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Chap 2 Experimental Techniques

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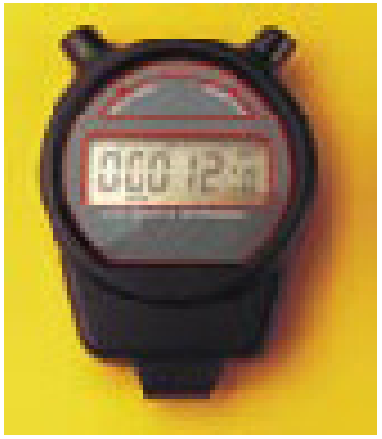
Measuring Time

The SI unit for measuring time is **second** (s).

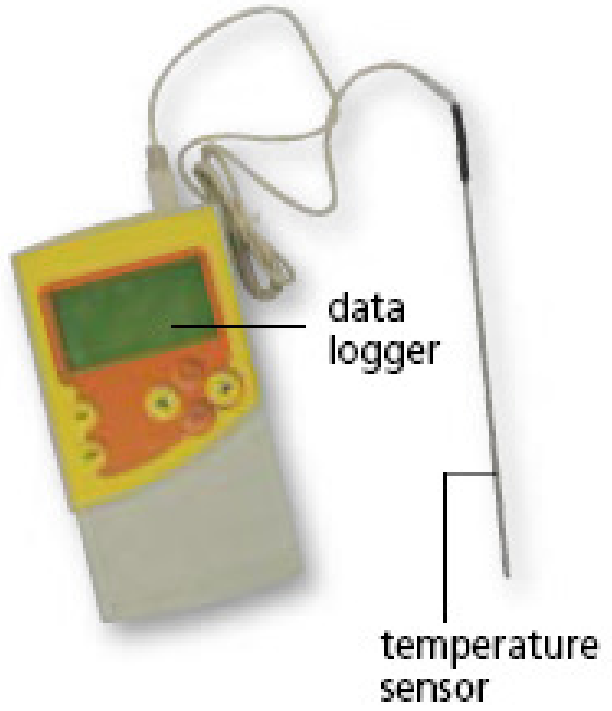
In a laboratory, a stopwatch or a stopclock is used to measure time. Two types of stopwatches are shown here.



Measuring Temperature

The SI unit for measuring temperature is **kelvin** (K). Degree celsius (°C) is often used.
K = C + 273
In a laboratory, a mercury thermometer or a datalogger is used to measure temperature.

A datalogger is useful to record changing temperatures.



Measuring Masses

The S.I. unit for mass is the **kilogram** (kg).

The mass of a substance is measured with a **beam balance** or an **electronic balance**.

Beam balance

Electronic balance

Often, small masses are measured in chemistry experiments. In these cases, an electronic balance, with an accuracy of up to 0.01 g (2 decimal places), is used.

Measuring Volumes

Chemistry experiments often involve measuring volumes.

The SI unit for volume is **m^3**. To measure volumes, a variety of different apparatus is used.

The apparatus chosen depends on the **volume** and **accuracy** needed.

Beaker
- Used to estimate the volume of a liquid, e.g. approximately 100 cm^3.

Fig. 2.4 Apparatus for measuring volume of liquids

Measuring cylinder
- More accurate than a beaker
- Measures up to the nearest cm^3, e.g. 99 cm^3

Fig. 2.4 Apparatus for measuring volume of liquids

Burette

- Accurately measures out **variable** volume of a liquid to the nearest ±0.1 cm^3
- Scale marked (graduated) in 0.1 cm^3 divisions
- Used to deliver different volumes of liquids, e.g. 24.0 cm^3 or 38.9 cm^3.

Fig. 2.4 Apparatus for measuring volume of liquids

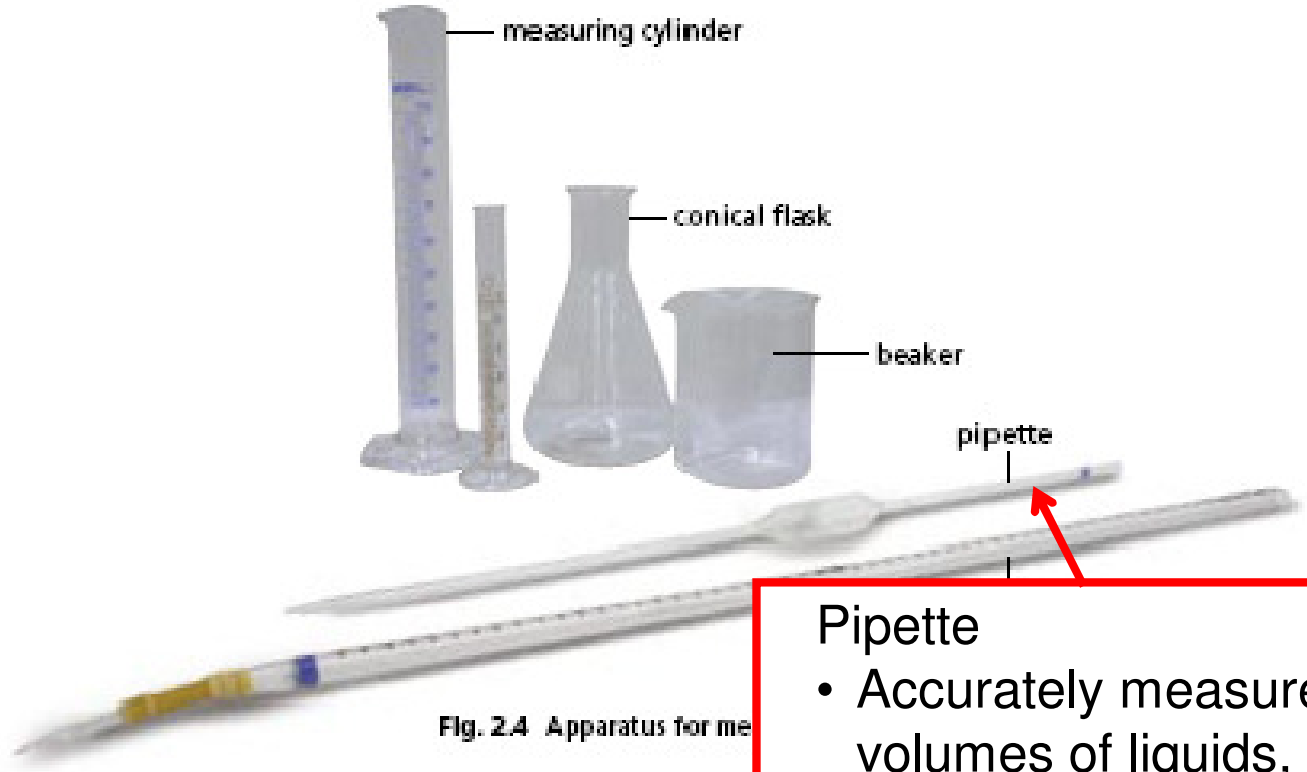


Fig. 2.4 Apparatus for me

Pipette

- Accurately measures out **fixed** volumes of liquids, e.g. 20.0 cm^3 or 25.0 cm^3

Collecting Gases and Measuring Volume of Gases

How we **collect** a gas depends on the physical properties of the gas, namely:

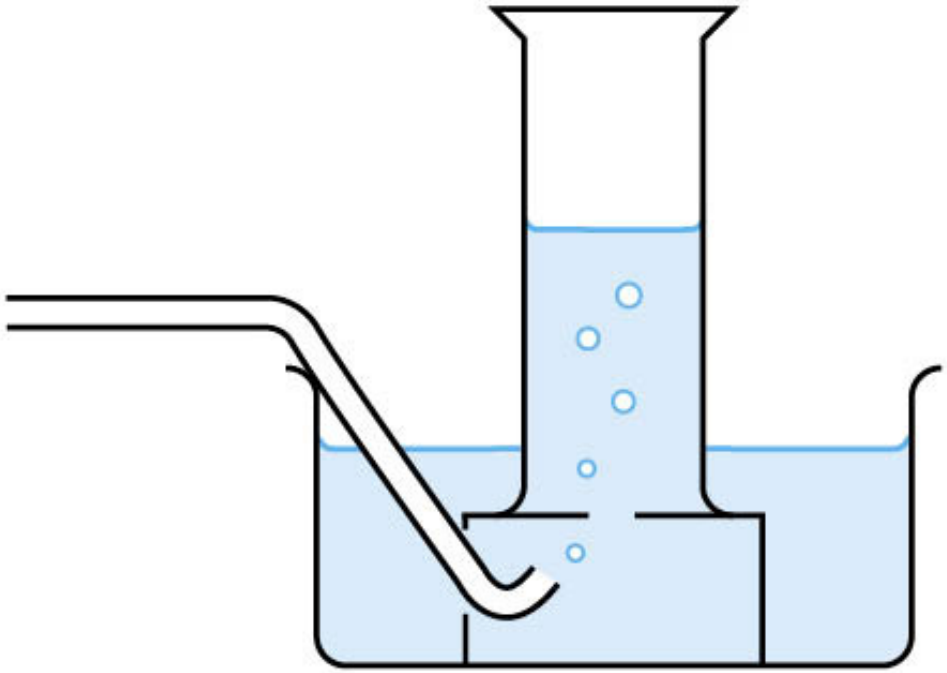
- **solubility** — whether a gas is soluble in water
- **density** — how dense the gas is compared to air

The solubility and density of some common gases

Gas	Solubility in water	Density compared to air
Ammonia	Extremely soluble	Less dense
Carbon dioxide	Slightly soluble	Denser
Chlorine	Soluble	Denser
Hydrogen	Not soluble	Less dense
Hydrogen chloride	Very soluble	Denser
Oxygen	Very slightly soluble	Slightly denser
Sulphur dioxide	Very soluble	Denser

Collecting Gases – Method 1

Displacement of water

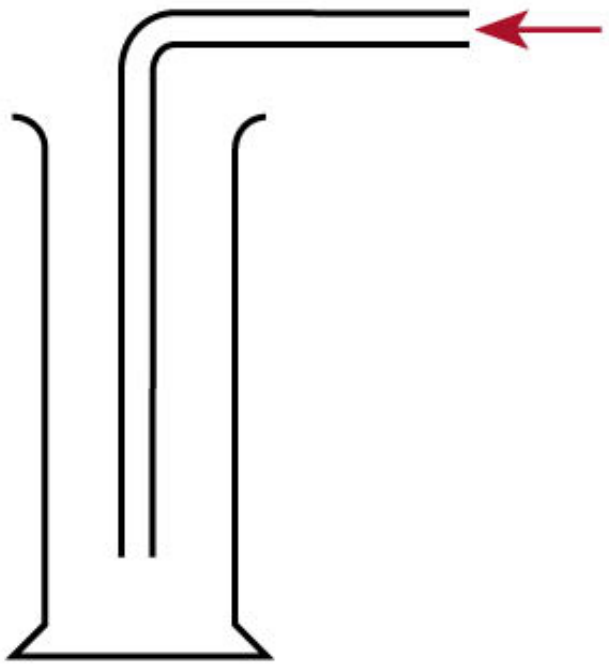


This method is used to collect **insoluble** gases.

Examples of insoluble gases: Hydrogen, oxygen, carbon dioxide.

Collecting Gases – Method 2

Downward delivery

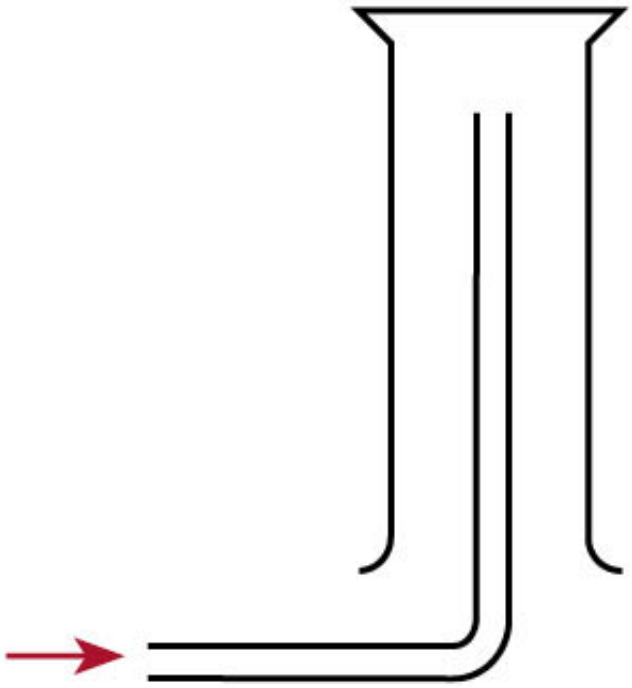


This method is used to collect gases that are **denser** than air (and **soluble** in water).

Examples of such gases:
Chlorine, hydrogen chloride.

Collecting Gases – Method 3

Upward delivery



This method is used to collect gases that are **less dense** than air (and **soluble** in water).

Examples of such gases:
ammonia.

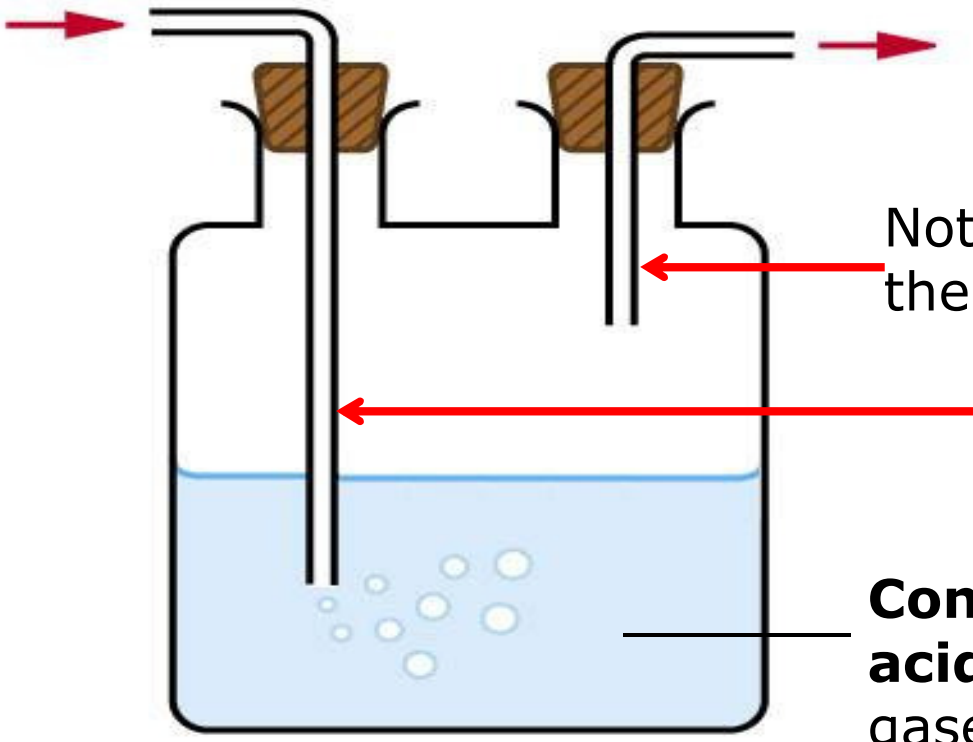
How do we collect a dry sample of a gas?

By passing it through a **drying agent**.

Some commonly used drying agents are

- **concentrated sulphuric acid**,
- **quicklime** (calcium oxide) and
- fused **calcium chloride**.

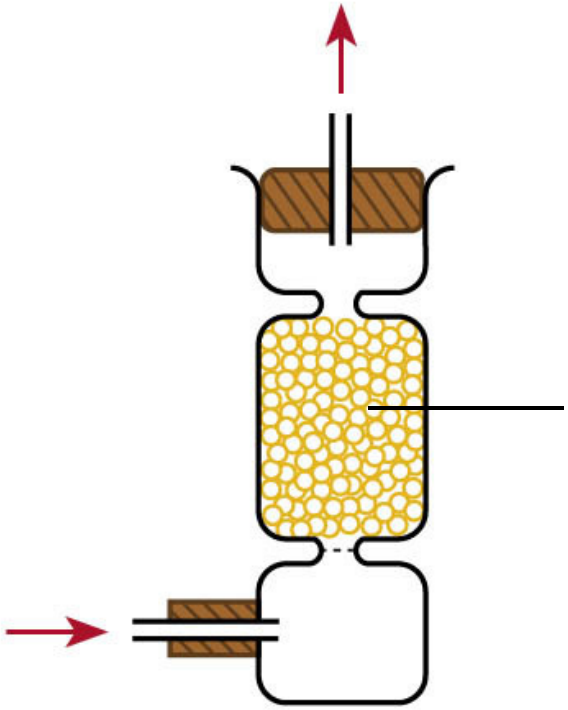
Drying a gas – method 1



Notice the positions of the delivery tubes

Concentrated sulphuric acid is used dry many gases except for **ammonia because it reacts to form ammonium sulphate**

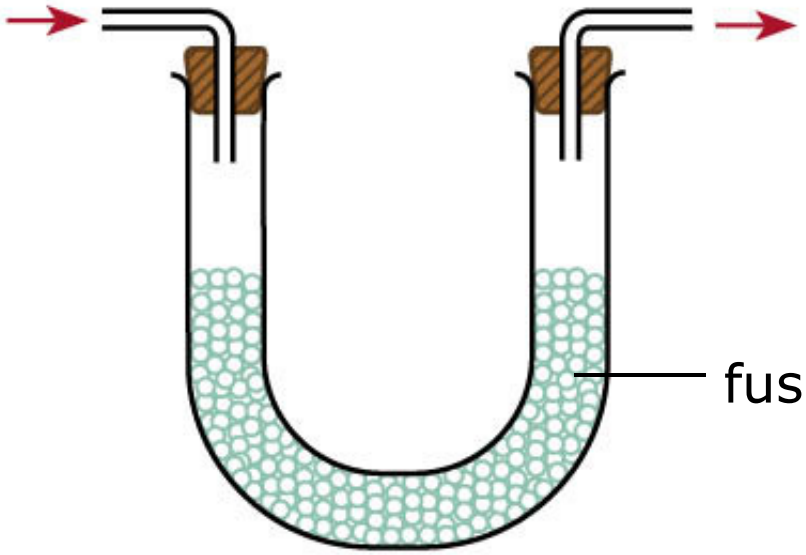
Drying a gas – method 2



We use **quicklime** to dry **ammonia** gas.

quicklime (calcium oxide)
A basic oxide (base)

Drying a gas – method 3



Fused calcium chloride can be used to dry most gases.

How do we measure the volume of a gas?

A **gas syringe** is used to measure the volume of a gas. The gas syringe measures a maximum volume of 100 cm^3.