

# GCSE Physics

## Worksheet: Pressure in gases

|                |                   |                       |                            |
|----------------|-------------------|-----------------------|----------------------------|
| TIME<br>35 min | TOTAL<br>31 marks | CALCULATOR<br>Allowed | DIFFICULTY<br>Easy, Medium |
|----------------|-------------------|-----------------------|----------------------------|

Topics: Pressure in gases

|      |       |      |
|------|-------|------|
| NAME | CLASS | DATE |
|------|-------|------|

- Use black ink or black ball-point pen. Pencil should only be used for drawing.
- Answer all questions in the spaces provided.
- In all calculations, show clearly how you work out your answer.
- The marks for questions are shown in brackets.

01

01.1

The pressure of a gas produces a net force on the walls of its container.

What is the direction of this force?

Tick (✓) **one** box.

|                             |                          |
|-----------------------------|--------------------------|
| At right angles to the wall | <input type="checkbox"/> |
| Parallel to the wall        | <input type="checkbox"/> |
| Always downwards            | <input type="checkbox"/> |
| Always upwards              | <input type="checkbox"/> |

[1 mark]

0 1 . 2

A fixed mass of gas has a pressure of 100 kPa and a volume of 0.030 m<sup>3</sup>. The gas is compressed to a volume of 0.010 m<sup>3</sup>. The temperature of the gas does not change.

Calculate the new pressure of the gas.

Use the equation:

pressure × volume = constant

.....

.....

.....

.....

Pressure = ..... kPa

[2 marks]

0 1 . 3

What happens to the pressure of a fixed mass of gas at constant temperature when its volume is increased?

.....

.....

.....

.....

[1 mark]

0 2

A bubble of air has a volume of  $1.2 \text{ cm}^3$  at the bottom of a lake, where the pressure is 120 kPa. The bubble rises to the surface, where the pressure is 100 kPa. The temperature of the air in the bubble does not change.

0 2 . 1

Calculate the volume of the bubble at the surface.

Use the equation:

pressure  $\times$  volume = constant

.....

.....

.....

.....

.....

Volume = .....  $\text{cm}^3$

[3 marks]

0 3

0 3 . 1

A syringe contains a fixed mass of gas at constant temperature. The plunger is pushed in, decreasing the volume of the gas.

What happens to the pressure of the gas?

Tick (✓) **one** box.

It increases.

☐

It decreases.

☐

It stays the same.

☐

[1 mark]

0 3 . 2

State what happens to the volume of a fixed mass of gas, at constant temperature, if its pressure is increased.

.....

.....

.....

.....  
[1 mark]

0 4

A fixed mass of gas has a volume of  $250\text{ cm}^3$  at a pressure of  $180\text{ kPa}$ . The gas is allowed to expand, at constant temperature, until its pressure falls to  $100\text{ kPa}$ .

0 4 . 1

Calculate the new volume of the gas.

Use the equation:

pressure  $\times$  volume = constant

.....

.....

.....

.....

.....

Volume = .....  $\text{cm}^3$

[3 marks]

.....

0 5

A student investigated how the volume of a fixed mass of air changes when the pressure changes. The temperature of the air was kept constant.

Table 1 shows the results.

Table 1

| Pressure in kPa | Volume in cm <sup>3</sup> |
|-----------------|---------------------------|
| 100             | 48                        |
| 120             | 40                        |
| 150             | 32                        |
| 200             | 24                        |
| 240             | X                         |

0 5 . 1

Show that pressure  $\times$  volume is constant for these results.

.....

.....

.....

.....

[2 marks]

0 5 . 2

Determine the value of X in Table 1.

.....

.....

.....

$X = \dots\dots\dots \text{cm}^3$

[1 mark]

0 5 . 3

Describe the relationship between the pressure and the volume of the air.

.....

.....

[1 mark]

0 5 . 4

After each change in pressure, the student waited for a short time before reading the volume.  
Suggest why.

.....

.....

[1 mark]

0 6

A student investigates how the volume of a fixed mass of trapped air affects its pressure. A gas syringe connected to a pressure gauge is held in a water bath to keep the temperature constant.

0 6 . 1

Write a hypothesis for how the pressure of the trapped air will change as its volume is decreased.

.....

.....

[1 mark]

0 6 . 2

Identify the independent variable and the variable that must be controlled in this investigation.

.....

.....

.....

.....

[2 marks]

0 6 . 3

The water bath is filled with hot water for one set of readings.  
State one hazard of this and a suitable control measure.

.....

.....

.....

.....

[2 marks]

0 7

A student sealed the end of a plastic syringe. The syringe contained  $60 \text{ cm}^3$  of air at a pressure of  $100 \text{ kPa}$ . The student slowly pushed the plunger in until the volume of the air was  $40 \text{ cm}^3$ . The temperature of the air did not change.

0 7 . 1

Calculate the pressure of the air when its volume was  $40 \text{ cm}^3$ .  
Use the Physics Equations Sheet.

.....

.....

.....

.....

Pressure = .....  $\text{kPa}$   
**[2 marks]**

0 7 . 2

The student then pulled the plunger out so that the volume of the air was greater than  $60 \text{ cm}^3$ . The temperature of the air stayed the same.  
Explain, in terms of the air molecules, why the pressure of the air decreased.

.....

.....

.....

.....

.....

.....

**[3 marks]**

0 7 . 3

Explain why the student pushed the plunger in slowly.

.....

.....

**[1 mark]**

.....

Table 2 shows the volume and pressure of the air trapped in a sealed syringe at a constant temperature.

Table 2

| Volume in cm <sup>3</sup> | Pressure in kPa |
|---------------------------|-----------------|
| 60                        | 120             |
| 120                       | X               |
| Y                         | 480             |

Calculate the values of X and Y.  
Use the Physics Equations Sheet.

[3 marks]

# Mark scheme

## GCSE Physics · Worksheet: Pressure in gases · 31 marks

---

---

### Question 1 (4 marks)

01.1 [1 mark]

**Correct:** At right angles to the wall

---

01.2 [2 marks]

**Answer:** 300 kPa

- $100 \times 0.030 = p \times 0.010$  (1)
  - $p = 300$  (kPa) (1)
- 

01.3 [1 mark]

**Answer:** It decreases.

- it decreases (1)
- 
- 

### Question 2 (3 marks)

02.1 [3 marks]

**Answer:**  $1.44 \text{ cm}^3$

- $p_1 V_1 = 120 \times 1.2 = 144$  (1)
  - $V_2 = 144 \div 100$  (1)
  - $1.44 \text{ (cm}^3\text{)}$  (1)
- 
- 

### Question 3 (2 marks)

03.1 [1 mark]

**Correct:** It increases.

---

03.2 [1 mark]

**Answer:** The volume decreases.

- the volume decreases (1)
-

---

## Question 4 (3 marks)

### 04.1 [3 marks]

**Answer:**  $450 \text{ cm}^3$

- $p_1V_1 = 180 \times 250 = 45\,000$  (1)
  - $V_2 = 45\,000 \div 100$  (1)
  - $450 \text{ (cm}^3\text{)} (1)$
- 

## Question 5 (5 marks)

### 05.1 [2 marks]

- pressure  $\times$  volume calculated for at least three results, e.g.  $100 \times 48 = 4800$ ,  $150 \times 32 = 4800$ ,  $200 \times 24 = 4800$  (1)
  - all the values are the same (4800), so pV is constant (1)
- 

### 05.2 [1 mark]

**Answer:**  $20 \text{ cm}^3$

- $20 \text{ (cm}^3\text{)} (1)$
- 

### 05.3 [1 mark]

**Answer:** Volume is inversely proportional to pressure.

- the volume is inversely proportional to the pressure / when the pressure doubles, the volume halves (1)

**Notes:** 'As the pressure increases, the volume decreases' on its own is not enough for the mark.

---

### 05.4 [1 mark]

**Answer:** Compressing the air warms it slightly, so waiting lets it return to room temperature.

- so that the temperature of the air returned to room temperature / stayed constant (compressing the air warms it) (1)
-

---

## Question 6 (5 marks)

### 06.1 [1 mark]

**Answer:** As the volume decreases, the pressure increases.

- as the volume of the trapped air decreases, its pressure increases (1)

---

### 06.2 [2 marks]

**Answer:** Independent: volume of the air. Controlled: temperature.

- independent variable: volume of the trapped air (1)
- controlled variable: temperature of the air / water bath (1)

**Notes:** Allow 'mass (amount) of air' for the controlled variable.

---

### 06.3 [2 marks]

**Answer:** Hazard: scalding from spilled hot water. Control measure: keep the water below about 50 °C and do not move the bath while it is hot.

- hazard: the hot water could scald the student (if it is spilled) (1)
  - control measure: e.g. keep the water below about 50 °C / do not move or carry the bath while it is hot / stand it securely away from the edge of the bench / wear heat-resistant gloves (1)
-

---

## Question 7 (6 marks)

### 07.1 [2 marks]

**Answer:** 150 kPa

- $100 \times 60 = p \times 40$  (1)
  - $p = 150$  (kPa) (1)
- 

### 07.2 [3 marks]

**Answer:** The molecules move at the same average speed but are more spread out, so they hit each unit area of the walls less often and the pressure falls.

- the (average) speed / kinetic energy of the molecules does not change (because the temperature is constant) (1)
  - the molecules are more spread out / travel further between collisions with the walls (1)
  - so there are fewer collisions with each unit area of the walls each second, so the pressure decreases (1)
- 

### 07.3 [1 mark]

**Answer:** Pushing quickly would do work on the air and warm it; pushing slowly keeps its temperature constant.

- so that the temperature of the air stayed constant / pushing quickly would do work on the air and raise its temperature (1)
- 

---

## Question 8 (3 marks)

### 08.1 [3 marks]

**Answer:**  $X = 60$ ,  $Y = 15$

- pressure  $\times$  volume =  $60 \times 120 = 7200$  (for the first row) (1)
  - $X = 7200 \div 120 = 60$  (kPa) (1)
  - $Y = 7200 \div 480 = 15$  (cm<sup>3</sup>) (1)
-