Chapter 16

1. What are Gases?

Gases are one of the fundamental states of matter. They:

- **Do not have a fixed shape or volume**
- Can expand to fill the container
- Are **compressible** and have **low density**
- Molecules in gases move freely and rapidly

Carbon Dioxide Gas (CO_2)

Introduction to Carbon Dioxide:

- A **colorless**, **odorless**, and **tasteless** gas
- Heavier than air
- Does **not support combustion**
- Found naturally in the atmosphere (~0.04%)

🧪 Laboratory Preparation of Carbon Dioxide

Word Equation:

Calcium carbonate ($CaCO_3$) + Hydrochloric acid (HCl) → Calcium chloride ($CaCl_2$) + Water (H_2O) + Carbon dioxide (CO_2)

Materials Required:

- Marble chips ($CaCO_3$)
- Dilute HCl
- Conical flask
- Delivery tube
- Gas jar
- Water trough

Procedure:

1. Place marble chips in a conical flask.
2. Add dilute hydrochloric acid through a thistle funnel.
3. The gas released passes through a delivery tube into an inverted gas jar over water.

Test for Carbon Dioxide:

- Pass the gas through **lime water**.
  👉 If it turns **milky**, CO_2 is present.

Safety Precautions:

- Handle acid with care (wear gloves and goggles).
- Avoid inhaling CO_2 directly.
- Ensure proper ventilation.

5 Physical Properties of Carbon Dioxide:

1. Colorless and odorless
2. Heavier than air
3. Slightly soluble in water
4. Non-combustible
5. Can be liquefied under pressure

5 Chemical Properties of Carbon Dioxide:

1. Turns lime water milky
2. Reacts with water to form carbonic acid (H_2CO_3)
3. Does not support combustion
4. Reacts with basic oxides to form carbonates
5. Forms precipitate with metal hydroxides

5 Uses of Carbon Dioxide:

- Used in **fire extinguishers**
- Used to **carbonate soft drinks**
- Used in **photosynthesis by plants**
- Used in **refrigeration** as dry ice (solid CO_2)
- Used in **welding** and inert gas shielding

Fire Extinguisher and Its Working

How it works:

- Fire extinguishers contain **CO_2 gas under pressure**.
- When released:
  - CO_2 **cuts off oxygen** supply
  - It **cools the burning material**
  - This **stops combustion**

Ammonia Gas (NH_3)

Introduction to Ammonia:

- **Colorless gas** with a **sharp, pungent smell**
- Composed of nitrogen and hydrogen
- **Lighter than air**
- Highly soluble in water

Laboratory Preparation of Ammonia

Word Equation:

Ammonium chloride (NH_4Cl) + Calcium hydroxide ($Ca(OH)_2$) → Ammonia (NH_3) + Calcium chloride ($CaCl_2$) + Water (H_2O)

Materials Required:

- Ammonium chloride

- Calcium hydroxide
- Round-bottom flask
- Delivery tube
- Drying agent (like quicklime)

Procedure:

1. Mix ammonium chloride and calcium hydroxide in a flask.
2. Heat the mixture gently.
3. Collect the gas by **downward displacement of air**.

Test for Ammonia:

- It turns **red litmus paper blue** (alkaline nature)
- Has a **sharp, choking smell**

Precautions:

- Do not inhale the gas directly
- Ensure proper ventilation
- Avoid overheating

5 Physical Properties of Ammonia:

1. Colorless with pungent odor
2. Lighter than air
3. Highly soluble in water
4. Easily liquefied under pressure
5. Forms dense white fumes with HCl

5 Chemical Properties of Ammonia:

1. Basic in nature

2. Reacts with acids to form salts
3. Combines with oxygen to form nitrogen and water
4. Reduces copper oxide to copper
5. Combines with hydrogen chloride to form ammonium chloride fumes

5 Uses of Ammonia:

- Used in **manufacturing fertilizers** (e.g. urea, ammonium nitrate)
- Used as a **refrigerant** in old refrigeration systems
- Used in **cleaning agents**
- Used in **textile and plastic industries**
- Used in **laboratories for qualitative tests**

Greenhouse Effect

What is a Greenhouse?

A structure made of **glass or plastic** that allows sunlight in but traps heat.

What is the Greenhouse Effect?

The **trapping of heat** in the Earth's atmosphere by gases like CO_2, CH_4, and water vapor.

Major Causes:

- Burning fossil fuels
- Industrial emissions
- Deforestation
- Livestock farming

Adverse Effects:

- Global warming
- Melting glaciers and rising sea levels
- Irregular climate patterns
- Extinction of species
- More frequent natural disasters

Methods to Reduce Greenhouse Effect:

- Reduce fossil fuel use
- Promote afforestation
- Use renewable energy
- Recycle and reuse
- Raise awareness

🌱 Artificial Greenhouse

Importance:

- Maintains **controlled temperature** for plant growth
- Useful in **cold climates**
- Helps in **early germination** and **longer growing season**
- Used for **commercial farming**

Acid Rain

Process of Acid Rain Formation:

1. **Formation of Sulphuric Acid:**
    - $SO_2 + O_2 \rightarrow SO_3$
    - $SO_3 + H_2O \rightarrow H_2SO_4$

2. **Formation of Nitric Acid:**
    - $NO_2 + H_2O \rightarrow HNO_3$
3. **Acid Formation:**
    - These acids dissolve in rainwater → **Acid Rain**

Effects of Acid Rain:

- Damages buildings and monuments (especially marble)
- Makes soil acidic, affecting crops
- Kills aquatic life in lakes and rivers
- Damages leaves and plant tissues
- Corrodes metals and infrastructure

Control Measures of Acid Rain:

- Use low-sulphur fuels
- Install scrubbers in factories
- Encourage use of public transport
- Promote renewable energy
- Enforce environmental regulations

Interesting Facts:

- The **first fire extinguisher** using carbon dioxide was invented in 1924.
- Ammonia is **one of the most produced chemicals** globally for fertilizers.
- **Dry ice** is the solid form of carbon dioxide used for refrigeration without water residue.
- Ammonia has a **higher affinity for water** than CO_2—so it's often collected dry.
- The **Great Smog of London (1952)** was a severe air pollution event, partly due to acid-producing gases.

Quick Revision Summary:

Topic	Key Points
Carbon Dioxide	Colorless, heavier than air, non-combustible
Ammonia	Pungent smell, lighter than air, alkaline
Greenhouse Effect	Caused by gases like CO_2, leads to warming
Acid Rain	Sulphuric and nitric acids in rainwater
Fire Extinguisher	CO_2 cuts oxygen and cools the fire

Common Mistakes to Avoid:

- Confusing **ammonia** with a neutral gas (it's basic)
- Thinking CO_2 supports combustion (it does NOT)
- Writing incorrect tests (e.g., lime water for ammonia)
- Mixing up greenhouse effect with ozone layer depletion
- Forgetting safety procedures in gas preparation