AQA GCSE Physics | 8463

SPECIFICATION POINT 4.3.3.1

Particle motion in gases

Past-paper questions

Tier	**Foundation**
Question groups	**5**
Available paper years	**2020–2025**

Using this booklet

1. Answer the questions in order and show your working.
2. Original question numbers and marks are retained.
3. Print at actual size (100%) for measuring questions.
4. Use the companion answer booklet to check your work.

Name: _____ **Date:** _____

Whole questions are retained for context, so some parts assess other specification points. Current and legacy sources are labelled. Continue on extra paper if needed.

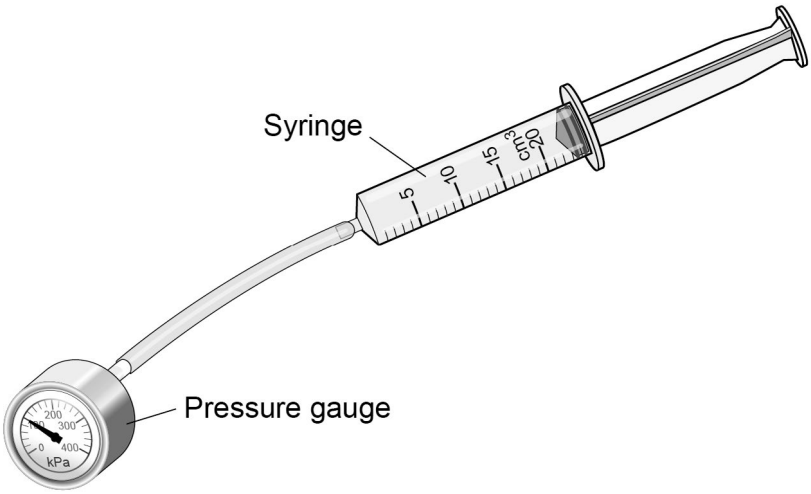
4.3.3.1 Particle motion in gases

Question 01

November 2020 | 8463/1F | Original Q6

0 6 A student used the equipment in **Figure 9** to investigate how the pressure of a gas varies with the volume of the gas.

Figure 9



The syringe is filled with air.

Table 2 shows the results.

Table 2

Volume in cm^3	Pressure in kPa
24	100
20	120
12	200
10	240

4.3.3.1 Particle motion in gases

Question 01 · continued

0 6 . 1 Describe how the student could use the equipment in **Figure 9** to obtain the data shown in **Table 2**.

[4 marks]

0 6 . 2 Describe what happens to the pressure of the air when the volume of the air is halved.

[2 marks]

Question 6 continues on the next page

4.3.3.1 Particle motion in gases

Question 01 · continued

0 6 . 3 The temperature of the air in the syringe remained constant during the student's investigation.

Which **two** properties of the air particles would change if the temperature increased?

[2 marks]

Tick (✓) **two** boxes.

- kinetic energy ☐
- mass ☐
- shape ☐
- speed ☐
- volume ☐

8

4.3.3.1 Particle motion in gases

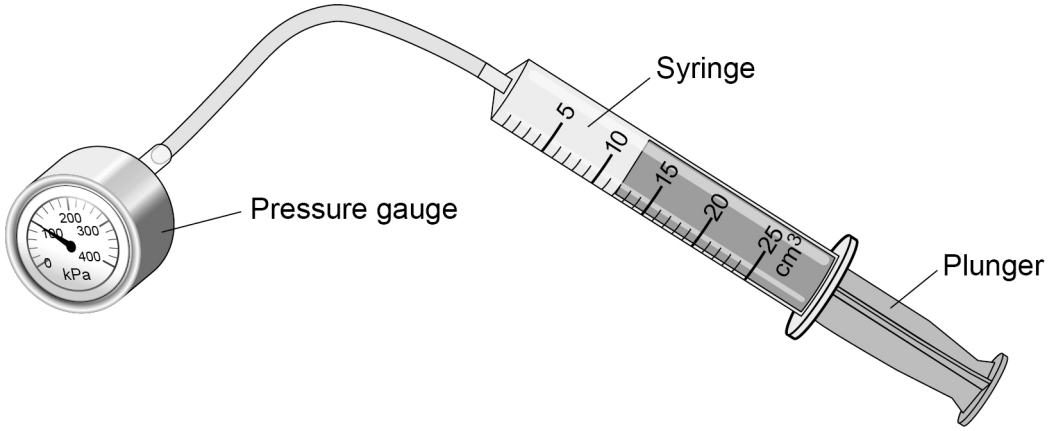
Question 02

November 2021 | 8463/1F | Original Q8

0 8 A teacher demonstrated the relationship between the pressure in a gas and the volume of the gas.

Figure 12 shows the equipment used.

Figure 12



0 8 . 1 What is the range of the syringe?

[1 mark]

Tick (✓) **one** box.

From 0 to 1 cm^3 ☐

From 0 to 5 cm^3 ☐

From 0 to 25 cm^3 ☐

0 8 . 2 The relationship between the pressure and volume of a gas is given by the equation:

pressure × volume = constant

Complete the sentence.

[1 mark]

For this equation to apply, both the mass of gas and the _____

of the gas must stay the same.

4.3.3.1 Particle motion in gases

Question 02 · continued

0 8 . 3 The initial volume of the gas in the syringe was 12 cm^3.

The initial pressure of the gas in the syringe was 101 000 Pa.

Calculate the constant in the equation below.

pressure × volume = constant

[2 marks]

Constant = _____ Pa cm^3

0 8 . 4 The teacher pulled the plunger slowly outwards and the gas expanded.

The new volume of the gas was 24 cm^3.

Calculate the new pressure in the gas.

The constant has the same value as in Question **08.3**

[3 marks]

New pressure = _____ Pa

Question 8 continues on the next page

4.3.3.1 Particle motion in gases

Question 02 · continued

0 8 . 5 Which change occurs when the plunger is pulled slowly outwards?

[1 mark]

Tick (✓) **one** box.

- The gas particles stop moving. ☐
- There are more frequent collisions between the gas particles. ☐
- There is more space between the gas particles. ☐

8

4.3.3.1 Particle motion in gases

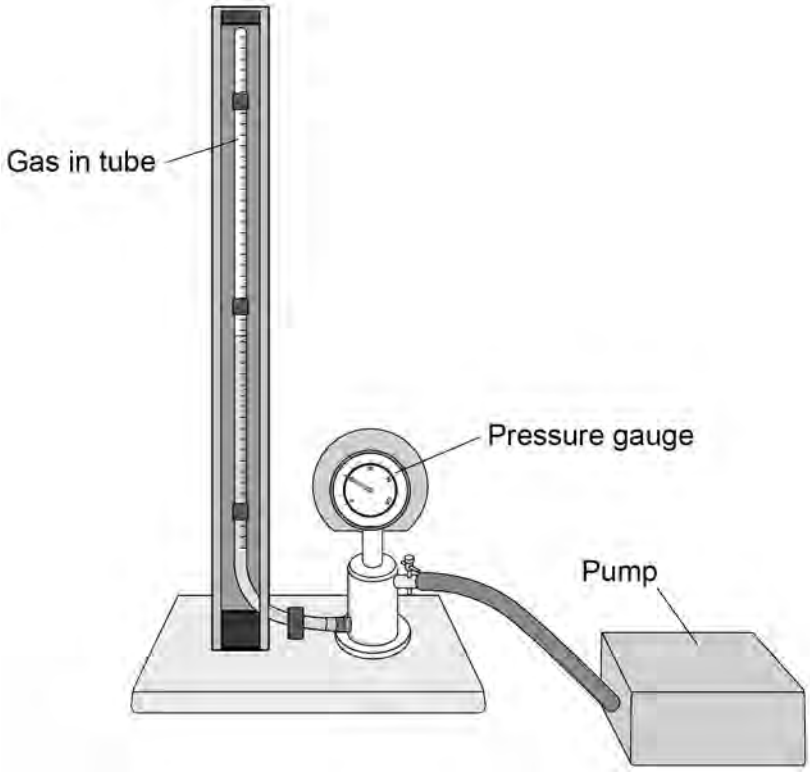
Question 03

June 2023 | 8463/1F | Original Q7

0 7 A teacher demonstrated the relationship between the pressure and the volume of a fixed mass of gas at a constant temperature.

Figure 9 shows the equipment used.

Figure 9



0 7 . 1 Complete the sentence.

Choose the answer from the box.

[1 mark]

circular paths	**random directions**	**the same direction**

Particles in a gas move in _____.

4.3.3.1 Particle motion in gases

Question 03 · continued

0 7 . 2 Complete the sentence.

Choose the answer from the box.

[1 mark]

a constant speed	**a constant velocity**	**a range of speeds**

Particles in a gas move with _____.

Question 7 continues on the next page

Question 03 · continued

0 7 . 3 **Table 6** shows some of the results.

Table 6

Pressure in kPa	Volume in cm^3
300	10
200	15
150	20
120	25
100	30

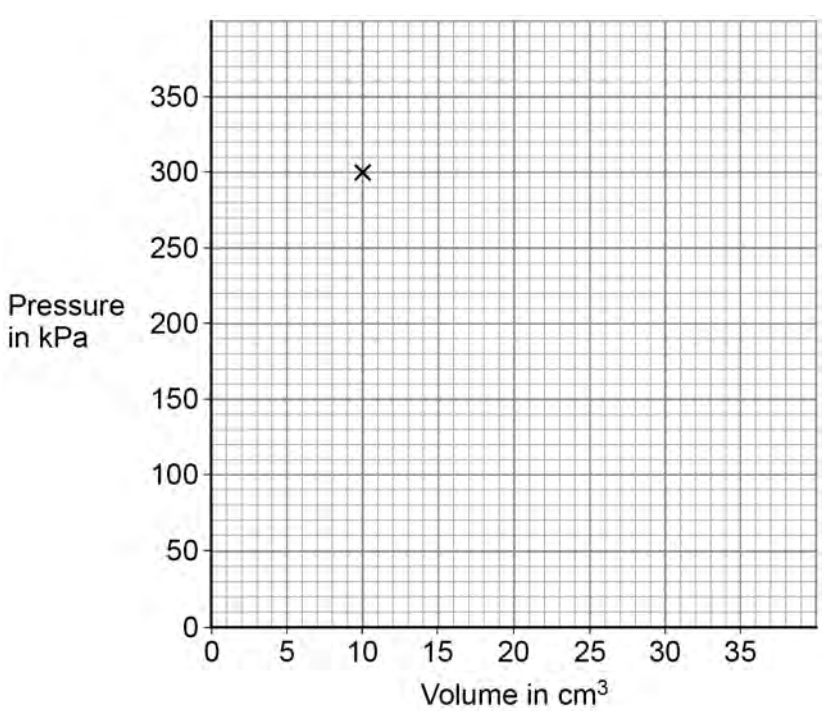
Complete **Figure 10**. The first point has been plotted for you.

You should:

- plot the points from **Table 6**
- draw the line of best fit.

[3 marks]

Figure 10



Question 03 · continued

0 7 . 4 The relationship between the pressure and the volume of a gas is given by the equation:

pressure × volume = constant

Calculate the constant when the pressure of the gas was 300 kPa.

Use **Table 6**.

[2 marks]

Constant = _____ kPa cm^3

0 7 . 5 When the volume of the gas increases, the pressure in the gas decreases.

The temperature of the gas stays the same.

How does increasing the volume affect each of the following quantities?

[3 marks]

Tick (✓) **one** box in **each** row.

Quantity	Decreases	Stays the same	Increases
Mean time between collisions of the particles with the tube			
Mean distance between the particles			
Mean speed of the particles			

10

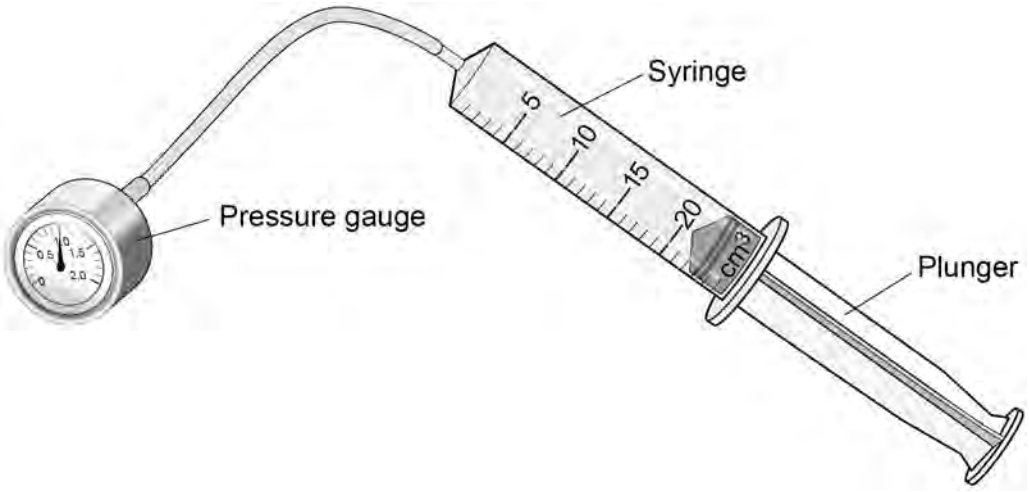
4.3.3.1 Particle motion in gases

Question 04

0 5 A student investigated how the pressure in a fixed mass of air varies with the volume of the air.

Figure 10 shows the equipment used.

Figure 10



When the plunger was pushed slowly into the syringe, the temperature of the air stayed the same.

0 5 . 1 How did pushing the plunger in affect the volume of air in the syringe?

[1 mark]

Tick (✓) **one** box.

The volume decreased. ☐

The volume stayed the same. ☐

The volume increased. ☐

4.3.3.1 Particle motion in gases

Question 04 · continued

0 5 . 2 How did pushing the plunger in affect the distance between the air particles in the syringe?

[1 mark]

Tick (✓) **one** box.

- The distance decreased. ☐
- The distance stayed the same. ☐
- The distance increased. ☐

0 5 . 3 How did pushing the plunger in affect the frequency of collisions between the air particles and the syringe walls?

[1 mark]

Tick (✓) **one** box.

- The frequency of collisions decreased. ☐
- The frequency of collisions stayed the same. ☐
- The frequency of collisions increased. ☐

0 5 . 4 How did pushing the plunger in affect the air pressure in the syringe?

[1 mark]

Tick (✓) **one** box.

- The air pressure decreased. ☐
- The air pressure stayed the same. ☐
- The air pressure increased. ☐

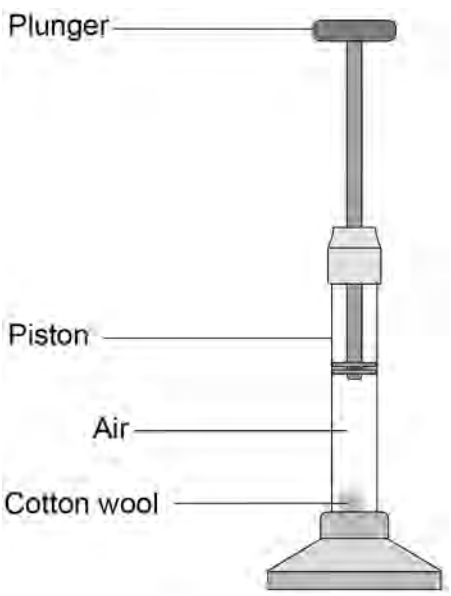
4.3.3.1 Particle motion in gases

Question 04 · continued

A fire piston is a special type of syringe that can be used to start fires.

Figure 11 shows a fire piston.

Figure 11



The plunger is pushed quickly downwards and compresses the air.

When the air is compressed quickly, the temperature of the air increases.

0 5 . 5 How does an increase in temperature affect the mean speed of the air particles inside the syringe?

[1 mark]

Tick (✓) **one** box.

The mean speed of the particles decreases. ☐

The mean speed of the particles does not change. ☐

The mean speed of the particles increases. ☐

4.3.3.1 Particle motion in gases

Question 04 · continued

0 5 . 6 When the air is hot enough, a small piece of cotton wool in the piston catches fire.

The energy transferred to the air in the piston is 0.0130 J.

The mass of air in the piston is 2.60×10^{-8} kg.

specific heat capacity of air = 1010 J/kg °C

Calculate the temperature change of the air.

Use the Physics Equations Sheet.

[3 marks]

Temperature change = _____ °C

8

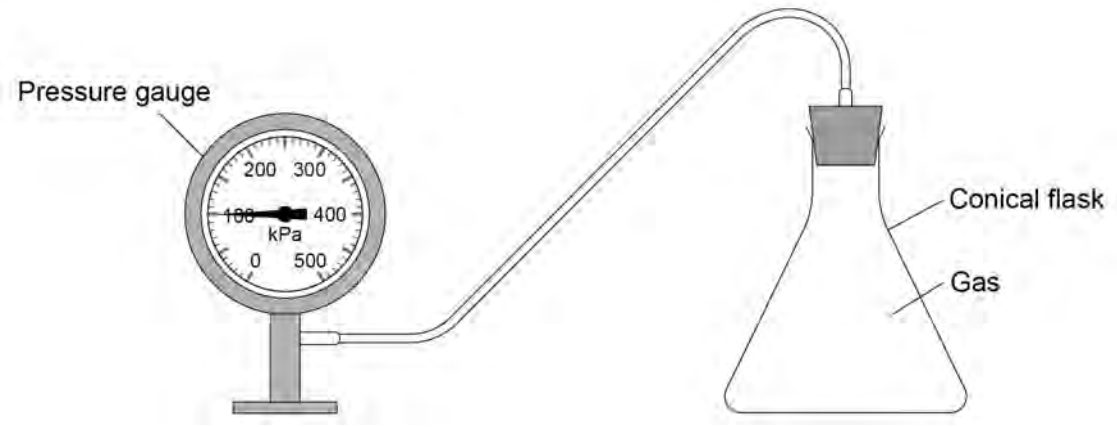
4.3.3.1 Particle motion in gases

Question 05

0 4 A teacher demonstrated how the pressure in a gas varies with temperature.

Figure 7 shows some of the apparatus used.

Figure 7



The teacher heated the conical flask.

The temperature of the gas in the flask increased.

0 4 . 1 How did heating the gas affect the average speed of the gas particles?

[1 mark]

Tick (✓) **one** box.

The speed decreased. ☐

The speed stayed the same. ☐

The speed increased. ☐

4.3.3.1 Particle motion in gases

Question 05 · continued

0 4 . 2 How did heating the gas affect the average kinetic energy of the gas particles?

[1 mark]

Tick (✓) **one** box.

The kinetic energy decreased. ☐

The kinetic energy stayed the same. ☐

The kinetic energy increased. ☐

As the temperature of the gas increased, the pressure of the gas inside the flask increased.

0 4 . 3 How did increasing the pressure affect the number of collisions each second between gas particles and the walls of the flask?

[1 mark]

Tick (✓) **one** box.

The number of collisions each second decreased. ☐

The number of collisions each second stayed the same. ☐

The number of collisions each second increased. ☐

Question 4 continues on the next page

Question 05 · continued

0 4 . 4 What happened to the force exerted on the walls of the flask by the gas particles when the pressure increased?

[1 mark]

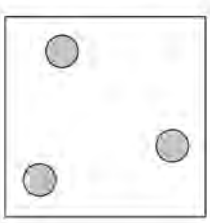
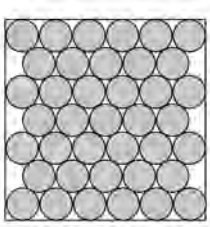
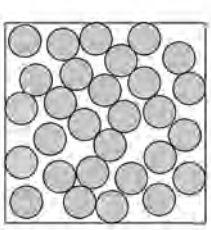
Tick (✓) **one** box.

- The force exerted decreased. ☐
- The force exerted stayed the same. ☐
- The force exerted increased. ☐

0 4 . 5 At different temperatures, nitrogen can be a gas, a liquid or a solid.

Draw **one** line from the state of matter to the arrangement of particles in each state.

[2 marks]

State of matter	Arrangement of particles
Liquid	
Solid	
Gas	

4.3.3.1 Particle motion in gases

Question 05 · continued

0 4 . 6 The boiling point of nitrogen is –196 °C and the melting point of nitrogen is –210 °C.

What is the state of matter of nitrogen at a temperature of –200 °C?

[1 mark]

Tick (✓) **one** box.

Solid ☐ Liquid ☐ Gas ☐

0 4 . 7 What is the state of matter of nitrogen when the temperature is lower than the melting point of nitrogen?

[1 mark]

Tick (✓) **one** box.

Solid ☐ Liquid ☐ Gas ☐

0 4 . 8 As a substance melts, the temperature of the substance is constant.

What happens to the kinetic energy **and** the potential energy of the particles as the substance melts?

[2 marks]

Tick (✓) **one** box in each row.

	Decreases	Stays the same	Increases
Kinetic energy of particles			
Potential energy of particles			

10