

# Changes of State & Particle Model

## Mark Scheme

<b>Level</b>	GCSE (9-1)
<b>Subject</b>	Combined Science: Trilogy - Physics
<b>Exam Board</b>	AQA
<b>Topic</b>	6.3 Particle Model of Matter
<b>Sub-Topic</b>	Changes of State & Particle Model
<b>Difficulty Level</b>	Gold Level
<b>Booklet</b>	Mark Scheme

**Time Allowed:** 43 minutes

**Score:** /41

**Percentage:** /100

**Grade Boundaries:**

**M1.(a)** random

*accept in all directions*

1

*description must be of random motion*

(b) heating increases the temperature of the gas

1

temperature is proportional to kinetic energy

1

if kinetic energy increases speed increases

1

(c) energy is needed to change the state of the water

1

to break the bonds

1

(d)  $1000 = m / 2.5 \times 10^{-5}$

1

$m = 2.5 \times 10^{-5} \times 1000$

1

$m = 0.025 \text{ (kg)}$

1

$E = 0.025 \times 2\,260\,000$

1

$$E = 56\,500 \text{ (J)}$$

1

*allow 56 500 (J) without working shown for 5 marks*

*0 marks awarded for  $E = m \times L$*

(e) any **four** from:

- because the water is preheated) the change in temperature of the water is less
- so less energy is used to heat the water ( $E=mc\Delta\theta$ )
- therefore they (condensing boilers) are more efficient
- so less energy is wasted
- less gas is burned to heat the same amount of water
- less waste gas ( $\text{CO}_2$ ) is produced by the boiler **or** (because less gas is used) they are cheaper to run / save money

4

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**M2.(a)** density = mass / volume

1

(b) any **two** from:

- no forces shown between spheres
- atoms / molecules / ions are not solid spheres
- not all the same size.

2

(c) at higher temperatures particles have more kinetic energy

1

(so) the (average) speed of the particles increases

1

(so there are) more frequent collisions with the wall of the container

1

which apply a greater force on wall of container (so pressure rises)

1

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**M3.(a)** most alpha particles went straight through, suggesting lots of empty space

1

a few alpha particles bounced back, suggesting small central nucleus

1

with all the positive charge

1

the plum pudding model does not explain the results because it shows the whole atom as a ball of positive charge with no empty space

1

(b) the figures show that the radius of an atom is 10 000 times bigger than the nucleus

1

consistent with the nuclear model, which says that the atom has a tiny nucleus at the centre of the atom

1

(c) all hydrogen atoms have just one proton (in the nucleus)

1

some hydrogen atoms also have one neutron

1

protons and neutrons have the same relative mass so mass number of these atoms is 2

1

(d) neutrons are not attracted or repelled by a positive nucleus

1

so the neutrons would all pass through the foil

1

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**M4.(a)** there are strong forces (of attraction) between the particles in a solid  
*accept molecules / atoms for particles throughout*  
*accept bonds for forces*

1

(holding) the particles close together  
*particles in a solid are less spread out is insufficient*

1

**or**

(holding) the particles in a fixed pattern / positions

but in a gas the forces between the particles are negligible  
*accept very small / zero for negligible*  
*accept bonds for forces*

1

so the particles spread out (to fill their container)  
*accept particles are not close together*  
*gas particles are not in a fixed position is insufficient*

1

- (b) (i) particles are (shown) leaving (the liquid / container)  
*accept molecules / atoms for particles throughout*  
*accept particles are escaping particles are getting further apart is insufficient*

1

- (ii) *accept molecules / atoms for particles throughout*  
*accept speed / velocity for energy throughout*

particles with most energy leave the (surface of the) liquid  
*accept fastest particles leave the liquid*

1

so the mean / average energy of the remaining particles goes down

1

and the lower the average energy (of the particles) the lower the temperature (of the liquid)

1

[8]