a) Rate of a reaction

(b) Digestion of food in human body

(c) Properties of plasma **(d) Ecosystem**

(e) Reactions taking place during fire works

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

Ans. **(a)** Rate of a reaction: **Physical Chemistry**

(b) Digestion of food in the human body: **Biochemistry**

(c) Properties of plasma: **Astrochemistry**

(d) Ecosystem: **Environmental Chemistry**

(e) Reactions taking place during fireworks: **Inorganic Chemistry**

(f) Measurement of the absorption of wavelength with the help of ultraviolet spectrometer: **Analytical Chemistry**

ii. What are allotropic forms? Explain the allotropic forms of carbon and sulphur. How does coal differ from diamond?

Ans. Here is the information in a three-column tabular format:

Element	Allotropic Forms	Properties
Carbon	Diamond	Giant macromolecular structure (hard, transparent, high density)
	Graphite	Layered hexagonal structure (soft, conducts electricity)
	Buckminsterfullerene (C_{60})	Spherical structure (soft, low melting point)
Sulphur	Rhombic Sulphur	Stable crystalline form
	Monoclinic Sulphur	Less stable crystalline form
Coal vs Diamond	Coal	Amorphous structure, less durable, lower density
	Diamond	Crystalline structure, very hard, high density

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

Ans. Supercritical fluids are substances at a temperature and pressure above their critical point, where liquid and gas phases coexist without distinction. Unlike ordinary liquids, they have gas-like diffusivity and liquid-like density, making them ideal for processes like extraction and reaction.

Aspect	Supercritical Fluids	Ordinary Liquids
Definition	Substances above their critical point with no distinct liquid or gas phases.	Substances with a clear distinction between liquid and gas phases.
Phase Characteristics	Exhibits properties of both gases and liquids (flows like gas, dense like liquid).	Has a definite shape and volume, with a clear phase separation from gas.
Density and Behavior	Density similar to liquids, but can diffuse through solids like gases.	Density is fixed and does not change like in supercritical fluids.
Usage	Used for processes like supercritical fluid extraction, where high temperatures are avoided.	Typically used for processes where phase separation is maintained.
Example	Carbon dioxide at high temperature and pressure.	Water, oil, and alcohol under normal conditions.

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

Ans. Solubility of a Solute: Solubility is defined as the maximum amount of solute that can dissolve in a given amount of solvent at a specific temperature to form a stable solution. It is generally expressed in terms of grams of solute per 100 grams of solvent or in molarity. Solubility of solutes usually increases with increase in temperature.

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

Ans. In gaseous molecules, the particles are in constant, random motion. They move freely and rapidly in all directions, with a wide range of speeds, due to the weak intermolecular forces between them. This movement causes gases to expand and fill the container they are in, and they are highly compressible.

In liquid molecules, the particles are closer together than in gases but still move randomly. They have more freedom of movement compared to solids but less than gases. The intermolecular forces are stronger than in gases, which keeps the molecules together, allowing liquids to maintain a definite volume, though they can flow and take the shape of their container.

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

Ans.

Aspect	Inorganic Chemistry	Organic Chemistry
Scope	Studies elements and compounds that contain little or no carbon, including metals, nonmetals, salts, acids, and bases.	Focuses on carbon-containing compounds, especially hydrocarbons and their derivatives (excluding simple salts like carbonates, bicarbonates, oxides, and carbides).
Examples of Compounds	Salts, acids, bases, metals, nonmetals (e.g., sodium chloride, potassium nitrate).	Methane, proteins, carbohydrates, lipids, and natural polymers.
Key Focus	Chemical synthesis, composition, properties, and structure of elements and compounds.	Study of the structure, formation, properties, and reactions of carbon compounds.
Applications	Used in industries like fertilizers, catalysts, pigments, and coatings.	Central to life sciences, pharmaceuticals, agriculture, and petrochemical industries.

5. Investigative Questions

i. Preparation of solutions leads to an important process in chemistry which enables us to purify a compound through crystalization. Describe a process in which potassium nitrate is purified by crystallizing it in water.

Ans. To purify potassium nitrate (KNO_3) through crystallization, follow these steps:

1. Dissolution: First, dissolve impure potassium nitrate in hot water. The solubility of potassium nitrate increases with temperature, so heating the water allows more of the compound to dissolve.

2. Filtration: After dissolving the potassium nitrate, filter the solution to

remove any insoluble impurities. This step ensures that only the dissolved potassium nitrate remains in the solution.

3. Cooling: Gradually cool the filtered solution. As the solution cools, the solubility of potassium nitrate decreases, causing it to crystallize.

4. Crystallization: Once the solution reaches a lower temperature, potassium nitrate begins to form crystals. The pure potassium nitrate will crystallize out of the solution, while the remaining impurities will stay dissolved in the water.

5. Separation: After sufficient crystallization, filter the crystals from the solution to separate the pure potassium nitrate. The crystals are then dried, leaving behind pure potassium nitrate.

This process of crystallization helps in purifying potassium nitrate by removing soluble impurities and obtaining it in its pure crystalline form.

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?

Ans. Properties of Graphene that Make It Useful in Electronics:

Graphene is considered a miracle material due to its remarkable properties that make it extremely useful in electronics:

1. High Electrical Conductivity: Graphene is an excellent conductor of electricity, which makes it ideal for use in electronic components such as transistors, sensors, and conductors in flexible electronics.

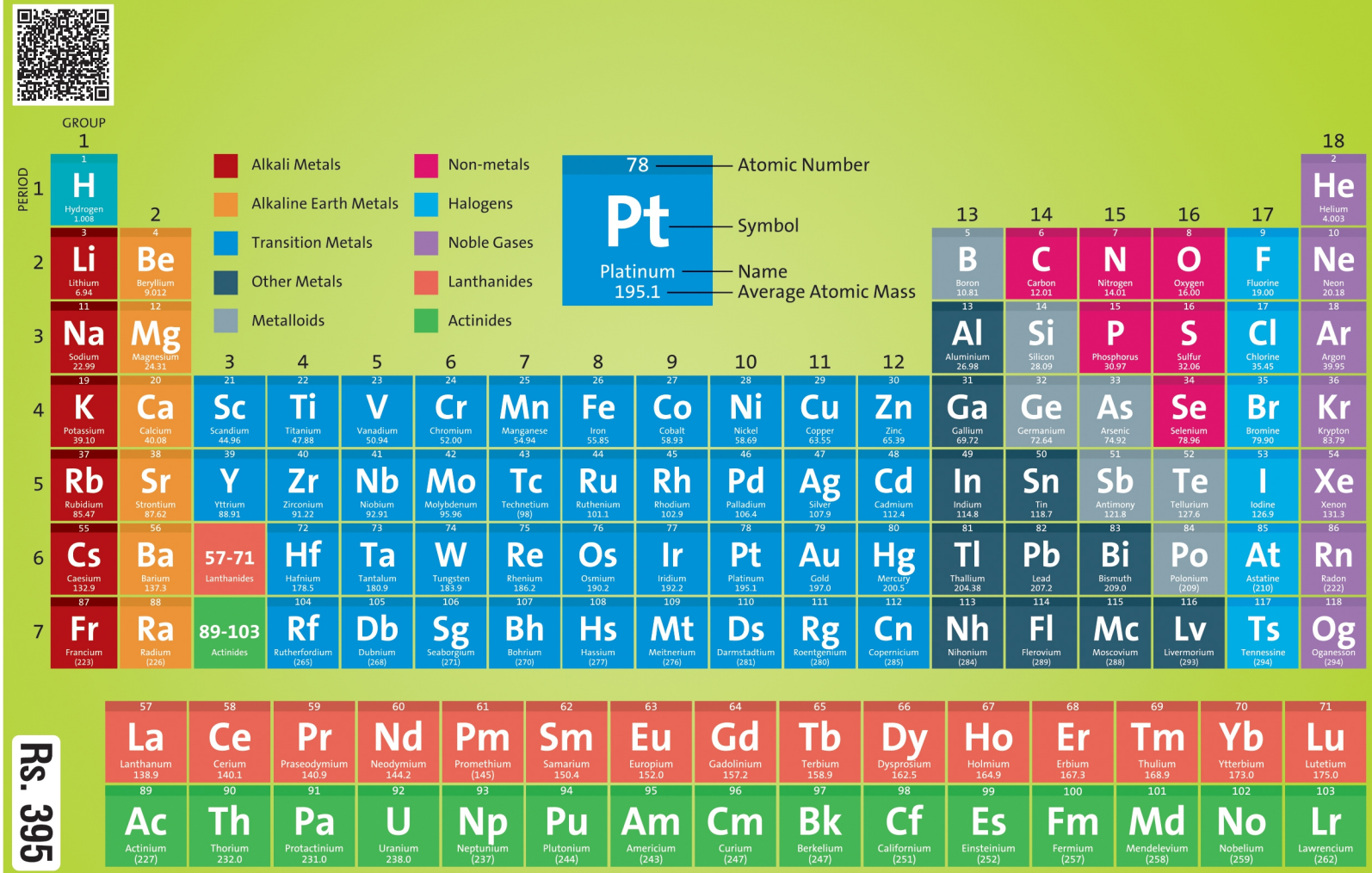
2. High Thermal Conductivity: It efficiently conducts heat, which is beneficial for dissipating heat in electronic devices, especially in high-performance chips and circuits.

3. Strength and Flexibility: Despite being extremely thin, graphene is incredibly strong and flexible, allowing it to be used in bendable or stretchable electronic devices without compromising durability.

4. Thinness and Lightness: Graphene is a single layer of carbon atoms, making it the thinnest material known. This property is crucial for creating ultra-thin and lightweight electronic devices such as flexible screens and lightweight batteries.

5. High Surface Area: The large surface area of graphene allows for more efficient use in applications such as supercapacitors and batteries, enabling better energy storage and faster charging.

These exceptional properties make graphene an attractive material for the development of next-generation electronic devices, from flexible electronics to energy-efficient systems. ☆☆☆☆☆



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