Mandatory experiment 25.1

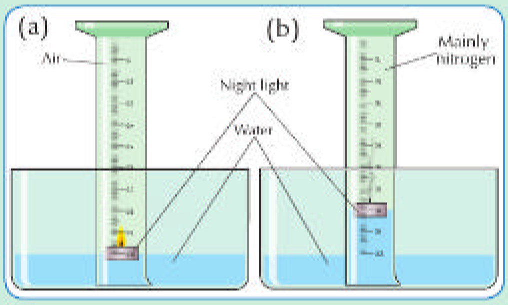
To investigate the percentage of oxygen in the air (using a night light)

Apparatus required: basin; night light; graduated cylinder (100 cm^3); matches

Chemicals required: water

Method

1. Light a night light. Float the night light on the surface of the water in a basin.
2. Place a graduated cylinder over the burning night light, *Fig. 25.2(a)*.



3. Note what happens as the night light burns. The water rises up inside the graduated cylinder. The water is pushed up by the pressure of the atmosphere.
4. Allow the apparatus to cool. Measure the volume of gas left in the graduated cylinder, *Fig. 25.2(b)*.
5. By subtraction, calculate the percentage of oxygen in the air.

Conclusion

Oxygen occupies approximately one fifth of the air.

Mandatory experiment 25.2

To measure the percentage of oxygen in air (using gas syringes)

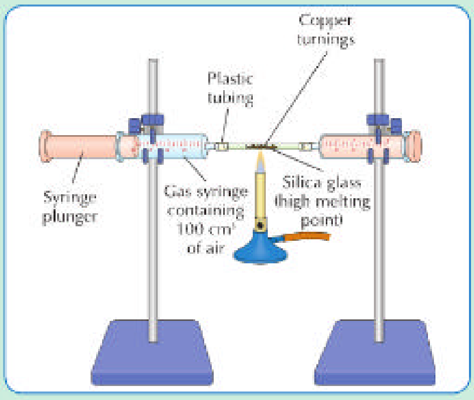


Fig. 25.3 This apparatus is used to find the volume of oxygen in the air. A volume of 100 cm^3 of air is passed over the heated copper a number of times. The copper reacts with the oxygen in the air. This removes the oxygen from the air. From the remaining volume of air left, we can work out the percentage of oxygen in the air.

Apparatus required: two gas syringes; two syringe holders; two retort stands; silica glass tube and connectors; Bunsen burner

Chemicals required: copper turnings

Method

1. Set up the apparatus shown in *Fig. 25.3*.
2. Fill one syringe with 100 cm^3 of air. The other syringe should read 0 cm^3.
3. Gently pass the 100 cm^3 of air from the left-hand syringe over the heated copper into the right-hand syringe. It will be observed that the brown copper begins to turn grey-black. This is because the copper is reacting with the oxygen in the air to form a substance called copper oxide.

copper + oxygen ⟶ copper oxide

Specimen Results

Volume of air in syringe before heating = 100 cm^3

Volume of gas left after first heating and cooling = 85 cm^3

Volume of gas left after second heating and cooling = 79 cm^3

Volume of gas left after third heating and cooling = 79 cm^3

∴ Decrease in volume of air = 21 cm^3

Mandatory experiment 25.3

To show that carbon dioxide is present in air

In this experiment we shall use a special chemical to test for the presence of carbon dioxide. This chemical is called **limewater**. If carbon dioxide is passed through limewater, the limewater turns milky white. (The reason why the limewater turns milky is covered in the next chapter).

Apparatus required: Gas-washing bottle; two-holed rubber stopper; glass tubing; vacuum pump (filter pump)

Chemicals required: limewater

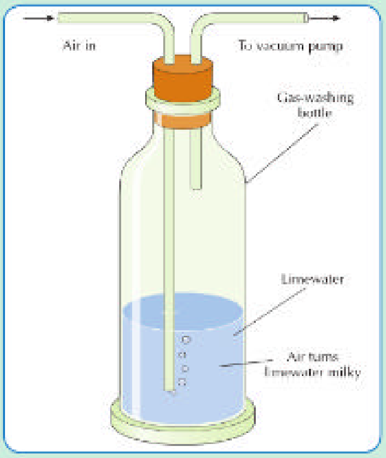


Fig. 25.7 The carbon dioxide in the air turns the limewater milky.

Method

1. Set up the apparatus as shown in *Fig. 25.7*. Take care to connect the vacuum pump to the shorter piece of glass tubing.
2. Turn on the tap to operate the vacuum pump. Allow the air to be drawn through the limewater for about half an hour.

Result

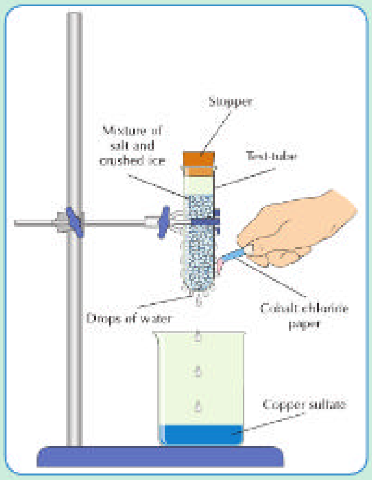
The limewater turns milky.

Mandatory experiment 25.4

To show that water vapour is present in air

Apparatus required: boiling tube; retort stand; rubber stopper; beaker

Chemicals required: salt; ice; anhydrous copper sulphate or cobalt chloride paper



Method

1. Set up the apparatus as shown in *Fig. 25.8*. Make sure that the outside of the tube is perfectly dry before you begin the experiment.
2. Observe that fine droplets of a colourless liquid condense on the outside of the tube. Collect this liquid and test with anhydrous copper sulfate. Anhydrous copper sulfate is a white powder. When water is added to anhydrous copper sulfate it turns blue. Another substance used to test for the presence of water is a chemical called cobalt chloride. Cobalt chloride paper is blue when dry, but turns pink in the presence of water.

Results

The liquid turns the white anhydrous copper sulfate blue.

Also, the liquid turns the blue cobalt chloride paper pink.

Conclusion

The liquid that condensed on the outside of the tube is water. Therefore, water vapour is present in air.

Mandatory experiment 25.5

(a) To prepare a sample of oxygen

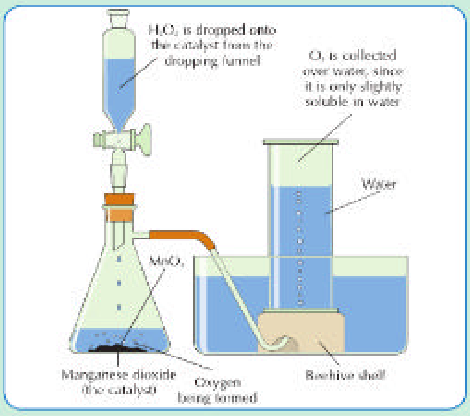
(b) To examine the properties of oxygen

Apparatus required: dropping funnel; Buchner flask; delivery tubing; trough; gas jars; gas jar covers (or test-tubes or boiling tubes and stoppers); beehive shelf; wooden splints; deflagrating spoon

Chemicals required: hydrogen peroxide (dilute – '20 volume'); manganese dioxide; water; red and blue litmus paper; charcoal; limewater; magnesium ribbon

(a) To prepare a sample of oxygen

Method



2. Allow the hydrogen peroxide to fall on the manganese dioxide so that oxygen is produced at a fairly fast rate. Wait for about half a minute before collecting the oxygen to allow for the air in the flask to escape. The oxygen is collected in a gas jar or a test-tube or a boiling tube. These are first filled with water and placed on top of the beehive shelf.
3. Collect five gas jars or boiling tubes or test-tubes of the gas.

(b) To examine the properties of oxygen

Method

1. **Litmus and oxygen.** Note that the gas is colourless and odourless. Place pieces of moist red litmus paper and blue litmus paper into a jar of the gas. Note that there is no change in colour of the paper indicating that oxygen is a neutral gas.
2. **Wooden splint and oxygen.** Light a wooden splint. Observe how it burns. Now place the wooden splint in a gas jar of oxygen. Note how it burns more vigorously. Take out the burning splint and shake it so that it is now just glowing. Place the glowing splint in the oxygen again, *Fig. 25.10*.

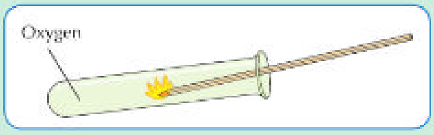


Fig. 25.10 Oxygen relights a glowing splint. This is the characteristic test for oxygen.

The glowing splint is re-kindled and bursts into flames. This is a characteristic test for oxygen. **Oxygen rekindles a glowing splint.** If the experiment is repeated with a candle, a similar observation is made. The candle burns more vigorously in oxygen.

3. **Carbon and oxygen.** Heat a small amount of carbon (charcoal) on a deflagrating spoon. When the charcoal is glowing, place it in a gas jar of oxygen as shown in *Fig. 25.11(a)*.

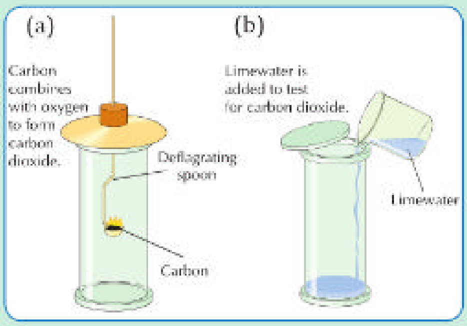


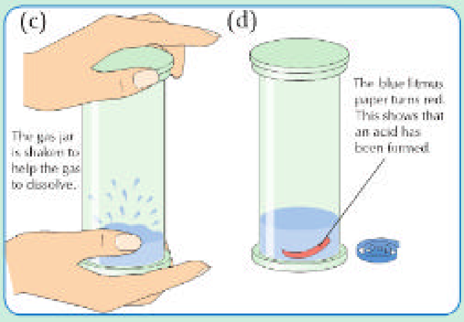
Fig. 25.11(a)(b) Experiment to verify that carbon dioxide is formed when carbon burns in oxygen.

The carbon continues to burn brightly. This is because the following reaction is occurring:

carbon + oxygen ⟶ carbon dioxide

Add limewater to the gas jar. Place a gas jar cover on the gas jar and shake the gas jar. Note that the limewater turns milky. This proves that carbon dioxide has been formed when carbon is burned in the gas jar of oxygen.

4. **Carbon dioxide and water**. Burn another sample of carbon in a fresh gas jar of oxygen. Add some water and some blue litmus paper to the gas jar. (Instead of adding water, you could just add moist blue litmus paper). Replace the gas jar cover and shake the gas jar, *Fig. 25.11(c)*.



Note: The blue litmus paper turns red. This implies that carbon dioxide dissolves in water to form an acidic substance. This acidic substance is called carbonic acid. This is the acid found in fizzy drinks.

carbon dioxide + water ⟶ carbonic acid

5 a. **Magnesium and oxygen**. Using metal tongs, burn some magnesium metal in air. Note that the magnesium burns easily with a bright flame. Do not stare directly at the flame as the light is very intense. You can see why magnesium is used in fireworks! Now investigate what happens when magnesium is burned in a gas jar of oxygen. Wrap a small piece of magnesium around a deflagrating spoon. Ignite the magnesium using the Bunsen burner and quickly place it in a gas jar of oxygen, *Fig. 25.12(a)*. Once again, do not stare directly at the flame as it is very dazzling.

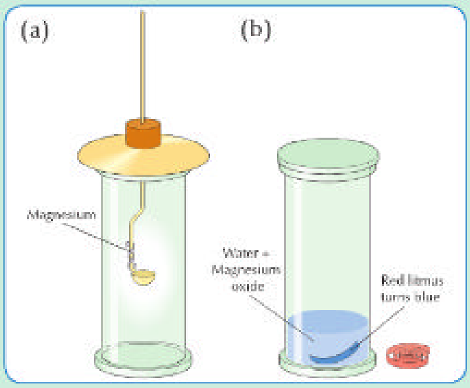


Fig. 25.12 Experiment to verify that a base is formed when magnesium oxide dissolves in water.

Note that the magnesium burns a lot more vigorously in oxygen than it does in air. It burns with a brilliant white flame in oxygen. When the magnesium has stopped burning, note that a white powder has been formed in the gas jar. This white powder is called magnesium oxide.