Gas Pressure

Answer the questions below.

1. Define density.
   Mass per unit volume
2. State the equation used to calculate density.
   $$\rho = \frac{m}{V}$$
3. Describe the movement of particles in a gas.
   Particles in a gas move randomly in all directions.
4. Define internal energy.
   The total amount of kinetic and potential energy of all the particles in a system.
5. Describe what happens to the movement of particles in a gas as they are heated.
   They gain kinetic energy so move more quickly.

Do Now

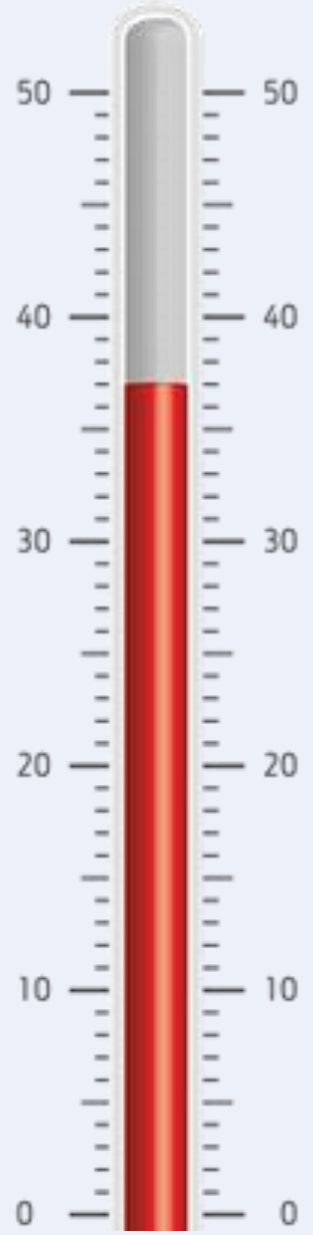
Gas Pressure

Do Now:

1. Define density.
2. State the equation used to calculate density.
3. Describe the movement of particles in a gas.
4. Define internal energy.
5. Describe what happens to the movement of particles in a gas as they are heated.

Drill:

1. State the unit usually used to measure temperature.
2. State the temperature shown on the thermometer.
3. State the resolution of this thermometer.



Do Now

Gas Pressure

Read Now:

Particles in a gas can take the shape of their container because they are constantly moving randomly throughout the container. The gas particles frequently collide with other gas particles, as well as with the walls of the container. Gas pressure is a measure of how often and how hard the particles of a gas collide with the walls of the container. As gas particles are moving quickly, they exert a force on the wall of the container when they hit it, and the faster the particles are moving, the greater this force will be. On aerosol canisters, such as spray deodorants, there will be a safety warning that instructs the user not to heat the canister. This is because if the particles are heated, they will move more quickly and hit the walls of the container with greater force, causing the gas pressure to build up so much that the canister may explode!

1. State two properties of gases.
2. Describe the movement of particles in a gas.
3. Explain what is meant by gas pressure.
4. Explain what happens to the force exerted by particles when they are heated.
5. Explain why it is not safe to heat an aerosol canister.

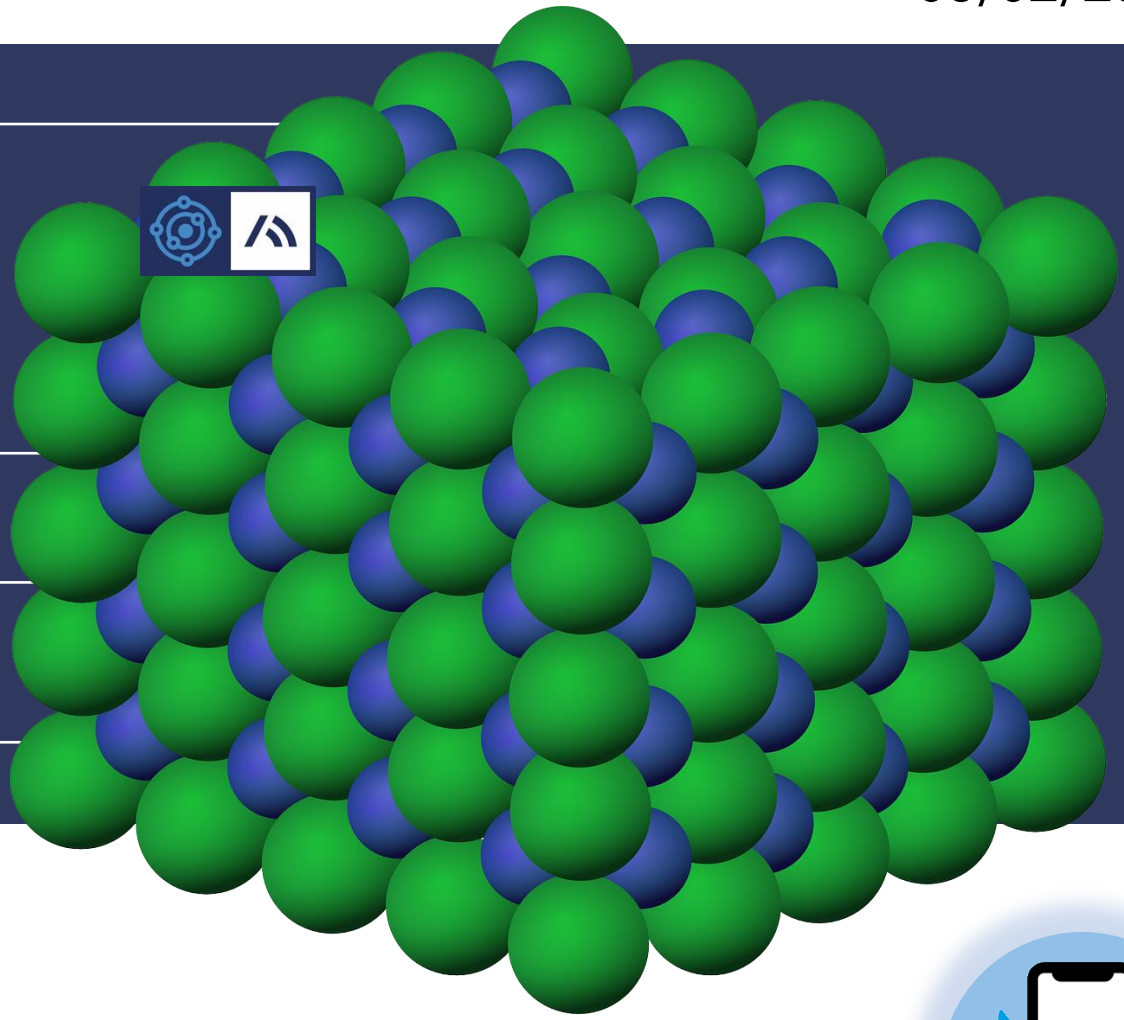
Do Now

03/02/2025

Gas Pressure

P4.1.4

Science Mastery

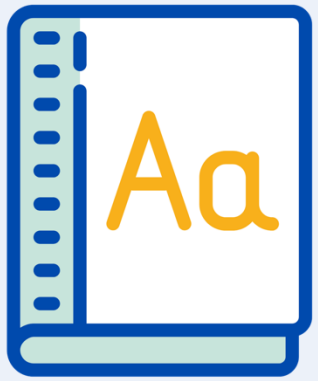


P4.1.1 Prior Knowledge Review
P4.1.2 Density
P4.1.3 Measuring Density
➢ **P4.1.4 Gas Pressure**
P4.1.5 Taking it Further: Pressure
P4.1.6 Taking it Further: Pressure in Fluids

Following this lesson, students will be able to:

- Explain what is meant by gas pressure
- Describe the relationship between temperature and pressure in a gas
- Explain the relationship between temperature and pressure in a gas

Key Words:



gas **pressure** **force**

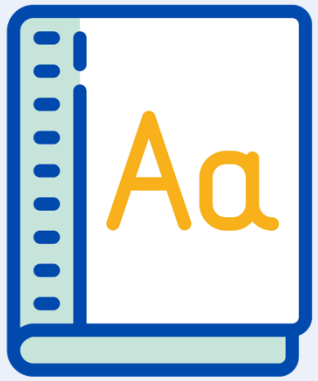
collision **area** **temperature**

Lesson Objectives

Following this lesson, students will be able to:

- Describe and explain the relationship between temperature and pressure in a gas
- Describe and explain the relationship between volume and pressure of a gas
- Apply the equation $p_1V_1 = p_2V_2$

Key Words:



gas **pressure** **force** **volume**

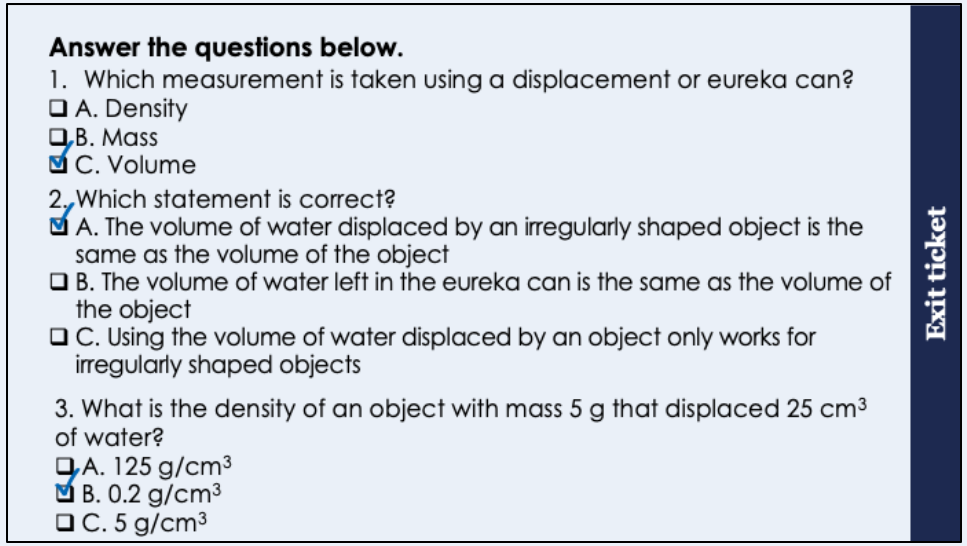
collision **area** **temperature**

Lesson Objectives

This is the fix-it portion of the lesson

The **fix-it** is an opportunity to respond to gaps in knowledge, especially those identified by the previous lesson's exit ticket.

- The teacher should customise this slide as needed, to facilitate
  - **reteach**, **explanation, demonstration** or **modelling** of ideas and concepts that students have not yet grasped or have misunderstood.
  - **practise** answering specific questions or of key skills.
  - **redrafting** or **improving** previous work.



Answer the questions below.

1. Which measurement is taken using a displacement or eureka can?
- ☐ A. Density
- ☐ B. Mass
- ☑ C. Volume

2. Which statement is correct?
- ☑ A. The volume of water displaced by an irregularly shaped object is the same as the volume of the object
- ☐ B. The volume of water left in the eureka can is the same as the volume of the object
- ☐ C. Using the volume of water displaced by an object only works for irregularly shaped objects

3. What is the density of an object with mass 5 g that displaced 25 cm^3 of water?
- ☐ A. 125 g/cm^3
- ☑ B. 0.2 g/cm^3
- ☐ C. 5 g/cm^3

Exit ticket

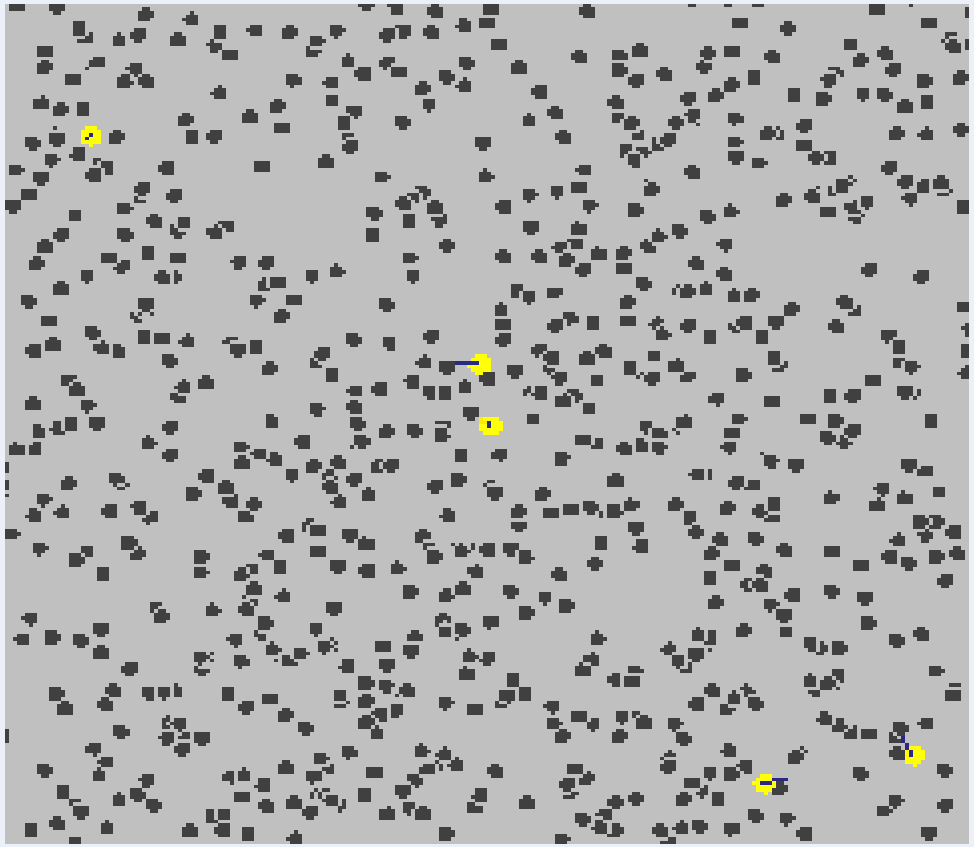
Fix-it

Gas Pressure

Particles is a gas move at **random speeds** in **random directions**.

They **collide** with each other and with the walls of their container.

When they **collide** with the walls of the container, they exert a force on it. This is **gas pressure**.



Pressure is a measure of the **force** exerted per unit **area**.

Gas Pressure and Temperature

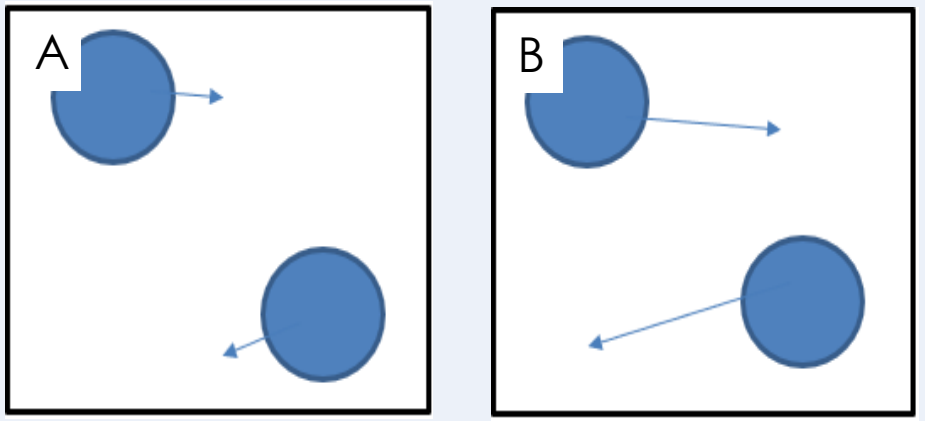
When a substance is heated, its **internal energy** increases.

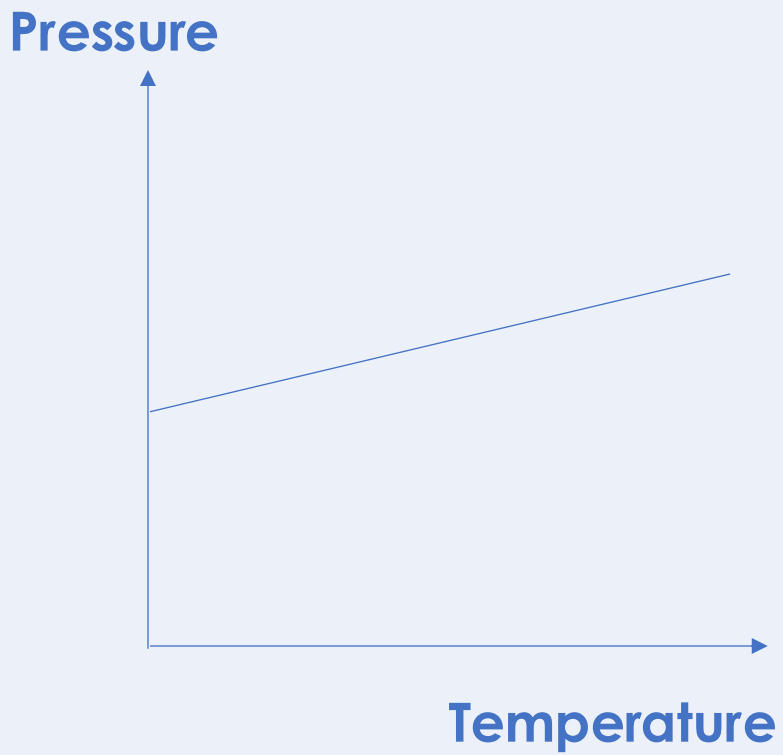
Temperature is a measure of the <u>average</u> **kinetic energy** of all the particles in a system.

When temperature is increased, gas particles **gain kinetic energy** and move more quickly.

The gas particles are moving **more quickly** so **collide more often** with the walls of the container and with **more force**.

This means they exert **more pressure**.



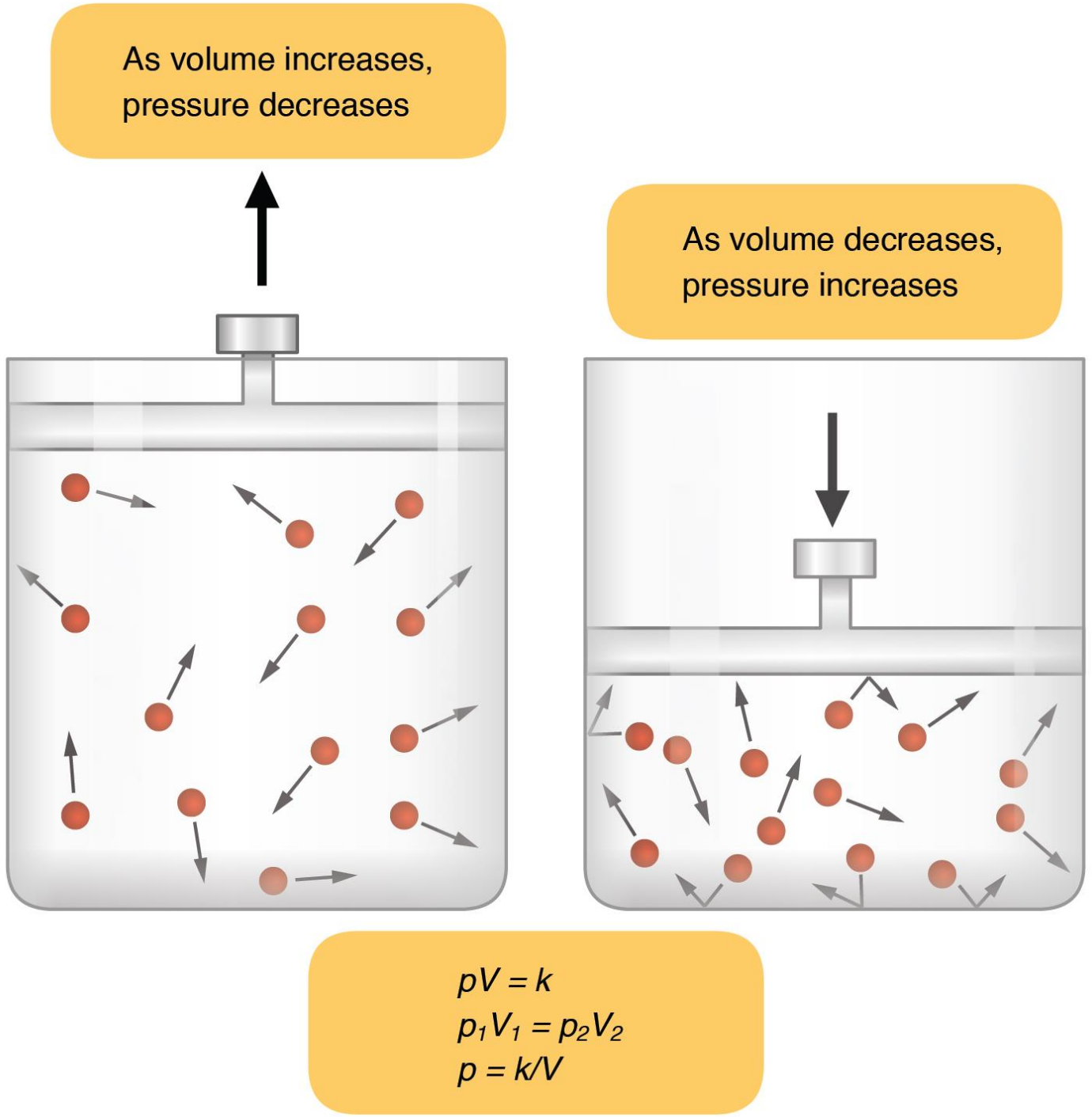


Pressure and Volume

When the **volume** of a container is **decreased**, the **pressure** exerted by the gas **increases**.

Particles have **less space** to move around, so **collide** with the walls of the container **more frequently**.

The **temperature** of the gas and the **mass** of the gas must remain **constant**.



Pressure and Volume

If the temperature and mass of the gas remain constant, the **volume** of the container is **inversely proportional** to the **pressure**.

$$\mathbf{p\,V = constant}$$

This is an equation you will need to **apply**.

We can use this equation to calculate the pressure or volume of a gas in a new scenario:

$$\mathbf{p_1\,V1 = p_2\,V2}$$

Example:

A gas has a volume of 0.45 m^3 at 120 Pa of pressure.
Calculate the pressure exerted by the gas if its container is expanded to 0.6 m^3.

$$\mathbf{p_1\,V1 = p_2\,V2}$$

$$\mathbf{120 \times 0.45 = p_2 \times 0.6}$$

$$\mathbf{0.6p2 = 54}$$

$$\mathbf{p_2 = 90\ Pa}$$

You: The relationship between volume and pressure

The table shows how the pressure exerted by a gas changes when the volume of its container changes.

Volume (cm^3)	Pressure (kPa)
30	200
48	125
60	100
96	62.5

Describe the relationship shown in the table.

The pressure of a gas is inversely proportional to its volume.

Use values from the table to show this relationship.

As volume doubles (from 30 to 60 cm^3, or from 48 to 96 cm^3), the pressure halves (from 200 to 100 kPa, or from 125 to 62.5 kPa.

According to the equation pV = constant. Calculate the constant of this gas.

pV = constant

30 x 200 = 6000

Use this information to predict the pressure of the gas when its volume is 100 cm^3.

pV = constant

p x 100 = 6000

p = 60 kPa

Changing Pressure

Higher Tier only

Work is the transfer of **energy** by a **force**.

When a force is applied to a gas, **work** is done on the gas.

This increases the **internal energy** of the gas and can cause an **increase** in its **temperature**.

Which statements do you agree with?

When a substance is cooled, the particles gain energy

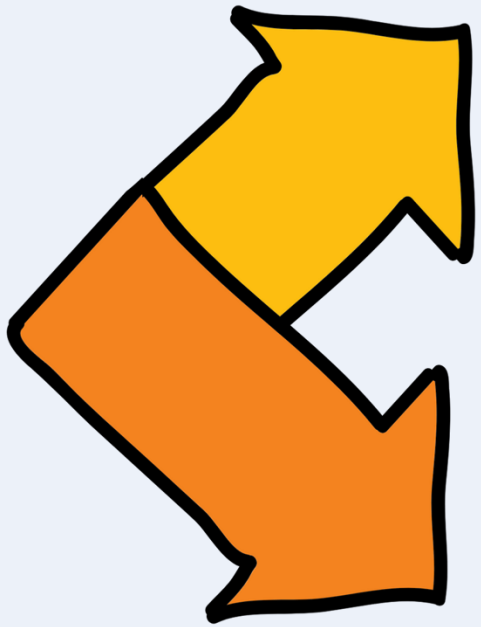
A gas at a higher temperature exerts more pressure than the same gas at a lower temperature

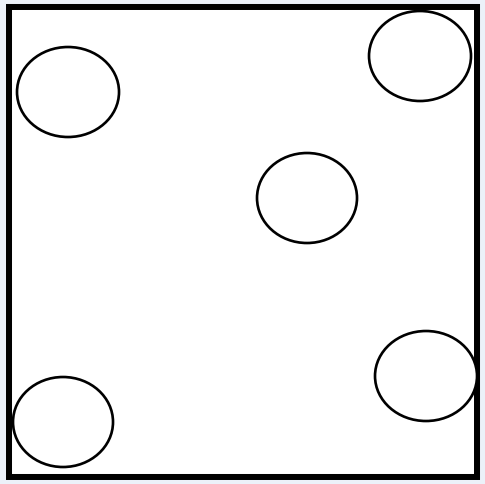
Gas pressure is caused by the particles of a gas colliding with each other

Pressure can be measured in Pascals

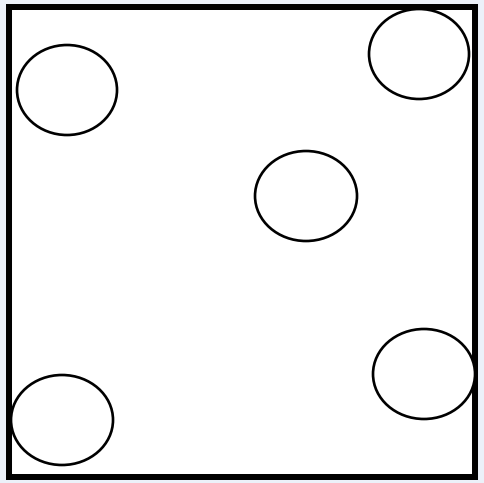
Talk Task

Can you describe and explain the difference between these two particle diagrams?





20 °C



40 °C

These two particle diagrams show the same gas.

How would the movement of particles be different?

How would the pressure exerted be different?

Why?

Talk Task

Drill

1. Describe the movement of particles in a gas.
2. Describe the properties of gases.
3. Describe what happens to the internal energy of a gas when it is heated.
4. Describe what happens to the movement of particles when a substance is cooled.
5. Describe the relationship between temperature and pressure.
6. Explain the relationship between temperature and pressure.

Physics

1. Describe the relationship between pressure and volume.
2. State the two factors that must stay the same for this relationship to apply.

Check for understanding

Drill answers

1. Particles move at random speeds in random directions
2. Gases can flow, take the shape of their container, do not have a fixed shape or volume and can be compressed
3. Internal energy increases
4. Particles lose kinetic energy so move less quickly
5. As temperature increases, pressure increases
6. Particles at higher temperatures have more kinetic energy so move more quickly, colliding with the surface of the container harder and more frequently, exerting more pressure

Physics

1. Pressure and volume are inversely proportional
2. The number of particles (mass) and the temperature of the gas

Check for understanding

I: Explain: *to use scientific understanding to make something clear or state the reason for something happening*

Example question:

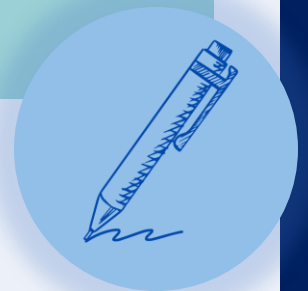
Explain what happens to the pressure of a gas as temperature increases.

Model answer:

- Increasing the temperature increases the **kinetic energy** of the particles in a gas
- This means the particles start to move more **quickly** and hit the surface of the container more often and with **more force**
- So, this **increases** the **pressure** exerted by the gas

To 'explain' your answer should:

- Begin with a **scientific statement**.
- Use 'this means that', 'because' or 'so' **to link your statement to the question**.



Writing like a scientist

We: Explain: *to use scientific understanding to make something clear or state the reason for something happening*

Example question:

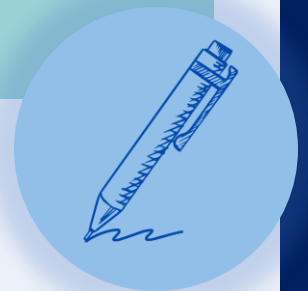
Explain what happens to the pressure of a gas as temperature decreases.

Model answer:

- Decreasing the temperature decreases the **kinetic energy** of the particles in a gas
- This means the particles start to move less **quickly** and hit the surface of the container less often and with **less force**
- So, this **decreases** the **pressure** exerted by the gas

To 'explain' your answer should:

- Begin with a **scientific statement**.
- Use 'this means that', 'because' or 'so' **to link your statement to the question**.



Writing like a scientist

You: Explain: *to use scientific understanding to make something clear or state the reason for something happening*

Example question:

Explain the relationship between temperature and pressure of a gas.

Model answer:

- Increasing the temperature increases the **kinetic energy** of the particles in a gas
- This means the particles start to move more **quickly** and hit the surface of the container more often and with **more force**
- So, this increasing temperature **increases** the **pressure** exerted by the gas

To 'explain' your answer should:

- Begin with a **scientific statement**.
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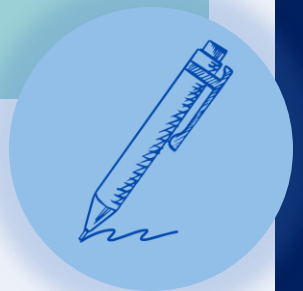


Writing like a scientist

I: Explain: *to use scientific understanding to make something clear or state the reason for something happening*

Example question:

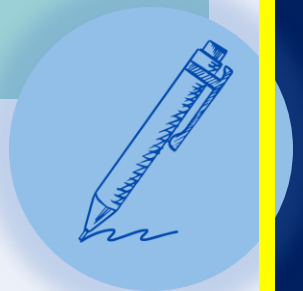
Explain what happens to the pressure of a gas as its volume decreases.

Model answer:

- Decreasing the volume of a gas reduces the amount of space the particles have to move around in
- This means the particles will collide with the surface of the container **more often**
- So, this **increases** the **pressure** exerted by the gas

To 'explain' your answer should:

- Begin with a **scientific statement**.
- Use 'this means that', 'because' or 'so' **to link your statement to the question**.



Writing like a scientist

We: Explain: *to use scientific understanding to make something clear or state the reason for something happening*

Example question:

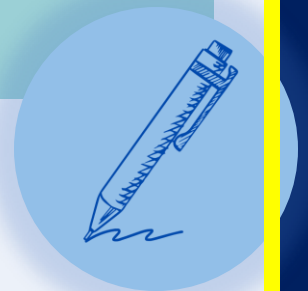
Explain what happens to the pressure of a gas as its volume increases.

Model answer:

- Increasing the volume of a gas increases the amount of space the particles have to move around in
- This means the particles will collide with the surface of the container **less often**
- So, this **decreases** the **pressure** exerted by the gas

To 'explain' your answer should:

- Begin with a **scientific statement**.
- Use 'this means that', 'because' or 'so' **to link your statement to the question**.



Writing like a scientist

You: Explain: *to use scientific understanding to make something clear or state the reason for something happening*

Example question:

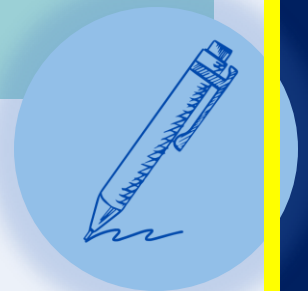
Explain the relationship between volume and pressure of a gas.

Model answer:

- Decreasing the volume of a gas reduces the amount of space the particles have to move around in
- This means the particles will collide with the surface of the container **more often**
- So, decreasing the volume **increases** the **pressure** exerted by the gas
- They are inversely proportional

To 'explain' your answer should:

- Begin with a **scientific statement**.
- Use 'this means that', 'because' or 'so' **to link your statement to the question**.



Writing like a scientist

Answer the questions below.

1. Which describes the movement of particles in a gas?

- ☐ A. All particles move randomly at the same speed
- ☐ B. All particles move at different speeds in a pattern
- ☑ C. All particles move at random speeds in random directions

2. What would happen to the pressure in a sealed pot if it was heated?

- ☑ A. The pressure would increase
- ☐ B. The pressure would decrease
- ☐ C. The pressure would stay the same

3. Which statement is correct?

- ☐ A. When particles are heated they expand
- ☑ B. When particles are heated their internal energy increases
- ☐ C. When particles are heated they exert less pressure on the walls of a container

Exit ticket

Feedback

Lesson P4.1.4	
What was good about this lesson?	What can we do to improve this lesson?

Send us your feedback by clicking this link. Thank you!