S1 New Curriculum chemistry

Theme: Introduction to Chemistry and experimental Techniques

S1 New Curriculum Chemistry Chapter 2 – Experimental Chemistry

Chemical experiments

A **chemical experiment** is a controlled test or procedure that involves chemical substances to study their properties, reactions, or behavior under different conditions. These experiments help scientists and students understand how matter interacts, transforms, and follows specific chemical principles.

Some common types of chemical experiments include:

- **Reaction Experiments:** Observing how substances react, like mixing acids with bases or metals with acids.
- **Separation Techniques:** Using methods like filtration, distillation, or chromatography to separate substances.
- **Energy Changes:** Studying heat transfer in reactions, such as combustion or exothermic/endothermic reactions.
- **Analytical Chemistry:** Identifying unknown substances through tests like pH indicators or flame tests.

Chemistry laboratory

A **chemistry laboratory** is a specialized space designed for conducting chemical experiments, research, and analysis. Some chemistry activities can be done outside the laboratory if it is deemed safe.

Laboratory rules and their purposes

Laboratory rules/precautions in a chemistry lab exist for **safety, accuracy, and efficiency**. They help prevent accidents, protect individuals, and ensure experiments yield reliable results.

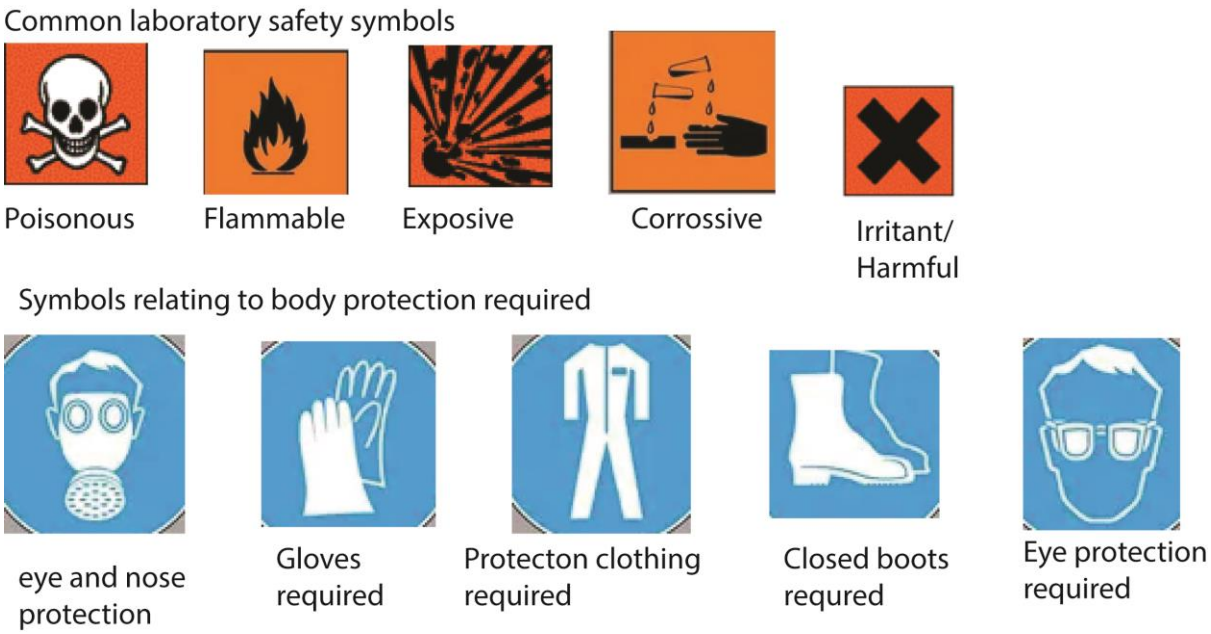
Some of the laboratory rules and the dangers avoided

Rule/precautions		Dangers avoided
1.	Do not run or move unnecessarily in the laboratory	To avoid causing accidents such as damage to specimen and apparatus or injuring fellow students
2.	Do not perform experiments unless you have been told to do so by your teachers	Avoids dangerous reactions like explosions, toxic fumes, or fires.
3.	Always wear lab coats, safety goggles, gloves, and closed shoes.	Prevents chemical spills, splashes, and exposure to hazardous substances that can cause burns or eye damage.
4.	Food and drinks are not allowed in the lab	Prevents accidental ingestion of toxic chemicals.
5.	After experiment is over, clean your apparatus and wash your hands with soap and clean water	to protect you from contaminations and keep apparatus safe
6.	Label all your chemicals and solutions	To avoid confusion and dangerous reaction
7.	Handle glassware, burners, and electrical devices with care.	Prevents fires, burns, and breakage that could lead to accidents.
8.	In case of an accident, burn or splash of any chemical, wash with plenty of cold water. Inform your teachers immediately	To protect yourself from being harmed by chemicals.
9.	Follow specific disposal instructions for chemicals and broken glassware.	Reduces environmental pollution and prevents injuries from sharp
10	In the case of any unusual smell, report to the teacher or laboratory technicians immediately	So that the teachers take the necessary precautions in case of danger.
11	Know the location of fire extinguishers, first aid kits, and emergency exits.	Allows quick response to accidents, minimizing harm.

Safety signs and symbols

Safety signs and symbols in a chemistry laboratory are crucial for preventing accidents and ensuring a secure working environment.

Here are some of the common chemistry safety signs and symbols



Meaning of some common safety instruction

- **Toxic Hazard:** Alerts to poisonous chemicals that can be harmful if inhaled or touched. Avoid contact with the skin.
- **Flammable Material:** Identifies substances that can easily catch fire.
- **Explosive Hazard:** Indicates chemicals that may explode under certain conditions.
- **Corrosive Material:** Warns of substances that can damage skin or materials.
- **Irritant or harmful:** for range of many dangerous chemical

Managing fire in the laboratory

Fire is a rapid chemical reaction involving oxygen and a fuel source, producing heat, light, and gases. It happens when **heat** raises a substance to its ignition temperature, triggering combustion. Fires can be beneficial (like cooking and heating) or dangerous, causing destruction and harm.

Types of Fires:

- **Class A:** Ordinary combustibles (wood, paper, fabric).
- **Class B:** Flammable liquids (gasoline, oil, alcohol).
- **Class C:** Electrical fires (faulty wiring, appliances).
- **Class D:** Metal fires (magnesium, sodium).
- **Class K:** Kitchen fires (cooking oils, grease).

How to Prevent Fires:

- Store flammable materials safely.
- Avoid overloading electrical circuits.
- Keep fire extinguishers accessible.
- Never leave open flames unattended.

Fighting fire

Fighting a fire depends on its type and severity. The main goal should be to save life. Then , property, and the environment.

1. Use a Fire Extinguisher

- Identify the type of fire (Class A, B, C, D, or K).
- Use the **PASS** method: **Pull** the pin, **Aim** at the base, **Squeeze** the handle, and **Sweep** side to side of fire.

2. Smother the Fire

- For small fires, use a fire blanket or sand to cut off oxygen.
- Never use water on electrical or grease fires—it can make them worse.

3. Remove the Fuel Source

- Turn off gas or electricity if safe to do so.
- Move flammable materials away from the fire.

4. Call for Help

A. If the fire is spreading, evacuate immediately and call emergency services.

5. Use Fire Suppression Techniques

- Firefighters use methods like **control lines**, **backburning**, and **hot spotting** to contain wildfires.

Components of a chemistry laboratory

It is equipped with scientific tools, glassware, and safety equipment to study and manipulate chemical substances safely. Common laboratory equipment include:

- **Workbenches & Fume Hoods:** Used for mixing chemicals and safely handling volatile substances.
- **Glassware:** Beakers, test tubes, flasks, pipettes, and burettes for measuring and mixing.
- **Heating Equipment:** Bunsen burners, hot plates, and water baths for heating substances.
- **Safety Equipment:** Goggles, lab coats, gloves, fire extinguishers, and emergency showers.
- **Chemicals & Reagents:** Various compounds for conducting experiments.
- **Analytical Instruments:** Spectrometers, balances, and pH meters for precise measurements.

Common chemistry laboratory apparatus

Measuring volume

Volume is the amount of **space** that a substance or object occupies. It is measured in cubic units like liters (L), milliliters (mL), cubic meters (m^3), and cubic centimeters (cm^3).

1L - 10001mL/cm^3. Volume of liquids are measured by volumetric flasks, measuring cylinders, burets and pipets.

Measurement of mass

Mass is the amount of matter present in an object. Mass is usually measured in grams (g) or kg. 1kg = 1000g. Mass is measured by beam balance

Beam balance for weighing mass

Measurements of time

Time is a fundamental concept that measures the **sequence and duration of events**. It is measured in seconds, minutes or hours. Time is measured by stop clocks.

Stop clocks to measure time

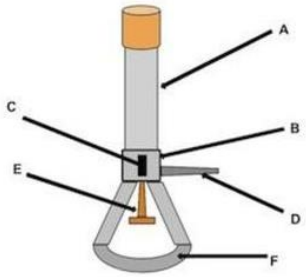
Measurements of temperature

Thermometer

Temperature is a measure of how hot or cold something is. It reflects the average kinetic energy (motion) of particles in a substance. The faster the particles move, the higher the temperature. Temperature is measured in ^{0}C or K. Temperature is measured by a thermometer.

Bunsen burner the apparatus for heating in the laboratory

Parts of Bunsen burner



A. Chimney or barrel – raises the flame to ease use
B. Collar – controls the amount of (air)oxygen (more oxygen, more intense and blue flame
C. Air hole- allows air to enter the burner
D. Gas intake hose – let in gas into the Bunsen Burner
E. Gas valve – adjust amount of gas (more gas, the larger the flame)
F. Base – wide and heavy to keep the burner stable and less likely to tople.

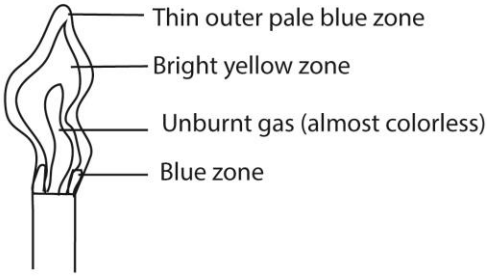
Stapes taken when lighting a Bunsen burner:

(i) Connect the burner to the gas supply using rubber tubbing.
(ii) Close the air hole of the Bunsen burner
(iii) Light a max box and hold the flame just at the side of the opening of the barrel
(iv) Slowly turn the gas on using the gas tap until the burner light

Types of flames produced by a Bunsen burner

1. **Luminous flame:** Is the flame obtained when the air wholes are closed.

Luminous flame (Air holes closed)

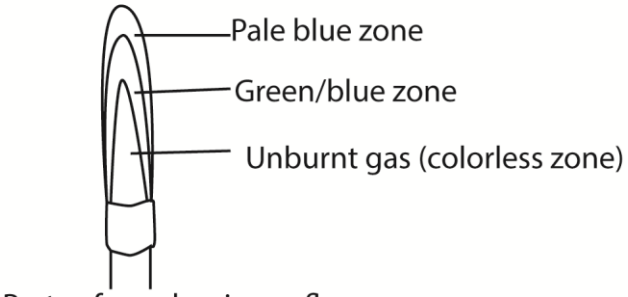


Parts of luminous flame

A luminous flame is yellow because: the town gas in the yellow zone is not completely burnt there is no enough air. Tiny particles of solid carbon form; they become white- hot and give out light.

2. **Non-luminous flame:** Is the flame obtained when the air wholes are open.

None-luminous flame (Air holes open)



Parts of non-luminous flame

- **Flames of a candle and oil are not used in the laboratory because:**
  i. They are not hot enough

  ii. They cover apparatus with black soot (carbon).

- **Burning back: -** when the air holes are fully opened: and too much air enters, burning takes place very quickly and the flame passes down the tube. The flame "strikes back or burns back to the jet". The flame is noisy and the colour is greenish.

When a Bunsen flame strikes back, re-light as follows:

i. Turn off the gas,

ii. Close the air-holes

iii. Turn on the gas and re-light it

Second way of re-light:

i. Close the air holes

ii. Struck / hit the rubber tubing sharply to stop the gas for a moment (usually the flame re-lights at the top of the tube)

Differences between a non luminous flame and a luminous flame

Non luminous	Luminous
Blue, steady flame	Yellow, unsteady flame
Has three zone	Has four zones
Forms no soot	Forms soot
Very hot	Not too hot
Noisy	Quiet
Sometimes 'burns back'	Does not 'burn back'

Some source of heating equipment at home

Charcoal stove

Paraffin stove

Gas cooker

Hot plate

Scientific method

The **scientific method** is a systematic process used to explore observations, answer questions, and test hypotheses in science. It ensures that discoveries are based on logic, evidence, and repeatable experiments.

Steps of the Scientific Method:

1. **Observation** – Identify a phenomenon or problem.
2. **Question** – Ask a specific question about what was observed.
3. **Hypothesis** – Make an educated guess or prediction that can be tested.
4. **Experiment** – Design and conduct experiments to test the hypothesis.
5. **Data Collection & Analysis** – Record results and analyze patterns.
6. **Conclusion** – Determine whether the hypothesis was correct or needs revision.
7. **Communication** – Share findings with others through reports or publications.

The scientific method is used in all fields of science, from chemistry to physics to medicine, ensuring discoveries are based on facts rather than assumptions.

Mixtures

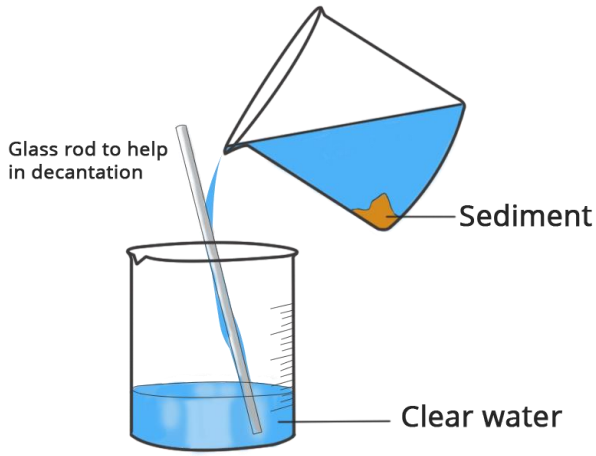
Types of Mixtures:

1. **Homogeneous Mixtures** (Solutions):
    - Uniform composition throughout.
    - Examples: Saltwater, air, lemonade.
2. **Heterogeneous Mixtures**:
    - Components are distinguishable and unevenly distributed.
    - Examples: Sand and water, salad, oil and vinegar.

Methods of Separation

(i) Decanting

Decanting is a separation process used to remove a liquid from solid particles(sedment) or from another liquid with different densities. It works by allowing heavier substances to settle at the bottom before carefully pouring off the lighter liquid.

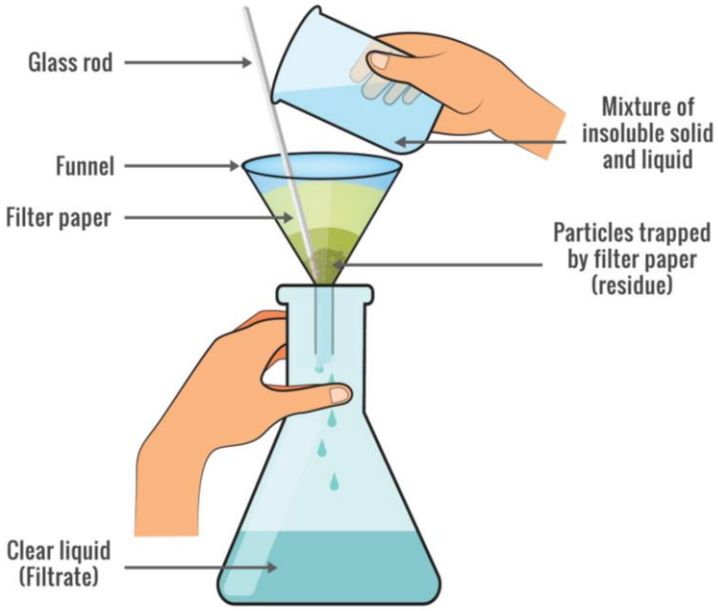


Examples of Decanting:

- **In the Lab:** Separating a liquid from sediment in a beaker.
- **In Cooking:** Pouring off fat from broth.
- **In Wine Serving:** Removing sediment from aged wine.
- **In Waste Treatment:** Separating oil from water.

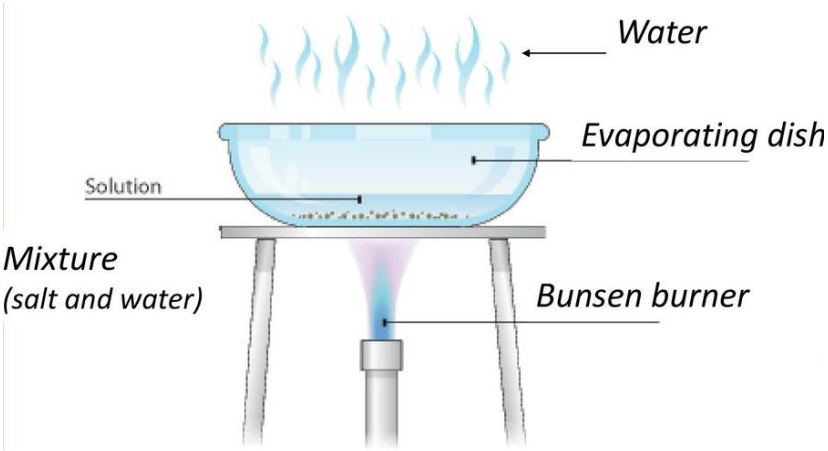
(ii) Filtration

Filtration is a separation technique used to remove solid particles from a liquid or gas by passing the mixture through a filter. It relies on the principle that solids cannot pass through tiny holes in the filter, while liquids or gases can.



(iii) Separation mixtures by evaporation

Evaporation is a method used to separate mixtures by removing the liquid component, leaving behind solids or concentrated solutions. It relies on heat to convert the liquid into vapor while the solid or dissolved substance remains.



Examples of Separation by Evaporation:

- **Salt Production:** Seawater is evaporated to obtain salt crystals.
- **Sugar Concentration:** Evaporation is used in food processing to make syrups.
- **Water Purification:** Removing water from contaminated solutions to extract pure components.
- **Drying Wet Clothes:** Heat and air evaporate water, leaving dry fabric.

Evaporation is a simple and widely used separation technique in industries and everyday life.

Revision questions

1. (a) Why is it a good idea to tie back long hair in the laboratory?
   (b) Explain why a student should not eat in the laboratory?
   (c) Why should you do laboratory work while standing?
   (d)Why is it wise to wear goggles when carrying out experiments?

2. State one use of each of the following laboratory equipment
   (a) Bunsen burner
   (b) Beam balance
   (c) Burette
   (d) Measuring cylinder
3. Explain the importance of safety signs to a chemist
4. (a) What is a Bunsen burner?
   (b) Outline steps taken in lighting and extinguishing a Bunsen burner
   (c) Write differences between Bunsen flames produced when air holes are closed and when open.
5. (a) What is importance of luminous flame in daily life?
   (b) Give sources of luminous flames in our homes.

Thanks

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