CHAPTER 1

States of Matter

Experiment 1.1 Brownian motion

Experimental skills

You will practise how to:

- follow a set of instructions
- safely use a microscope
- make careful observations.

Theory:

The kinetic particle model of matter says that particles (atoms, molecules or ions) in solids vibrate, but particles in liquids and gases move about randomly. The moving particles in liquids and gases will collide with the other particles present.

Objective: To see evidence for the kinetic particle model by observing Brownian motion.

Materials:

- microscope
- dropping pipette

and EITHER: Method A:

- illuminated smoke cell
- power supply
- paper straw
- matches
- cover slip

OR: Method B:

- 20 cm^3 water
- cream
- glass rod
- slide
- cover slip

Procedure:

You must not look directly at sunlight reflected by the mirror of a microscope.

1 Set up a microscope.

Method A:

2 Use a match to light one end of the straw, then draw up some smoke with the dropping pipette.

3 Use the pipette to fill the smoke cell with smoke, then use the cover slip to close the opening.

4 Place the smoke cell on the microscope stage as shown in **Fig. 1.1**, attach it to the power supply and turn on the power.

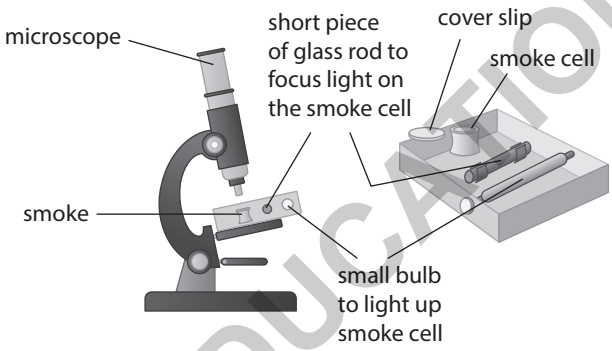


Fig. 1.1

Method B:

2 Use the dropping pipette to add a few drops of cream to the water. Stir with the glass rod.

3 Place some of the mixture on a glass slide and cover with a cover slip.

4 Place the slide on the microscope stage.

Methods A and B:

5 Focus the microscope until you can see small dots of light moving around.

Observations:

1 Describe what you see.

Analysis:

2 State which particles in the mixture appear as dots of light.

3 Explain why the illuminated particles keep changing direction.

4 Explain why the illuminated particles hardly ever bump into each other.

Conclusion:

5 What conclusion can you draw about the movement of particles in a liquid or gas?

Evaluation:

6 Why do the illuminated particles sometimes go out of focus and then disappear?

7 Each particle in your sample will show random motion. However, the illuminated dots may also drift together in one direction. What causes this drift?

8 Brownian motion is named after the Scottish scientist Robert Brown. He sailed from the United Kingdom to Australia in 1801, on an expedition to collect biological specimens. After this trip, he presented a paper to a scientific society in London, describing a family of flowering plants (*Proteaceae*), including some he had found in Australia.

Explain why it is useful and important for scientists to publish their work.

Experiment 1.2 The evaporation of propanone

Experimental skills

You will practise how to:

- follow a set of instructions
- safely use a liquid
- measure temperature
- consider the control of variables
- plot a graph.

Theory:

Propanone is a liquid with a relatively low boiling point. The evaporation of a liquid absorbs energy.

Objective: To measure the temperature change when a liquid evaporates.

Materials:

- thermometer
- cotton wool
- elastic band
- dropping pipette
- 1 cm^3 propanone (flammable, moderate hazard)
- clamp and stand
- stopwatch

Procedure:

Put on safety goggles before you start the experiment.
Keep propanone away from naked flames.

1. Take a piece of cotton wool and an elastic band.
2. Wrap the cotton wool around the bulb of a thermometer and use the elastic band to hold it in place.
3. Clamp the thermometer as shown in the diagram.
4. Take 1 cm^3 propanone in a dropping pipette and drip it onto the cotton wool.
5. Start the stopwatch and take the temperature. Record this value in **Table 1.1**.
6. Measure and record the temperature each minute for six minutes.

Fig. 1.2

Observations:

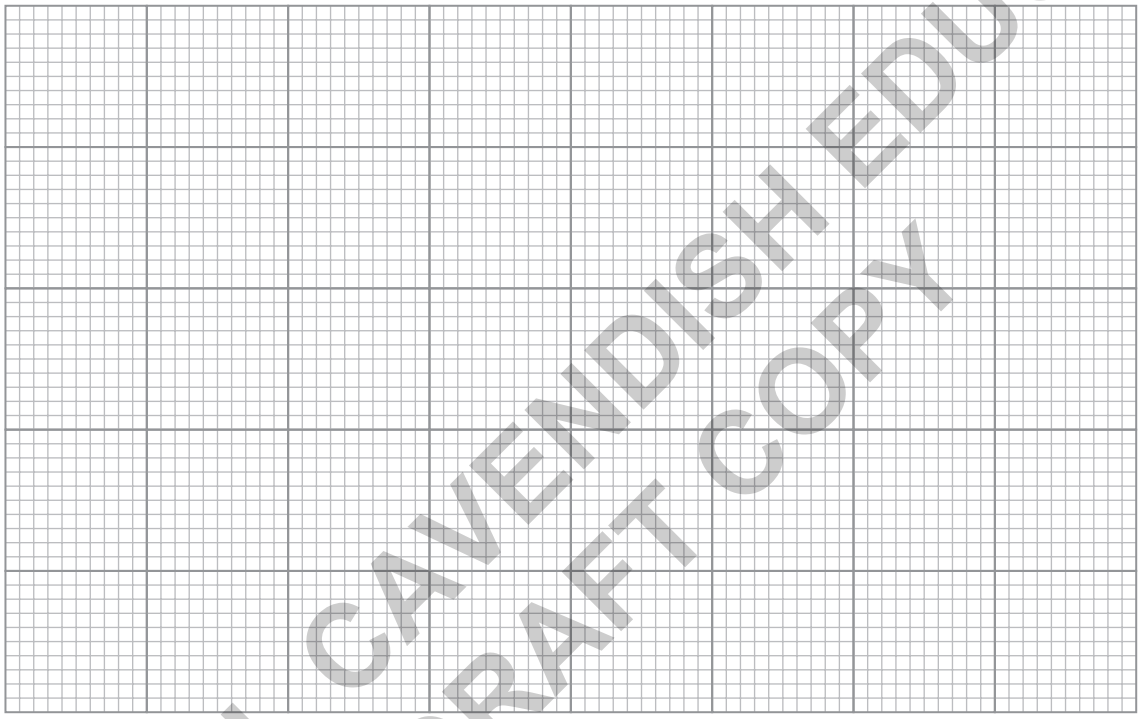
1 Record your results in **Table 1.1**.

Table 1.1

Time / minutes	0	1	2	3	4	5	6
Temperature / °C							

Analysis:

2 Plot a graph of temperature (on the *y*-axis) against time (on the *x*-axis).
Draw a smooth curve of best fit through the plotted points.



3 Estimate from your graph:

(a) the minimum temperature reached _____

(b) the time taken to reach the minimum temperature. _____

Conclusion:

4 Explain why the temperature at first went down.

_____

_____

_____

_____

5 Explain why the temperature started to rise at the end of the experiment.

Evaluation:

6 Propanone is flammable and presents a moderate hazard to health.
State the safety precautions you should take when using propanone.

7 **(a)** Why should scientists repeat experiments?

(b) Explain what you would have to control if you wanted to repeat this experiment.

8 Plan an experiment to test how airflow affects the rate of evaporation of propanone.

This is a planning exercise but if the experiment is carried out, a full risk assessment will be required.