CHEMISTRY

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Combustion and Flame

One Shot

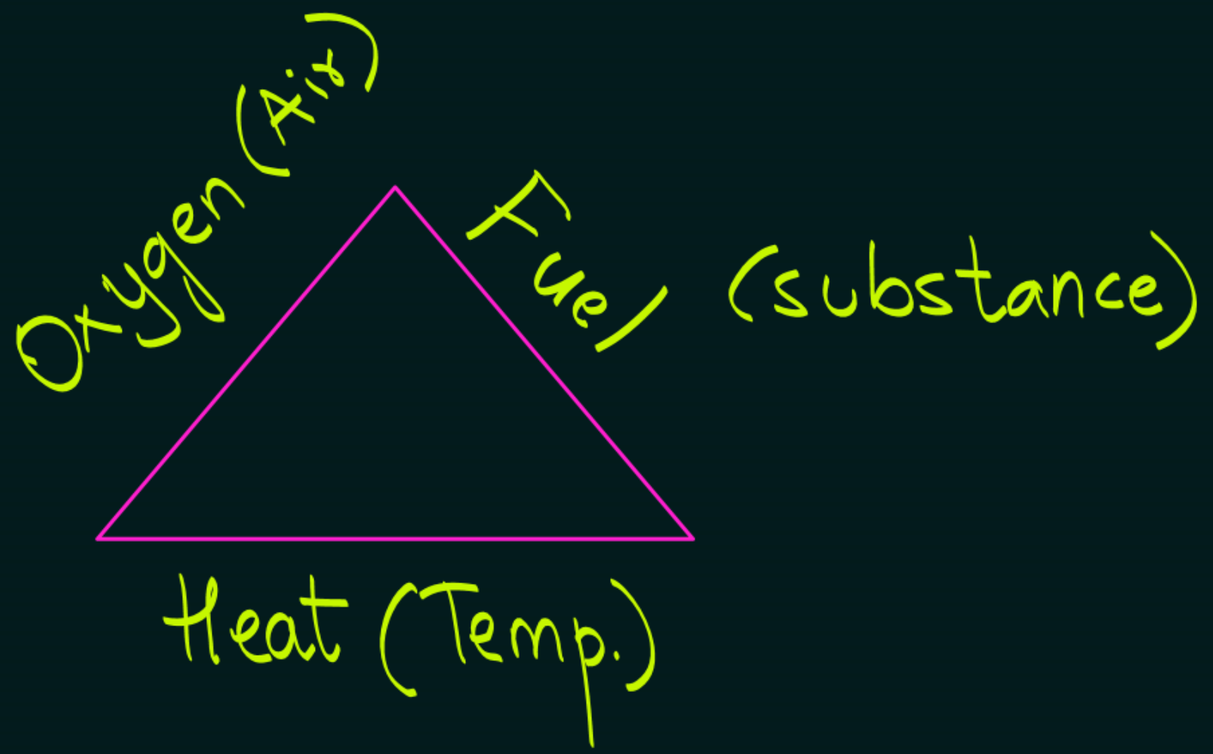
Topics To Be Covered

1. Combustion
2. Zones of Flame
3. Fuel
4. Pollution

Combustion

- A chemical process in which a substance reacts with oxygen to give off heat is called combustion.

Combustion



Combustion

- Complete combustion occurs when a substance burns in an adequate supply of oxygen. The products are carbon dioxide and water. It is also known as clean combustion.
- Incomplete combustion occurs when a substance burns in an insufficient supply of oxygen. The products are carbon monoxide and water.

Ignition Temperature

- The lowest temperature at which a substance catches fire is called its ignition temperature.

Material	Ignition Temperature
White Phosphorus	35 degree Celsius
Petrol	246 degree Celsius
Kerosene	220 degree Celsius
Diesel	210 degree Celsius
Wood	300 degree Celsius
Coal	454 degree Celsius
Piece of paper	233 degree Celsius

Combustible and Non-combustible

- Substances that easily catch fire are combustible substances, such as paper, coal, and wood.
- Substances that do not catch fire readily are non-combustible substances like sand, water, and glass.

Material	Combustible/ Non-combustible
Wood	Combustible
Paper	Combustible
Iron Nails	Non-combustible
Kerosene Oil	Combustible
Stone piece	Non-combustible
Straw	Combustible
Charcoal	Combustible
Match Stick	Combustible
Glass	Non-combustible

Flammable and Inflammable

- The substances with very low ignition temperatures and can easily catch fire with a flame are known as inflammable substances, such as diesel, LPG, and acetone.
- The substances that can be set on fire with an ignition source are known as flammable substances, for example, wood.

Types of Combustion

RAPID

SPONTANEOUS

EXPLOSION

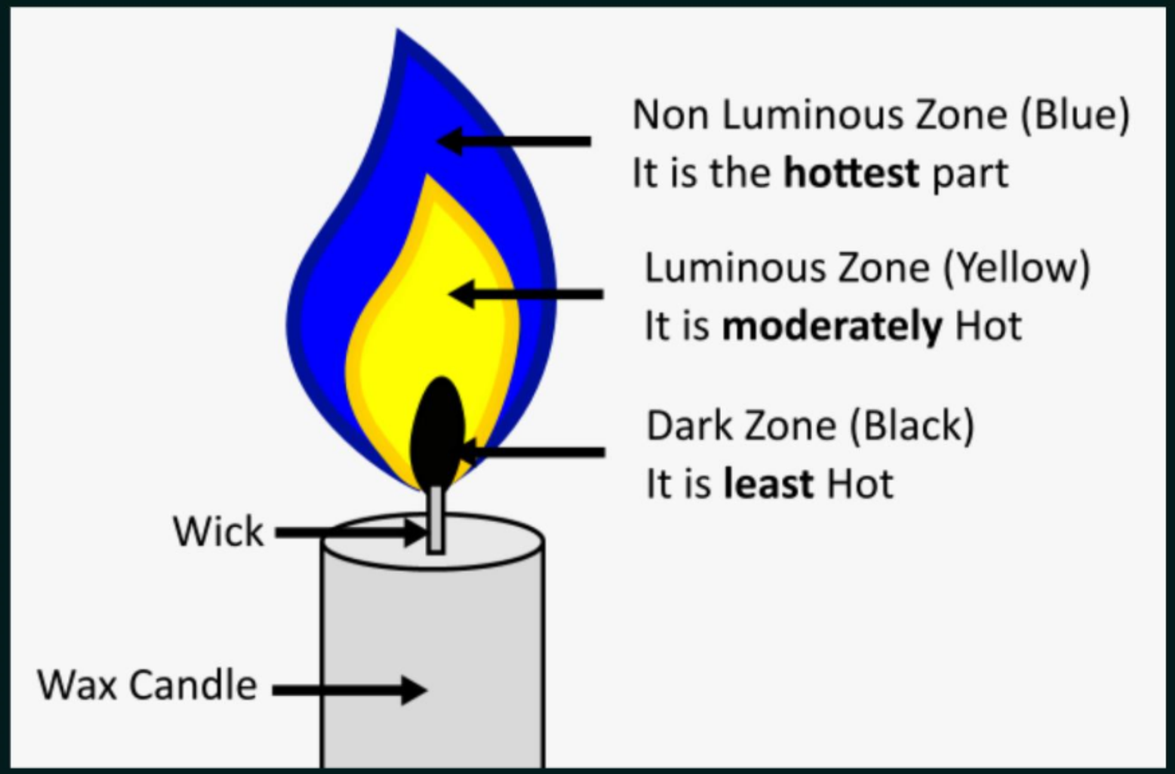
Types of Combustion

- **Rapid Combustion:** A combustion, that takes place rapidly/at high speed, with the production of heat and light is called rapid combustion.

- **Spontaneous Combustion:** A combustion in which a material suddenly bursts into flames, without the application of any apparent cause is called spontaneous combustion.

- **Explosion:** The process of combustion in which a large number of gases are evolved with the production of a tremendous amount of heat, light and sound is called an explosion.

Zones of a Flame



Zones of a Flame

3m (3 zones Candle diagram)

- **Dark Zone:** It contains vapours of fuel and unburnt carbon particles.
- **Luminous Zone:** The middle zone of partial combustion that is yellow in colour and produces light, is called the luminous zone of flame.
- **Non-luminous Zone:** It is the outer zone of flame, that is faintly blue in colour and undergoes complete combustion of the substance.

Fuel

- Fuel is a substance, which may be burnt to produce considerable heat without the formation of undesirable products.
- Calorific Value: The amount of heat energy produced on complete combustion of 1 kg of a fuel is called its calorific value. It is expressed in a unit called kilojoule per kg (kJ/kg).

Define/MCQ

1m

1kg → complete combustion

Heat energy (kJ) ←

Types of Fuel

Fossil fuels

Ideal Fuel

- The fuel, which fulfils all the requirements for a particular use is called an ideal fuel.

- Characteristics of an ideal fuel:
- The ideal fuel is cheap, easily available and readily combustible.
- It has a high calorific value.
- It does not produce harmful gases or residues that pollute the environment.

Pollution

- Unburnt carbon particles ✓
- The incomplete combustion ✓
- Global warming ✓
- Acid rains ✓
- The use of CNG (Compressed Natural Gas)

Pollution

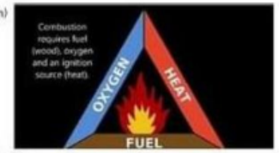
- The burning of fuels like wood, coal and petroleum products releases unburnt carbon particles in the air, which causes respiratory problems.
- The incomplete combustion of fuels produces a very poisonous gas called carbon monoxide.
- The rise in the average temperature of the earth's atmosphere due to the release of carbon dioxide on combustion of fuels is termed global warming.
- Acid rains are caused by emissions of sulphur dioxide and nitrogen oxide, which react with the water molecules in the atmosphere to produce acid.
- The use of diesel and petrol as fuels in automobiles is being replaced by CNG (Compressed Natural Gas) because it is less polluting and cleaner fuel.

Fire Control

- Fire can be controlled by removing any or all of the factors of combustion, i.e. fuel, oxygen (air) and ignition temperature (by lowering the temperature).
- The fire extinguisher is a device used by the fire brigade to control fire as it cuts off the supply of oxygen or brings down the temperature of the fuel, or both.
- Water is commonly used to control the fire.
- Water cannot be used to control fires involving electrical equipment or oils.
- Sand can be used to put out fires in situations like small outdoor fires, electric fires, oil and gas fires, flammable liquid spills, etc.

Combustion and Flame

- **Combustion Process**
  - Chemical reaction with air (oxygen)
  - Produces heat and light

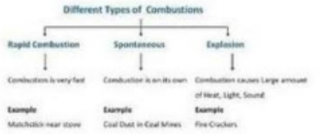


- **Examples of Combustion**
  - Wood or Coal for heating
  - Petrol or Diesel in cars
  - Natural Gas or LPG on stovetops
  - Energy production in thermal power plants
  - Fireworks

Combustible Substances

- **Combustible Substances**
  - Substances that undergo combustion
  - Also known as fuel
  - Can be solid, liquid, or gas
  - Examples: Wood, Charcoal, LPG, Kerosene
- **Non-Combustible Substances**
  - Substances that do not support combustion
  - Examples: Glass, stones
- **Ignition Temperature**
  - Lowest temperature for combustion
  - Different for each substance
  - Phosphorus: 35 °C

- **Conditions for Combustion**
  - Presence of fuel
  - Supply of air (oxygen)
  - Ignition temperature
- **Fire Control**
  - Removing one of the three conditions
  - Use of fire brigade, fire extinguisher
- **Types of Combustion**
  - Rapid Combustion: Needs external heat, continuous fuel supply
  - Spontaneous Combustion: Occurs without external heat, due to self-heating
  - Explosion: Rapid reaction producing gas and heat



- **Flame**
  - Inner Part: Least hot, contains unburnt particles
  - Middle Part: Luminous, limited oxygen supply
  - Outer Part: Hottest, complete combustion
- **Fuel & Fuel Efficiency**
  - Any substance that provides heat when burned
  - Wood, charcoal, petrol & kersene

Zones of Flame

- **Types of Fuel**
  - Solid Fuel: Coal, wood
  - Liquid Fuel: Petrol, diesel
  - Fuel Gas: Methane, propane
  - Bio-fuel: Derived from biomass, e.g., ethanol from sugarcane
  - Fossil Fuel: Non-replenishable, formed from fossilized remains

Homework

Q. Burning of candle is which type of change?

Q. If I put an inverted glass (empty) on a burning candle, what will happen?

Thank You