

AQA GCSE PHYSICS (HIGHER) • 8463

# PHYSICS



EXAM QUESTION PACK

4.3.3 PARTICLE MODEL AND PRESSURE (PACK 2)

SCORE

/31

PERCENTAGE

%

STEMUP

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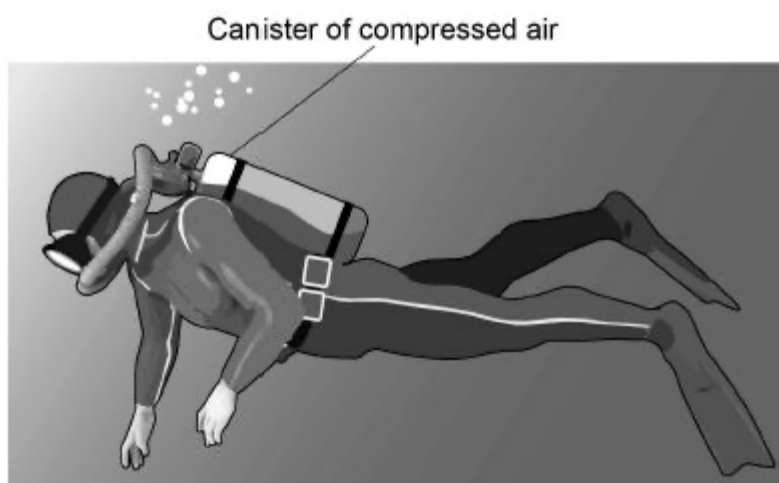
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**Q1.**

**Figure 1** shows a diver.

**Figure 1**



- (a) Which two sentences describe the movement of the air particles in the canister?

Tick **two** boxes.

They vibrate about a fixed position.

☐

They move in random directions.

☐

The motion of all the particles is predictable.

☐

They move with a range of different speeds.

☐

They move in circular paths.

☐

**(2)**

- (b) The temperature of the air inside the canister increases.

What happens to the movement of the air particles?

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**(1)**

- (c) It could be dangerous if the temperature of the air inside the canister increased by a large amount.

Explain why.

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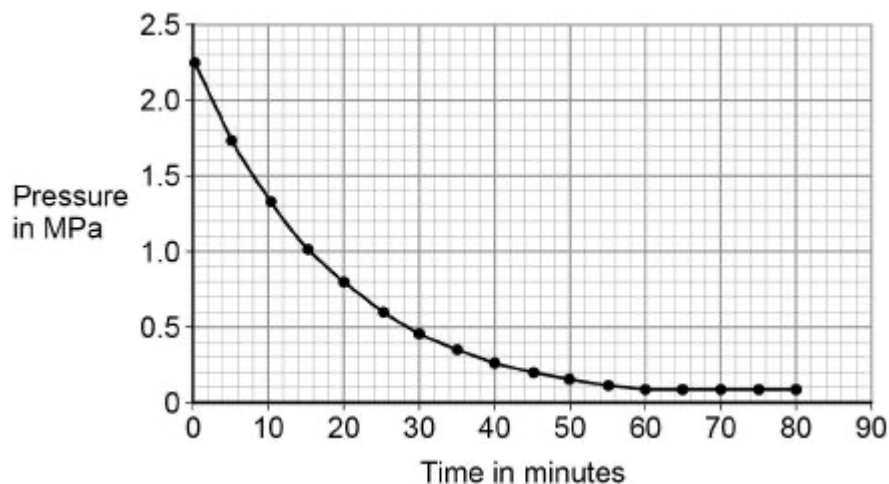
(2)

A canister of air was tested to find out how the pressure changed when it was used by a diver.

- Air was allowed to escape from the canister.
- The pressure of the air in the canister was recorded every 5 minutes for 80 minutes.

**Figure 2** shows the results.

**Figure 2**



- (d) Estimate the atmospheric pressure.

Use **Figure 2**

Atmospheric pressure = \_\_\_\_\_ MPa

(1)

- (e) Divers can safely stay underwater until the pressure of the air in the canister has reduced to 25% of its original value.

Determine the maximum time the diver can safely stay underwater.

Use **Figure 2**

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Time = \_\_\_\_\_ minutes

(3)

- (f) What happens to the volume of the air when it is released from the canister?

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(1)

**Q2.**

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.



© Dwight Eschliman/Getty Images

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

Density of water =  $1000 \text{ kg / m}^3$

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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(4)  
(Total 15 marks)

**Q3.**

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

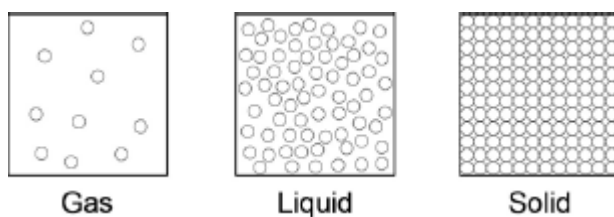
☐

kilograms per metre cubed,  
kg / m<sup>3</sup>

☐

(1)

- (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.

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(2)

- (c) Complete the sentences.

Use answers from the box.

|                  |                |                |                  |                 |               |
|------------------|----------------|----------------|------------------|-----------------|---------------|
| <b>downwards</b> | <b>kinetic</b> | <b>nuclear</b> | <b>potential</b> | <b>randomly</b> | <b>slowly</b> |
|------------------|----------------|----------------|------------------|-----------------|---------------|

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)

## Mark schemes

### Q1.

- (a) they move in random directions 1
- they move with a range of different speeds 1
- (b) the (mean) speed of the particles would increase  
*allow kinetic energy increases* 1
- (c) (if the temperature increases) the pressure increases  
*allow an explanation in terms of large pressure difference* 1
- so it could explode 1
- (d)  $p = 0.1$  (MPa) 1
- (e)  $p = 2.25 \times \left( \frac{25}{100} \right)$   
*allow any correct method of determining 25% of 2.25*  
*allow use of 2.2–2.3* 1
- $p = 0.56$   
*allow 0.55–0.575* 1
- $t = 27$  (minutes)  
*allow 26–28 minutes*  
*allow correct value of  $t$  using their calculated value of  $p$*  1
- an answer of 27 scores 3 marks*
- (f) (the volume of the air) increases 1
- [10]**

### Q2.

- (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 |
| <i>allow 56 500 (J) without working shown for 5 marks</i><br><i>0 marks awarded for <math>E = m \times L</math></i>                                                                                                                                                                                                                                                                                                                                                                                                                                  |   |
| (e) any <b>four</b> from:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |   |
| <ul style="list-style-type: none"> <li>• because the water is preheated) the change in temperature of the water is less</li> <li>• so less energy is used to heat the water (<math>E=mc\Delta\theta</math>)</li> <li>• therefore they (condensing boilers) are more efficient</li> <li>• so less energy is wasted</li> <li>• less gas is burned to heat the same amount of water</li> <li>• less waste gas (<math>\text{CO}_2</math>) is produced by the boiler <b>or</b> (because less gas is used) they are cheaper to run / save money</li> </ul> | 4 |

[15]

### Q3.

|                                                                                            |   |
|--------------------------------------------------------------------------------------------|---|
| (a) kilograms per metre cubed, $\text{kg} / \text{m}^3$                                    | 1 |
| (b) (solid has) more particles<br><i>allow atoms for particles</i>                         | 1 |
| in the same volume <b>or</b> in a given volume<br><i>allow description of a given area</i> | 1 |
| (c) randomly                                                                               |   |

*this order only*

1

kinetic

1

(d) (pressure) rises

1

[6]

## Examiner reports

### Q1.

- (a) Over 90% of students scored at least 1 mark and 73 % scored 2 marks.
- (b) 69% of students answered correctly. Many students who weren't awarded the mark probably intended to say that the speed increased, but simply offered 'increased' as their response, which is ambiguous. Many incorrect responses referred to increased vibration or faster vibration in the air.
- (c) A little over 70% of students recognised that the canister was in danger of exploding/bursting. 33% went on to say that the increase in pressure was the cause. Of the students that failed to score any marks, most just made simple statements such as 'the diver will not be able to breathe'.
- (d) Only 31% of students deduced that the pressure would stop dropping when the pressure inside the can was the same as the atmospheric pressure.
- (e) 32% of students scored all three marks on the question. 27% were able to calculate the final pressure but then read the value from the graph incorrectly.

A number of students incorrectly calculated 75% of the initial pressure and then read the value off the graph correctly as  $t = 6$ , and scored one mark.