P3
PARTICLE MODEL OF MATTER
TEST 3

GCSE
PHYSICS
AQA - COMBINED SCIENCE

Materials
For this paper you must have:
• Ruler
• Pencil, Rubber, Protractor and Compass
• Scientific calculator, which you are expected to use when appropriate

Instructions
• Answer all questions
• Answer questions in the space provided
• All working must be shown
• Do all rough work in this book. Cross out any rough work you don’t want to be marked

Information
• The marks for the questions are shown in brackets
(a) The diagrams show the arrangement of the particles in a solid and in a gas. Each circle represents one particle.

![Solid and Gas Diagrams](image)

(i) Complete the diagram below to show the arrangement of the particles in a liquid.

![Liquid Diagram](image)

(ii) Explain, in terms of the particles, why gases are easy to compress.

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(2)
(b) The diagram below shows the model that a science teacher used to show her students that there is a link between the temperature of a gas and the speed of the gas particles.

The ball-bearings represent the gas particles. Switching the motor on makes the ball-bearings move around in all directions.

![Diagram of a gas model](image)

(i) How is the motion of the ball-bearings similar to the motion of the gas particles?

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(1)

(ii) The faster the motor runs, the faster the ball-bearings move. Increasing the speed of the motor is like increasing the temperature of a gas.

Use the model to predict what happens to the speed of the gas particles when the temperature of a gas is increased.

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(1) (Total 6 marks)
Figure 1 shows solid ice on a car's rear window.

The glass window contains an electrical heating element.
(a) Use the particle model in Figure 2 to describe how the heating element causes the arrangement of the ice particles to change as the ice melts.

Figure 2

![Diagram of solid ice melting into liquid water]

You should include a description of how the particles are arranged in the solid ice and in the water.

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(6)
(b) A car manufacturer tests different heating elements by measuring how long it takes ice to melt.

During the test some variables must be controlled.

Identify two control variables in the car manufacturer’s test.

Tick two boxes.

- The colour of the car
- The current in the heating element
- The mass of ice
- The size of the car
- The time taken for the ice to melt

(c) Some of the energy supplied by the heater causes the ice to melt without the temperature of the ice increasing.

What is the name given to this energy supplied by the heater?

Tick one box.

- Latent heat of freezing
- Latent heat of fusion
- Latent heat of vaporisation
(d) When the heater is supplied with 120 J of energy each second, the internal energy of the ice increases by 45 J each second.

Use the following equation to calculate the efficiency of the heater.

\[
\text{Efficiency} = \frac{\text{Output energy transfer}}{\text{input energy transfer}}
\]

Give your answer to two decimal places.

Efficiency = ____________________

(Total 11 marks)

The diagram shows two thermometers. The bulb of each thermometer is covered with a piece of wet cotton wool. One of the thermometers is placed in the draught from a fan.
The graph shows how the temperature of each thermometer changes with time.

(a) Which of the graph lines, A or B, shows the temperature of the thermometer placed in the draught?

Write the correct answer in the box. [ ]

Explain, in terms of evaporation, the reason for your answer.

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(3)
(b) A wet towel spread out and hung outside on a day without wind dries faster than an identical wet towel left rolled up in a plastic bag.

Explain why.

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(Total 5 marks)

Solid, liquid and gas are three different states of matter.

(a) Describe the difference between the solid and gas states, in terms of the arrangement and movement of their particles.

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(b) What is meant by ‘specific latent heat of vaporisation’?

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(2)
(c) While a kettle boils, 0.018 kg of water changes to steam. Calculate the amount of energy required for this change.

Specific latent heat of vaporisation of water = $2.3 \times 10^6$ J / kg.

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Energy required = __________________ J

(2)

(d) The graph shows how temperature varies with time for a substance as it is heated. The graph is not drawn to scale.

Explain what is happening to the substance in sections AB and BC of the graph.

Section AB
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Section BC
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(4)
(Total 12 marks)
In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.

The information in the box is about the properties of solids and gases.

<table>
<thead>
<tr>
<th>Solids:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• have a fixed shape</td>
</tr>
<tr>
<td>• are difficult to compress (to squash).</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Gases:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• will spread and fill the entire container</td>
</tr>
<tr>
<td>• are easy to compress (to squash).</td>
</tr>
</tbody>
</table>

Use your knowledge of kinetic theory to explain the information given in the box.

You should consider:
• the spacing between the particles
• the movement of individual particles
• the forces between the particles.
According to kinetic theory, all matter is made up of small particles. The particles are constantly moving.

**Diagram 1** shows how the particles may be arranged in a solid.

![Diagram 1](https://via.placeholder.com/150)

(a) One kilogram of a gas has a much larger volume than one kilogram of a solid.

Use kinetic theory to explain why.

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(4)
(b) **Diagram 2** shows the particles in a liquid. The liquid is evaporating.

Diagram 2

(i) How can you tell from **Diagram 2** that the liquid is evaporating?

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(1)

(ii) The temperature of the liquid in the container decreases as the liquid evaporates. Use kinetic theory to explain why.

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(3)

(Total 8 marks)