CHEMISTRY 9th Chapter #1

1. What is Chemistry?

- Chemistry is the science of matter and its changes.
- It studies the **properties**, **composition**, and **structure** of substances.
- It also explains **physical and chemical changes** in matter.
- It follows certain **laws and principles** that govern these changes.

2. Physical Chemistry

- Studies how substances behave at the **atomic or molecular level**.
- Explains how **basic physical laws** affect atoms and molecules.
- Helps understand and **control chemical reactions**.
- Used to **improve reactions** for **industrial purposes**.

3. Inorganic Chemistry

- It is the branch of chemistry that studies **elements and compounds** which contain **little or no carbon**.
- It focuses on their **synthesis**, **structure**, **properties**, and **composition**.
- It includes substances like **metals**, **salts**, **acids**, and other **inorganic compounds**.

4. Organic Chemistry (نامیاتی کیمسٹری)

- It is the branch of chemistry that studies **carbon compounds**, especially **hydrocarbons** and their **derivatives**.
- It **does not include** simple carbon salts like **carbonates**, **bicarbonates**, **oxides**, and **carbides**.
- It focuses on the **structure**, **formation**, **properties**, **composition**, and **reactions** of carbon-based compounds.

5. Environmental Chemistry

- It is the study of **chemical and biochemical processes** that occur on Earth.
- Focuses on **sources, reactions, effects**, and **fate** of chemicals in **air, soil, and water**.
- Helps us understand how **human activities** affect the environment through chemical release.
- Without it, we can't properly study the **impact of pollutants** on nature.

6. Analytical Chemistry

- It studies **what substances are made of**.
- Involves **separating**, **identifying**, and **measuring** components in a sample.
- Uses **modern instruments** to test and analyze materials.

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7. Biochemistry

- It explains **life using chemistry**.
- Studies **chemicals** and **processes** inside living organisms.
- Focuses on molecules like **proteins, carbohydrates, lipids**, and **nucleic acids**.

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8. Nuclear Chemistry

- Deals with **reactions in the nucleus** of atoms.
- Includes **radioactivity** and **nuclear transformations**.
- Useful in **medicine, agriculture, industry**, and **scientific research**.

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9. Polymer Chemistry

- Studies **polymers** – big molecules made of repeating units.
- Explores their **structure, properties**, and **how they're made**.
- **Proteins, cellulose**, and **DNA** are natural polymers.

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10. Geochemistry

- Study of the Earth's chemical composition, elements, and minerals.
- Used in: mineral exploration, environmental studies, forestry, and medical research.

 Fun Fact:
Geothermal heat pumps use underground heat to warm buildings in winter and cool them in summer.

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11. Medicinal Chemistry

- Focuses on designing and developing medicines to improve human health.
- Involves discovery, absorption, delivery, and the effect of drugs in the body.

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12. **Astrochemistry**

- Study of atoms, molecules, and ions found in space and between stars.
- Explores their reactions, abundance, and interaction with light in the universe.

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13. States of Matter

What is Matter?
Matter is *anything that has weight (mass) and takes up space (volume)*. Everything around us – like water, air, wood, and ice – is made of matter.

What is Energy?
Energy is *not matter*. It doesn't have mass or volume. Examples: light, heat, and sound.

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14. Main States of Matter

There are **three common (primary)** states of matter:

1. **Solid**
   - Has **fixed shape** and **fixed volume**
   - Particles are **tightly packed** and **don't move freely**
   - Cannot be easily compressed
   - Example: Ice, wood, metal
2. **Liquid**
   - Has **fixed volume** but **no fixed shape**
   - Takes the shape of the container
   - Particles are **close together but can move around**
   - Not easily compressed
   - Example: Water, milk, oil
3. **Gas**
   - Has **no fixed shape or volume**
   - Fills the entire container
   - Particles are **far apart and move freely**
   - Can be compressed easily
   - Example: Air, steam, oxygen

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15. Plasma (Fourth State)

- Not common in daily life
- Found in **fluorescent lights, lightning, and the sun**
- Made of **very fast-moving charged particles** (like ions and electrons)

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16. Other Special (Exotic) States

These are **rare** and seen in special conditions:

- **Supercritical Fluid**: Behaves like both gas and liquid
- **Liquid Crystal**: Between liquid and solid; used in **screens**
- **Graphene**: A very thin layer of carbon atoms; **strong and light**
- **Bose-Einstein Condensate**: A very cold state where atoms behave as one
- **Dark Matter & Quantum States**: Found in **space or physics labs**

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17. **Element**:

- Simplest form of matter.
- Pure substance made of same kind of atoms.
- Cannot be broken down by ordinary chemical reactions.
- Exists as solid, liquid, or gas (mostly solids).
- Types: metals, non-metals, metalloids, noble gases.
- Examples: oxygen, gold, carbon, copper, mercury, etc.

18. **Compound**:

- Pure substance made by chemical combination of two or more different elements in a fixed ratio.
- Elements are bonded strongly through chemical bonds.
- Types: molecular, ionic, intermetallic, coordination complexes.
- Can be organic or inorganic.
- Examples: water (H_2O), carbon dioxide (CO_2), sodium chloride (NaCl), proteins, starch.

19. **Mixture**:

- Formed by mixing elements or compounds in any ratio (no chemical bonding).
- Can be homogeneous (uniform composition) or heterogeneous (non-uniform composition).
- Examples: air (homogeneous), rock (heterogeneous), milk, tap water.

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20. Allotropy:

- When an element exists in more than one structural form with different physical and chemical properties.
- These different forms are called **allotropic forms**.

21. **Examples of Allotropy**:

- **Oxygen**:
  - Exists as **O_2** (oxygen gas) and **O_3** (ozone).

- **Carbon**:
  - **Diamond**: Hard, giant structure, does not conduct electricity.
  - **Graphite**: Soft, layered structure, can conduct electricity.
  - **Buckminster fullerene (C_{60})**:
    - Cage-like, made of pentagons and hexagons.
    - Soluble in organic solvents.
    - Low melting point, soft, non-conductor.
- **Sulphur**:
  - Exists in two forms: **Rhombic sulphur** (more stable) and **Monoclinic sulphur**.

22. Difference:

Property	Element	Compound	Mixture
Definition	Simplest form of matter, made of same kind of atoms.	Pure substance formed by chemical combination of different elements.	Impure substance made by mixing elements or compounds without fixed ratio.
Purity	Pure substance.	Pure substance.	Impure substance.
Breakdown	Cannot be broken into simpler substances by ordinary chemical reactions.	Can be broken into elements by chemical reactions.	Components can be separated by physical methods.
Representation	Represented by symbols (e.g., Na for sodium, Ca for calcium).	Represented by chemical formulas (e.g., H_2O for water).	No fixed formula.
Ratio of Components	Only one type of atom.	Fixed ratio by weight (e.g., water: H and O in 1:8 ratio).	No fixed ratio.
Examples	Sodium (Na), Calcium (Ca).	Water (H_2O), Ammonia (NH_3).	Salt water, air, rocks.
Properties	Same throughout.	Same throughout.	Different depending on composition; can be homogeneous or heterogeneous.

23. **Solution (True Solution):**

- A mixture where solute particles completely dissolve in the solvent.
- Particles are so small that they cannot be seen with the naked eye.
- Particles do not settle down even after some time.
- On filtration, particles pass through filter paper without leaving any residue.
- Examples: salt in water, sugar in water.

24. **Colloidal Solution:**

- A mixture where solute particles are slightly bigger than in a true solution but still cannot be seen directly.
- Particles do not settle down even after standing for a long time.
- Particles also pass through filter paper.
- Examples: starch solution, egg white.

25. **Suspension:**

- A mixture where solute particles do not dissolve in the solvent.
- Particles are large enough to be seen with the naked eye.
- Particles settle down if left undisturbed.
- On filtration, particles do **not** pass through filter paper (they form residue).
- Examples: chalk in water, muddy water.

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26. Answers to the Exercise Questions

1. Which elements are found in pure state on Earth?

- Gold (Au)
- Platinum (Pt)
- Silver (Ag)
- Copper (Cu)
- Sometimes Sulphur (S)

2. Which elements are present in very small amounts on Earth?

- Rhenium (Re)
- Tellurium (Te)
- Osmium (Os)
- Iridium (Ir)

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27. Unsaturated Solution:

- A solution that **can still dissolve more solute** at a certain temperature.
- Example: If you add sugar into water and it keeps dissolving, it is an **unsaturated solution**.

28. Saturated Solution:

- A solution that **cannot dissolve any more solute** at a certain temperature.
- If you add more solute, it will **settle at the bottom** and will not dissolve anymore.
- Example: When you keep adding sugar to water, and after a point, sugar stops dissolving, the solution becomes **saturated**.

29. Solubility:

- Solubility means **how much of a substance** (solute) can dissolve in **100g of a liquid** (solvent) at a certain temperature.

- Solubility means **how much of a substance** can dissolve in a certain amount of solvent (like water) at a certain temperature.
- Example:
  - At 20°C, **36g** of salt (sodium chloride) can dissolve in **100g** of water.
  - At the same temperature, **203.9g** of table sugar can dissolve in **100g** of water.
- This shows that **sugar** is much more soluble than **salt**.

30. Reason:

- Sugar molecules are **larger** than salt ions.
- More water molecules can **surround and dissolve** each sugar molecule, so **more sugar** can dissolve.

31. Extra Interesting Information:

- Mixtures are **everywhere** in daily life!
- The air we breathe, the food we eat, the steel we use — all are **mixtures** (either homogeneous or heterogeneous).

32. Effect of Temperature:

- **Usually**, when temperature **increases**, the solubility of **most solids** in water also **increases**.
- But, this is **not always true** for all substances.

33. Examples Where Solubility Increases with Temperature:

- **Potassium nitrate (KNO_3)**
- **Silver nitrate ($AgNO_3$)**
- **Potassium chloride (KCl)**
- **Copper sulfate ($CuSO_4$)**
- **Sodium nitrate ($NaNO_3$)**

Example Where Solubility Does Not Increase Much:

- **Sodium chloride (NaCl)** — it dissolves only **a little more** even when the temperature increases.

34. Examples Where Solubility Decreases with Temperature:

- **Lithium carbonate (Li_2CO_3)**
- **Calcium chromate ($CaCrO_4$)**
- **Calcium hydroxide ($Ca(OH)_2$)**

35. Gases:

- **Gases dissolve less** in water when the temperature **increases**.
- **Carbon dioxide** is **more soluble** at **low temperatures**.
- That's why **soda water bottles** are kept in the **refrigerator** — to keep the carbon dioxide gas **dissolved**.

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36. Extra Interesting Information:

- When a **solid's solubility** increases with temperature, we can **purify solids** easily by making beautiful **crystals**.
- **Crystals** of potassium nitrate are a good example!

37. Important Points:

1. **Gas solubility and temperature:**
   Gases dissolve less in water when temperature increases.
2. **Carbon dioxide solubility:**
   Carbon dioxide dissolves better in cold water.
3. **Soda water storage:**
   Soda bottles are kept in the fridge to keep the gas (carbon dioxide) dissolved for a longer time.

38.Quick Key Points:

- **More heat → More solubility** (for many solids).
- **More heat → Less solubility** (for gases and some solids like lithium carbonate).
- Solubility **depends on the type of substance**.

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39. Solved Activity Explanation:

- You took **100 g of water** and added sugar to it **until no more could dissolve** — this is called a **saturated solution**.
- Then you **heated** the solution and added **a little more sugar**.
- Now, the extra sugar **dissolved** in hot water.
- This shows that **more sugar can dissolve at higher temperature**.

 Conclusion: Solubility of sugar increases when temperature increases.

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40. Exercise Answer:

Q: How variation of solubility at different temperatures can be useful for us?

Answer (Simple and Clear):
When temperature increases, the solubility of many solids (like sugar or salt) in water also increases. This is useful because:

- It helps us dissolve **more sugar in tea or coffee** when hot.
- In industries, **more solid chemicals** can be dissolved during heating.
- It helps in making **crystals** of pure substances during cooling (called crystallization).