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, X, Y and Z, show how the particles are arranged in the three states of matter.

(i) Which one of the diagrams, X, Y or Z, shows the arrangement of particles in a liquid? Write the correct answer in the box. 

(ii) Which one of the diagrams, X, Y or Z, shows the arrangement of particles in a gas? Write the correct answer in the box.

(b) Draw a ring around the correct answer in each box to complete each sentence.

(i) In a gas, the particles are moving randomly.
not moving.

(ii) In a solid, the forces between the particles are stronger than equal to weaker than the forces between the particles in a liquid.
(c) The picture shows a puddle of water in a road, after a rain shower.

During the day, the puddle of water dries up and disappears. This happens because the water particles move from the puddle into the air.

What process causes water particles to move from the puddle into the air?

Draw a ring around the correct answer.

- condensation
- evaporation
- radiation

(ii) Describe one change in the weather which would cause the puddle of water to dry up faster.

________________________________________________________________________

________________________________________________________________________

(1)

(Total 6 marks)

2 A student investigated the cooling effect of evaporation. She used the equipment (datalogger and probe) shown in Figure 1 to measure how the temperature of a liquid changed as the liquid evaporated.

Figure 1
(a) Which type of variable was the temperature in this investigation?

Tick (✓) one box.

<table>
<thead>
<tr>
<th>Control</th>
<th>Dependent</th>
<th>Independent</th>
</tr>
</thead>
</table>

Tick (✓)

(b) Before the investigation started, the student checked the accuracy of three different temperature probes. The student put the probes in a beaker of boiling water that had a temperature of 100.0 °C. The readings from the three temperature probes are shown in Figure 2.

Figure 2

<table>
<thead>
<tr>
<th>Probe A</th>
<th>Probe B</th>
<th>Probe C</th>
</tr>
</thead>
<tbody>
<tr>
<td>99.8</td>
<td>100.1</td>
<td>103.2</td>
</tr>
</tbody>
</table>

Which one of the temperature probes, A, B or C, was least accurate?

Write the correct answer in the box.

Give a reason for your answer.

___________________________________________________________________
___________________________________________________________________

(2)
(c) Figure 3 shows how the temperature recorded changed during the investigation.

Figure 3

(i) Use Figure 3 to determine the lowest temperature recorded as the liquid evaporated.

Temperature = ______ °C

(ii) Use Figure 3 to determine how long it took for all the liquid to evaporate. Give a reason for your answer.

Time = ________ seconds

Reason: __________________________________________________
______________________________________________________________

(iii) How would increasing the starting temperature of the liquid above 20 °C affect the rate of evaporation of the liquid?

______________________________________________________________
______________________________________________________________

(Total 7 marks)
Density can be explained using the particle model.

(a) What is the unit of density ($\rho$)?

Tick one box.

- joules, J
- joules per kilogram, J / kg
- kilograms, kg
- kilograms per metre cubed, kg / m$^3$

(b) The figure below shows particles of the same substance in three states of matter.

Use the figure above to explain why the solid has the highest density.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

(1)

(2)
(c) Complete the sentences.

Use answers from the box.

<table>
<thead>
<tr>
<th>downwards</th>
<th>kinetic</th>
<th>nuclear</th>
<th>potential</th>
<th>randomly</th>
<th>slowly</th>
</tr>
</thead>
</table>

The particles in a gas are constantly moving.

The particles move _____________________________________________

When the temperature of the particles in a gas is increased

the particles have more _______________________________________ energy.

(2)

(d) A gas is put into a closed container.

The container and the gas inside it are heated.

What will happen to the pressure inside the container?

___________________________________________________________________

(1)

(Total 6 marks)

Figure 1 shows a model of the particles in a liquid.

(a) Give one similarity and one difference you would see in Figure 1 if it showed the same substance as a gas.

Similarity _______________________________________________________

___________________________________________________________________

Difference _______________________________________________________

___________________________________________________________________

(2)
(b) Describe two limitations of the model shown in Figure 1.

1. _________________________________________________________________
   __________________________________________________________________

2. _________________________________________________________________
   __________________________________________________________________

(c) Explain why substances have different melting points.
   __________________________________________________________________
   __________________________________________________________________
   __________________________________________________________________
   __________________________________________________________________

(d) Some fire extinguishers contain liquid carbon dioxide.

Suggest how carbon dioxide gas can be changed to liquid carbon dioxide without reducing its temperature.

   __________________________________________________________________
   __________________________________________________________________

Ice was heated at a constant rate.

Eventually all the ice changed to a gas.

**Figure 2** shows how the temperature changed over 800 seconds.
(e) What change of state occurs between 200 seconds and 750 seconds?

___________________________________________________________________
___________________________________________________________________

(1)

(f) Explain how Figure 2 shows that the specific latent heat of vaporisation is greater than the specific latent heat of fusion.

Use data from Figure 2.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

(2)

(g) 1695 kJ of energy is transferred to water at 100 °C

The specific latent heat of vaporisation of water is $2.260 \times 10^6$ J/kg

Calculate the mass of water changed into a gas at 100 °C

Use the Physics Equations Sheet.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

Mass of water = ____________________ kg

(3)

(Total 13 marks)
A student investigated the cooling effect of evaporation. She used the equipment in Figure 1 to measure how the temperature of three different liquids changed as the liquids evaporated.

**Figure 1**

![Datalogger and Temperature Probe](image)

(a) The temperature and volume of each liquid was the same at the start of the investigation. State one further control variable in this investigation.

___________________________________________________________________
___________________________________________________________________

(1)

(b) Give two advantages of using dataloggers and temperature probes compared to using the thermometer shown in Figure 2.

**Figure 2**

![Magnified Thermometer View](image)

1. _________________________________________________________________
___________________________________________________________________
2. _________________________________________________________________
___________________________________________________________________

(2)
(c) The student's results are shown in **Figure 3**.

**Figure 3**

(i) Calculate the average rate of temperature decrease of liquid C between 0 and 100 seconds.

______________________________________________________________
______________________________________________________________

Average rate of temperature decrease = __________ °C / s

(2)

(ii) Give one conclusion that can be made about the rate of temperature decrease of all three liquids from the results in **Figure 3**.

______________________________________________________________
______________________________________________________________

(1)

(iii) Which liquid had the lowest rate of evaporation? Give a reason for your answer.

Liquid ______________________________________________________
Reason ______________________________________________________

______________________________________________________________

(1)
(iv) A second student did the same investigation but using a smaller volume of liquid than the first student.

All other variables were kept the same.

What effect would this have on the results of the second student’s investigation?

___________________________________________________________________

___________________________________________________________________

(1)

(d) Explain how the evaporation of a liquid causes the temperature of the remaining liquid to decrease.

___________________________________________________________________

___________________________________________________________________

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___________________________________________________________________

___________________________________________________________________

(3)

(Total 11 marks)

6

The particle model can be used to explain the properties of gases.

(a) Describe the direction of motion of the particles in a gas.

___________________________________________________________________

___________________________________________________________________

(1)
(b) Explain why heating a gas increases the average speed of the gas particles.

___________________________________________________________________
___________________________________________________________________
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___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

(c) Water can exist as either a liquid or a gas at 100 °C.

Explain why a mass of gaseous water at 100 °C contains more energy than an equal mass of liquid water at 100 °C.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

(2)
(d) Water vapour is a gas. Gases change state when they cool.

The figure below shows condensation on a cold bathroom mirror.

![Condensation on a cold bathroom mirror](image)

© Dwight Eschliman/Getty Images

A volume of $2.5 \times 10^{-5}$ m$^3$ of condensation forms on the mirror.

Density of water = 1000 kg / m$^3$

Specific latent heat of vaporisation of water = $2.26 \times 10^6$ J / kg.

Calculate the energy released when the condensation forms.

___________________________________________________________________

___________________________________________________________________

___________________________________________________________________

___________________________________________________________________

___________________________________________________________________

___________________________________________________________________

Energy released = _______________________ J

(5)
Central heating boilers burn gas and use the energy released to heat water.

Modern condensing central heating boilers take advantage of the energy that is released when water condenses.

Waste water vapour produced when the water is heated in the boiler is used to preheat the cold water entering the boiler.

Give some of the arguments in favour of condensing boilers compared to older non-condensing boilers.

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___________________________________________________________________
___________________________________________________________________

(4)
(Total 15 marks)