

GCSE Physics (9 – 1)

Pressure in Gases

Name:

Group:

Instructions

- Read each question carefully before you begin to answer it.
- Use black ink or black ball-point pen for your answers.
- Fill in the boxes at the top of this page with your name and group.
- Attempt to answer every question in the booklet.
- Answer the questions in the spaces provided – there may be more space than you need in some answer spaces.
- Calculators may be used for this booklet.
- For any calculations, you **must** show all your working.
- Any and all drawings or graphs should be completed in pencil.



For markers use	
Question	Mark
1	/4
2	/8
3	/8
4	/14
5	/6
Total	/40
%	
Grade	

Information

- The maximum mark for this paper is 40 marks.
- The marks for each question are shown in brackets.
- Please be aware that good English and clear presentation are required in your answers.



1. Whether inflating a balloon or a bicycle tyre, gas pressure is caused by the combined force of billions of microscopic particles constantly colliding with the inside walls of their container.

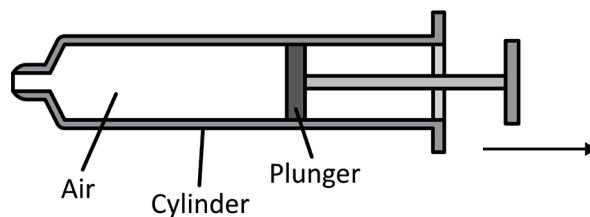
For each of the following questions **circle** the letter of the correct answer.

- a) A gas is trapped inside a syringe at a constant room temperature. If the plunger is pushed in, halving the volume of the gas, what happens to the pressure?

A	B	C	D
It halves	It stays the same	It doubles	It quadruples

(1 mark)

- b) The figure below shows some air inside a movable piston in the shape of a cylinder.



The piston is pulled 2 cm in the direction of the arrow, but stays in the cylinder.

One of the following increases. Which one of the following increases?

- A** The pressure of the air in the cylinder.
- B** The mass of the air in the cylinder.
- C** The volume of the air in the cylinder
- D** The rate at which the air particles in the cylinder collide with the walls of the cylinder.

(1 mark)

- c) Why does atmospheric pressure decrease as you climb higher up a mountain?

- A** Because the air temperature is much colder at higher altitudes.
- B** Because the Earth's gravitational pull is significantly stronger at higher altitudes.
- C** Because the gas particles move much faster at the top of a mountain.
- D** Because there are fewer air molecules above you pushing down.

(1 mark)

- d) A gas has a volume of 2.0 m^3 at a pressure of $100\,000 \text{ Pa}$.

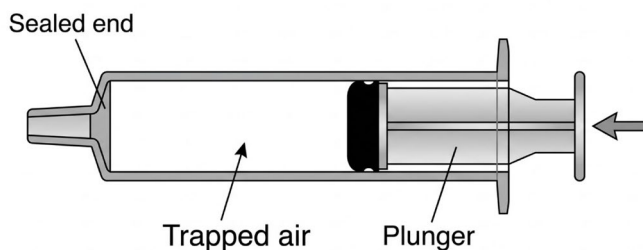
If the gas is allowed to expand to a volume of 4.0 m^3 at a constant temperature, what will the new pressure be?

A	B	C	D
25,000 Pa	50,000 Pa	100,000 Pa	200,000 Pa

(1 mark)

(Total for Question 1 is 4 marks)

2. A student is investigating how the volume of a trapped gas affects its pressure.
The figure below shows the equipment used in the investigation



- a) Describe, in terms of particles, how the trapped air exerts a pressure on the inside walls of the syringe.

.....

.....

.....

.....

.....

(2 marks)

- b) A student slowly pushes the plunger inward, decreasing the volume of the trapped air.
The temperature of the air remains constant.

Explain, using the particle model, why the pressure of the trapped air increases.

.....

.....

.....

.....

.....

.....

.....

(3 marks)

- c) Before the plunger is pushed in, the trapped air has a volume of 24 cm^3 and a pressure of $100\,000 \text{ Pa}$.
The student pushes the plunger in until the volume of the air is 15 cm^3 .

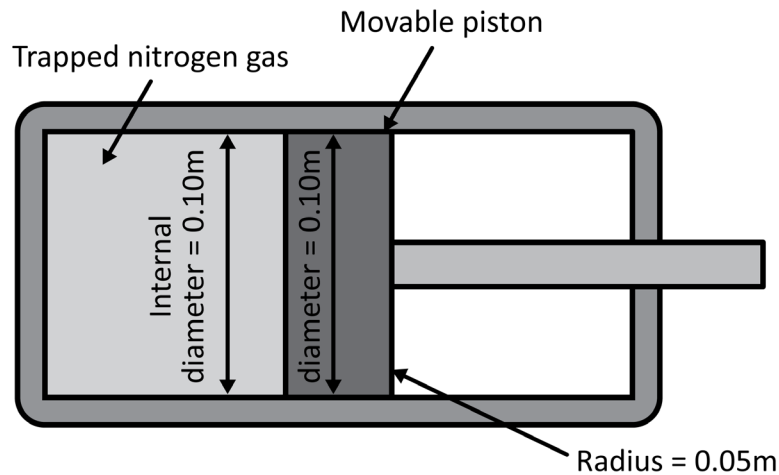
Assuming the temperature remains constant, calculate the new pressure of the gas.

Pressure = ...

(3 marks)

(Total for Question 2 is 8 marks)

3. An engineer is testing a sealed cylinder containing a fixed mass of nitrogen gas at a constant room temperature. The figure below shows the cylinder the engineer used.



- a) The trapped nitrogen gas has an initial volume of 0.060 m^3 and an initial pressure of $150\,000 \text{ Pa}$. Calculate the total outward force exerted by the initial gas pressure on the circular piston.

Force = ...
(2 marks)

- b) A machine pushes the piston inwards, compressing the gas to a new volume of 0.025 m^3 . The temperature of the gas remains constant. Calculate the new pressure of the trapped gas. Give your answer in standard form.

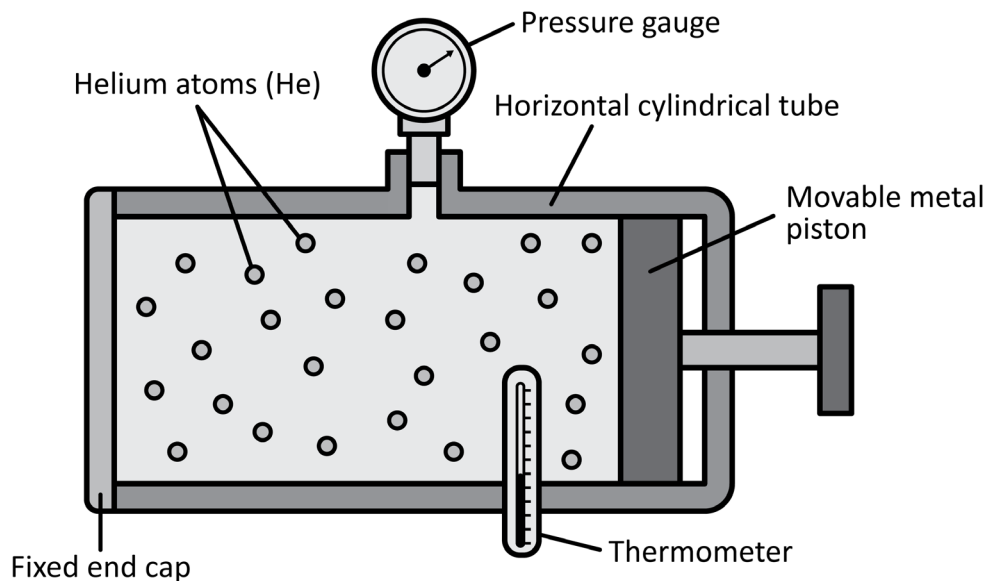
Pressure = ...
(3 marks)

- c) Using your answers from previous parts, calculate the new outward force exerted by the gas on the piston after it has been compressed. Give your answer to **3 significant figures**.

Force = ...
(3 marks)

(Total for Question 3 is 8 marks)

4. A scientist is investigating the properties of a gas. The figure shows a sealed metal cylinder containing helium gas. The cylinder has a tightly fitting, movable piston.



- a) Explain, in terms of the motion of helium atoms, how the gas exerts a pressure on the inside of the cylinder.

.....

.....

.....

.....

.....

.....

(3 marks)

- b) The scientist slowly pushes the piston inwards. The temperature of the helium gas remains constant.

- Initial volume of the gas = 0.050 m^3 .
- Initial pressure of the gas = 120 kPa .
- Final volume of the gas = 0.020 m^3 .

Calculate the final pressure of the gas in kPa.

Pressure = ...

(3 marks)

- c) The cross-sectional area of the movable piston is 0.0040 m^2 .

Using your answer from Part (b), calculate the outward force exerted by the helium gas on the piston after it has been compressed.

Force = ... N
(3 marks)

- d) The scientist locks the piston in place so the volume of the gas cannot change.
She then heats the cylinder.

Explain, in terms of particles, why the pressure reading on the gauge increases.

.....
.....
.....
.....
.....
.....
.....

(3 marks)

- e) Later, the scientist unlocks the piston and pushes it inwards very rapidly.
She notices that the reading on the thermometer goes up.

Explain why the temperature of the helium gas increases when it is compressed very quickly

.....
.....
.....
.....
.....
.....

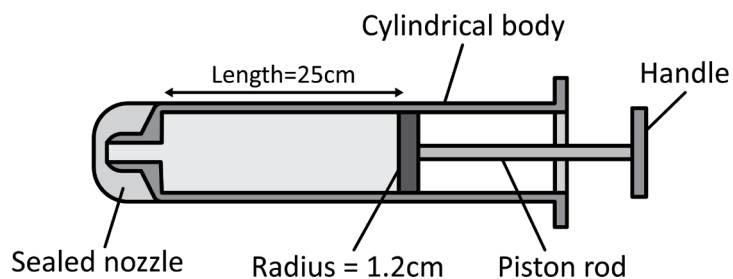
(2 marks)

(Total for Question 4 is 14 marks)

5. A sealed cylindrical pump contains a fixed mass of air.
Initially, the length of the trapped air column is 25 cm and the pressure of the air is 101 000 Pa.

A student pushes the plunger inwards at a constant temperature until the length of the trapped air column is reduced to 10 cm.

The figure below shows the pump that the student uses.



Calculate the outward force exerted by the gas on the plunger in this new position.
Give your answer to 3 significant figures.

Force = ... N

(6 marks)

(Total for Question 5 is 6 marks)