

LESSON NOTES

Year/Level: 11 C/D

week 25

Subject: Chemistry

Strand	5 Environmental Chemistry
Sub Strand	5.1 Air and Air Pollution
Content Learning Outcome	<ul style="list-style-type: none">✓ Describe the extraction, preparation and uses of some gases✓ Differentiate between Bunsen and candle flame✓ Identify some air pollutants and explain how each pollutant affects the environment✓ State ways of reducing the effects of pollution on the environment

Air

- Air is a mixture of gases
- Most of it – 78% is nitrogen, oxygen, argon, carbondioxide, water vapor

Test for Gases

Oxygen

- Oxygen is detected by lighting a wooden splint and blowing it out.
- Then place it into the gas you think might be oxygen.
- If it is, the splint will burst into flames again.

Carbon dioxide

- You can test a gas to see if it carbon dioxide by using limewater.
- Limewater is a solution of calcium hydroxide in water.
- When carbon dioxide is mixed with it, calcium carbonate (chalk) is formed.
- This is not soluble in water, so it makes the limewater look cloudy (milky).

Water Vapour

- A cold trap is used to detect water vapour in the air.
- A cold trap is a U-tube that is immersed in a container of ice and salt.
- The salt makes the ice melt at a temperature lower than 0°C.
- When air passes through the U-tube it freezes the water vapour in the air and this can be seen.

Obtaining gases from the air

- Air may be changed to liquid by compressing it cooling it and then releasing the pressure. This process is called **liquefaction**
- Nitrogen, oxygen, argon and other gases may be separated from liquid air by **fractional distillation** on the basis of their boiling point
- The gases that are purified from air have many uses

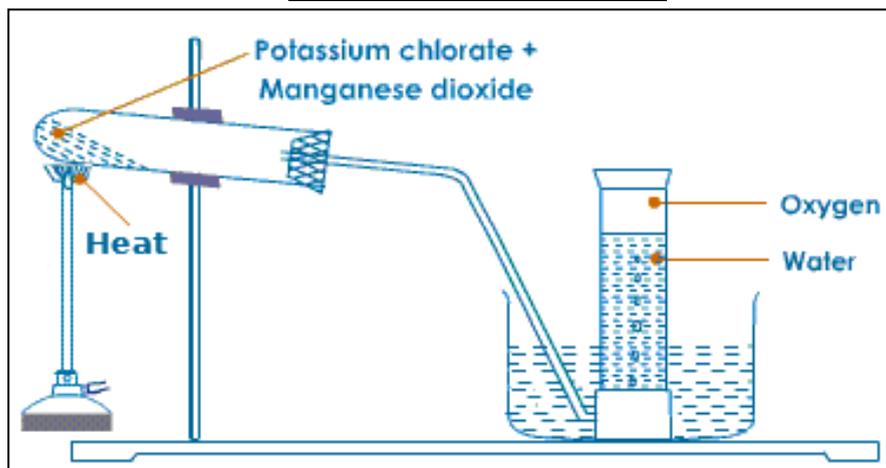
Uses of some gases

Gas	Formula	Use
Helium	He	Filling balloons
Neon	Ne	Filling coloured tube lights
Nitrogen	N ₂	Refrigerant, packing foods
Argon	Ar	Welding and filling light bulbs
Oxygen	O ₂	Steel industry, welding and medicine

Laboratory preparation of Oxygen

- Oxygen can be prepared in the laboratory by heating potassium permanganate.
- Oxygen is colorless, odorless, slightly soluble in water, and it re-lights a glowing splint
- Oxygen is collected over water which prevents it from being mixed with air

Lab Preparation of Oxygen



Safety Features:

1. Glass wool prevents hot KMnO_4 from splattering into the tubing
2. A section of rubber tubing between the test-tube and water is pinched to prevent water from “sucking back” into the hot test-tube

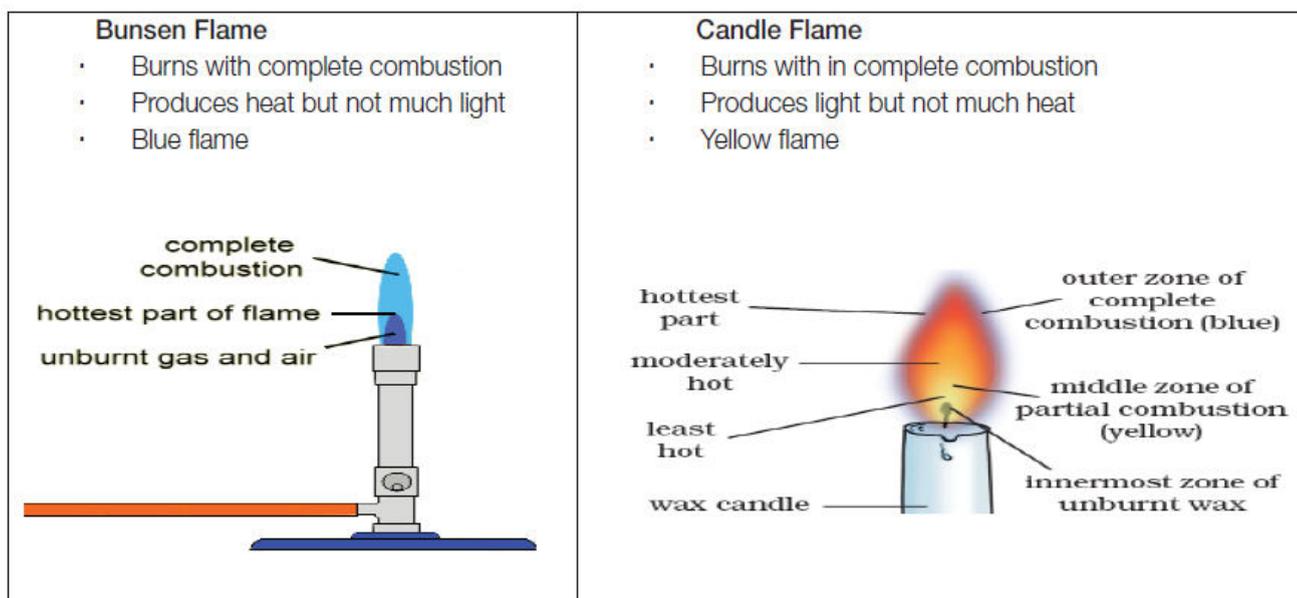
Combustion

- Combustion is the reaction that occurs when a substance burns in air
- When a substance combines fully with oxygen it is called **complete combustion**
- When a substance combines only partially with oxygen, it is called **incomplete combustion**

Combustion of Selected Elements

Substance	Observation	Product	Equation
Magnesium	burns with a bright white flame	A grey powder, magnesium oxide is produced	$2\text{Mg}_{(s)} + \text{O}_{2(g)} \longrightarrow 2\text{MgO}_{(s)}$
Calcium	burns with a bright white flame	A white powder, calcium oxide is produced	$2\text{Ca}_{(s)} + \text{O}_{2(g)} \longrightarrow 2\text{CaO}_{(s)}$
Iron	Glows red and makes sparks	Iron oxide and black powder	$4\text{Fe}_{(s)} + 3\text{O}_{2(g)} \longrightarrow \text{Fe}_2\text{O}_{3(s)}$
Copper	Surface turns black	Copper oxide a black powder	$2\text{Cu}_{(s)} + \text{O}_{2(g)} \longrightarrow 2\text{CuO}_{(s)}$
Sulphur	Blue flame	Sulphur dioxide a noxious gas	$\text{S}_{(s)} + \text{O}_{2(g)} \longrightarrow \text{SO}_{2(g)}$
Carbon	Glows red	Carbondioxide a colourless gas	$\text{C}_{(s)} + \text{O}_{2(g)} \longrightarrow \text{CO}_{2(g)}$
Wood and Paper – burns with a yellow flame. A greyish white powder, ash is produced			

Bunsen and Candle Flame



Air pollution

Effect of Air Pollutants

Pollutant	Symbol	Source	Effects
Sulphur dioxide	SO ₂	Incineration of garbage, motor vehicles, power plants, metal smelters, petroleum refineries	Irritant to the eye and respiratory tract, causes acid rain, retards the formation of chlorophyll in plants
Nitrogen Oxides	NO, NO ₂ , N ₂ O	Motor vehicles, planes	Produces smog, harmful to the respiratory system.
Carbon dioxide	CO ₂	Motor vehicles, industries, deforestation	Contributes to enhanced greenhouse effect
Carbon Monoxide	CO	Motor vehicles, wood fires	Causes dizziness and weakness, stops blood from carrying oxygen
Chlorofluoro –carbons	CFCs	Aerosols, air conditioners, and refrigeration systems, fast – food cartons	Destroys ozone layer
Ozone	O ₃	Secondary pollutant from automobiles	Harms lungs, destroys trees
Dust		Industries, motor vehicles	Irritates eyes and lungs

Other Problems

1. **Ozone Depletion**- the layer of gas that surrounds the earth's atmosphere which prevents the sun-rays from directly reaching the earth is ozone (O₃). Hence, the thinning process where ozone levels decrease by as much as 67% is called ozone depletion.

Causes

- Release of CFC's by humans has caused ozone depletion. The usage of Styrofoam, aerosol spray cans and refrigerators are all sources of CFC

Effect

- **Animals**- causes skin cancer due to high radiation of UV rays which also results in the weakening of the immune system.
- **Plants**- UVB radiation affects the physiological and developmental processes of plants (such as changes in plant form, how nutrients are distributed within the plant, timing of developmental phases and secondary metabolism)

Solutions

Should completely eliminate the use of CFC. Some countries have already banned on the usage of aerosol spray cans with CFC.

2. **Acid Rain**- when sulphur oxide and nitrogen oxide dissolves in atmospheric water they become acidic and when this water condenses and falls on earth is referred to as acid rain

Causes

Main sources of sulphur are coal burning industries and power plants. Also nitrogen fertilizers and combustion of fossil fuels in vehicles produces nitrogen

Effects

- ✓ Has killed many forest in Europe and North America
- ✓ Fish are dying in acidified lakes and streams
- ✓ Crops are suffering damage
- ✓ The metal roofs are corroding away

Solutions

- ✓ Reduce fossil fuel combustion by travelling by government bus rather than using your own vehicle
- ✓ We should use more of renewable energy to produce electricity

Solutions to Reduce Air Pollution

- **Reduce fossil fuel combustion**- we should use more renewable resources such as solar and water.
- **Reduce deforestation and plant trees**- we need trees to make paper and we clear lands for livestock's. Hence we should reduce the usage of paper and consumption of beef.
- **Eliminate the use of CFC's**- minimize the use of Styrofoam's and bring containers from home for take away. We should use CFC free refrigerator and reduce the usage of air conditioners.

ACTIVITY:

1. From the key list given below:

Lead	Nitrogen oxide	Ozone
Sulphur dioxide	Carbon dioxide	Dust

Identify the correct pollutant for each of the problems given below.

- (i) Irritates eyes. _____
- (ii) Produces smog. _____
- (iii) Causes acid rain. _____
- (iv) Causes poisoning in fish. _____

2. Air is a mixture of gases, including oxygen. Liquid oxygen is widely used in medical emergencies for patient care.
- (i) Describe a method for obtaining liquid oxygen from the air.
 - (ii) Give **one** other use of oxygen gas in the industry.
3. Ozone (O₃) is found in two regions of the Earth's atmosphere, at ground level and in the upper regions of the atmosphere.
- (i) Explain the role of ozone in the upper regions of the atmosphere.
 - (ii) State the **name** and **source** of a chemical which can cause ozone depletion.