

Changes of State & Particle Model

Question Paper

Level	GCSE (9-1)
Subject	Combined Science: Trilogy - Physics
Exam Board	AQA
Topic	6.3 Particle Model of Matter
Sub-Topic	Changes of State & Particle Model
Difficulty Level	Gold Level
Booklet	Question Paper

Time Allowed: 43 minutes

Score: /41

Percentage: /100

Grade Boundaries:

Q1. The particle model can be used to explain the properties of gases.

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

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(1)

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

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(3)

- (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.

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(2)

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

The figure below shows condensation on a cold bathroom mirror.



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

Density of water = 1000 kg / m^3

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

Calculate the energy released when the condensation forms.

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Energy released = J

(5)

- (e) 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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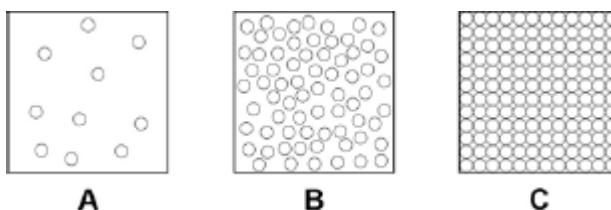
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(Total 15 marks)

Q2. The figure below shows a simple model of the three states of matter.



- (a) What is the correct equation to work out the density of a material?

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(1)

- (b) A student explains density to his teacher using the particle model in the figure above.

His teacher says there are limitations to the model.

Give **two** limitations of the particle model in the figure above.

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(2)

- (c) When the gas in a container with a fixed volume is heated, the pressure increases as the temperature increases.

Explain why the pressure increases.

Use the model in the figure above to help you.

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(4)

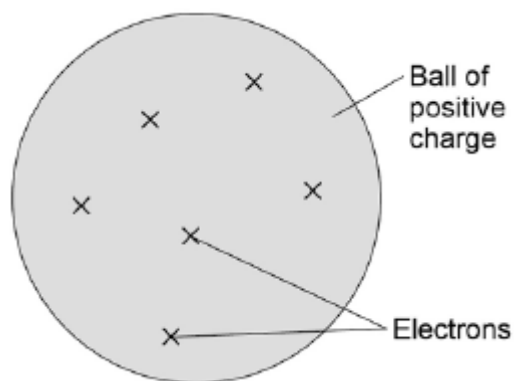
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Q3.Figure 1 shows the plum pudding model of the atom.

This model was used by some scientists after the discovery of electrons in 1897.

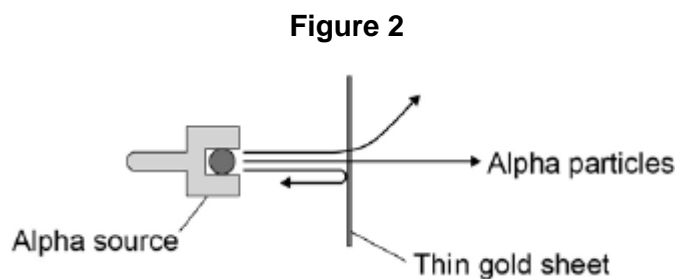
Figure 1

Plum-pudding model



In 1911 the scientists Geiger and Marsden investigated the effect of firing alpha particles at very thin sheets of gold foil.

Their experiment is shown in **Figure 2**. The arrows show the paths taken by alpha particles in the experiment.



- (a) Explain why scientists replaced the plum pudding model of the atom with the nuclear model of the atom as a result of the experiment.

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- (b) According to modern measurements:

- the radius of an atom is about $1 \times 10^{-10}\text{m}$

- the radius of an atomic nucleus is about $1 \times 10^{-14}\text{m}$

Show that these values fit with the nuclear model of the atom.

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(2)

- (c) In 1931 a scientist discovered that there are hydrogen atoms with mass number 2 as well as hydrogen atoms with mass number 1.

A year later, another scientist discovered neutrons.

Explain why the discovery of neutrons could explain the presence of hydrogen atoms with different mass numbers.

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- (d) How would the results of the experiment shown in **Figure 2** change if neutrons were used instead of alpha particles to bombard a thin sheet of gold?

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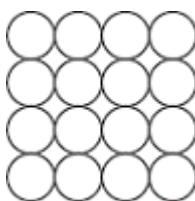
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(Total 11 marks)

Q4. 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



- (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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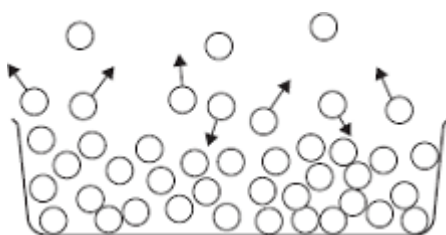
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(4)

- (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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- (ii) The temperature of the liquid in the container decreases as the liquid evaporates.

Use kinetic theory to explain why.

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(Total 8 marks)