

# Science Bank: Chemistry

## Programme 4: Motion of Particles

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### Activity 1 worksheet: Particles and diffusion

Do particles of different gases move at the same speed? You could investigate this problem by finding the speed at which some familiar smells diffuse.

- Working with a partner, find the time it takes for the smell of an onion to diffuse a measured distance. Calculate the rate of diffusion,  $R_1$ , of the onion smell using the formula,

$$R_1 = \text{distance}/\text{time}$$

- You will need to repeat your measurements and a calculator or spreadsheet will be needed. If you can, find the mean speed of diffusion.
- Repeat this investigation with another strongly smelling substance – you could try a block of air freshener. Find the rate of diffusion,  $R_2$ , of the smell from this second substance in the same way.

1. Is there a measurable difference in the rates at which these smells diffuse?
2. What does this difference in diffusion rates (if any) tell you about the particles in each of these substances? How could the particles be different?

#### Extension

We could compare the mass of a particle of onion vapour with the mass of a particle of air freshener using the formula,

$$M_1/M_2 = (R_2/R_1)^2$$

where  $M_1$  = mass of onion particle and  $M_2$  = mass of air freshener particle.

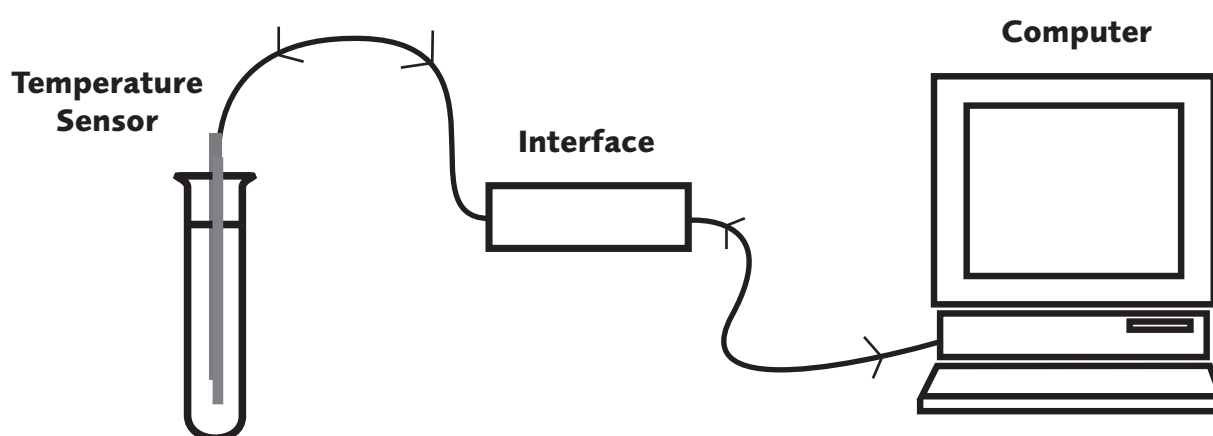
- Use this formula to find out how much heavier or lighter the onion particles are.

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### Activity 2 worksheet: Melting point measurement

Pure substances change from solid to liquid at a fixed temperature called the melting point. To find the melting point of a substance we record its temperature at regular time intervals while it changes state. When these temperature measurements are plotted against time, we get a cooling curve. Having a temperature sensor linked to a computer with data-logging software gives us a quick way of obtaining a cooling curve. The apparatus in the diagram is used to measure the melting point of a waxy solid called stearic acid.



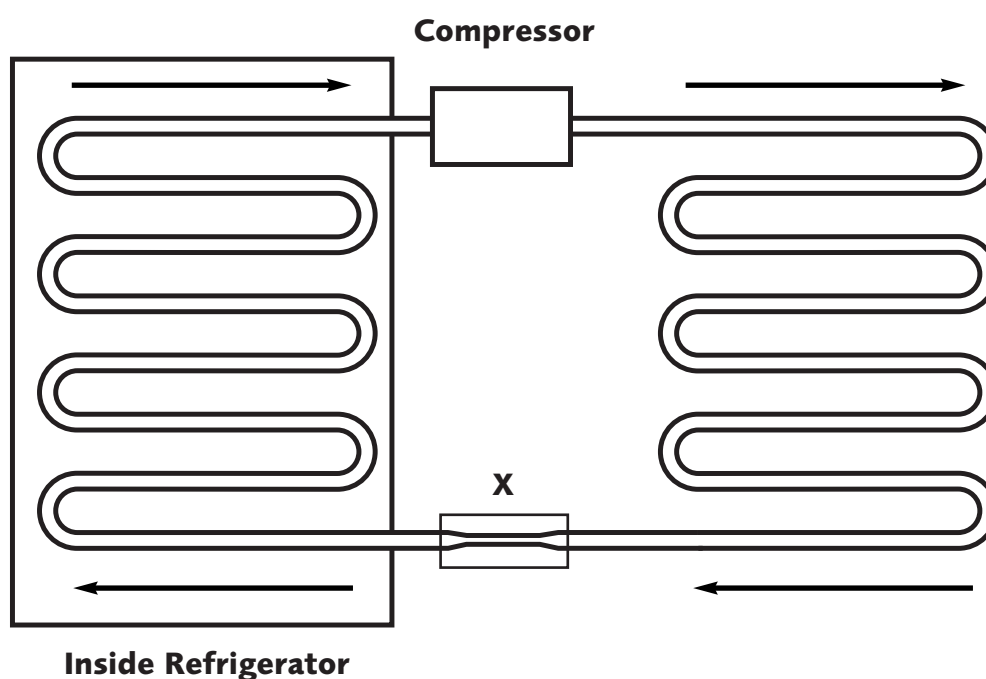
- Clamp a boiling tube half-filled with stearic acid in boiling water and leave the tube in the water until all the waxy solid has melted.
  - Remove the tube from the water and place the sensor in the molten stearic acid. Start recording the temperature at once with the data-logging software.
  - Stop recording when all the stearic acid has solidified and the temperature has fallen several degrees below the melting point.
1. Your data-logging software will have plotted a cooling curve. Use this curve to find the melting point of stearic acid.
  2. Describe the movement and arrangement of the particles in stearic acid at temperatures above and below its melting point.
  3. What happened to the temperature of the stearic acid when it changed from liquid to solid? Try to explain what happened to the stearic acid particles while this happened.
  4. How can you tell from your cooling curve whether the sample of stearic acid is pure?

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### Activity 3 worksheet: Keeping cool

The diagram shows the direction of flow of refrigerant (the cooling substance) in a fridge. The refrigerant has a low boiling point. The coiled pipes carry the refrigerant inside and outside the fridge.



1. Where would you expect the refrigerant to evaporate? Explain why and describe what happens to the particles of refrigerant when this happens.
2. Where would you expect the refrigerant to condense? Again explain why and describe how the refrigerant particles behave when this happens.
3. How do the changes in 1. and 2. help to keep the food inside the fridge cool?
4. Why is the back of the fridge often hot?
5. The fridge has an expansion valve fitted at the point marked X in the diagram. Find out what this valve does and explain, using particle theory, how it works.