

Gas pressure, volume and the kelvin scale

Physics grades 9-10 (GCSE · IGCSE · O Level · Class 9-10) · Lab

Name: _____ Date: _____ Class: _____

Does squeezing a gas increase its pressure in a predictable way? You will compress trapped air in a syringe, record the pressure, and test whether $p \times V$ stays constant. Then you will plot a graph that gives a straight line and use it to make a prediction.

Level: Physics grades 9-10 (GCSE · IGCSE · O Level · Class 9-10) · **Curriculum:** IGCSE 2.1, HS-PS3-2

Aim

To test whether the pressure of a fixed mass of air is inversely proportional to its volume at constant temperature.

Equipment

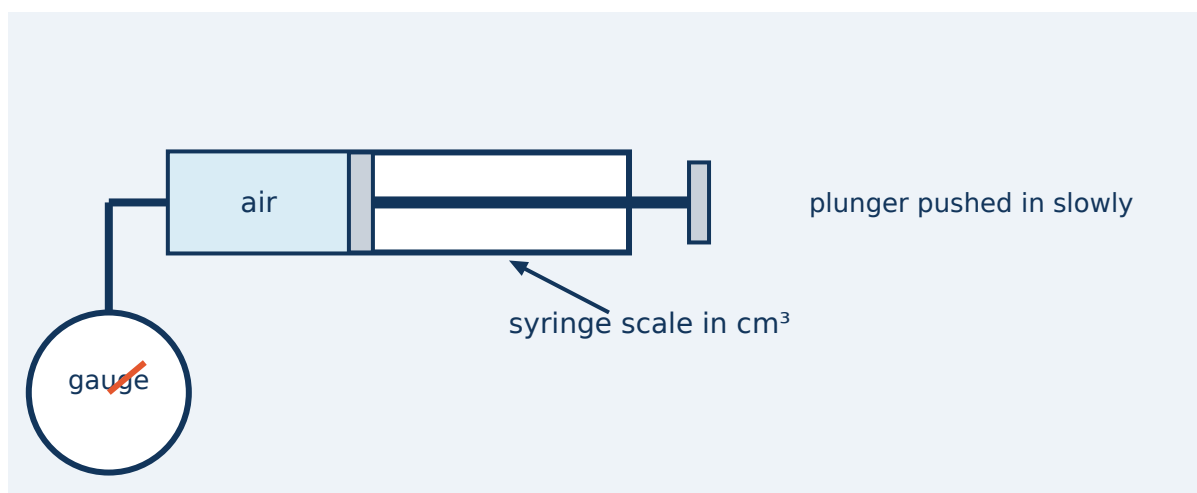
- 100 cm³ gas syringe or sturdy plastic syringe with a sealed nozzle
- pressure gauge or sensor (absolute pressure in kPa) with a short rigid tube
- silicone grease for the plunger
- thermometer (room temperature)
- clamp stand

Safety

Safety

Do not exceed the maximum reading of the gauge or syringe rating. Push the plunger slowly and keep your face away from the nozzle in case a joint pops off. Wear safety glasses.

Method



Syringe connected to a pressure gauge to test Boyle's law.

1. Smear a thin film of grease on the plunger and set it at 50 cm³. Connect the syringe to the gauge with the short tube so that no air can escape.
2. Record the room temperature and the volume V and pressure p .
3. Push the plunger in slowly to 40 cm³. Wait 30 s so the air returns to room temperature, then record p .
4. Repeat for 30, 25 and 20 cm³.
5. Calculate $p \times V$ and $1 / V$ for each reading.

Results

Sample measurements at 21 °C (V in cm³, p in kPa):

Volume V (cm ³)	Pressure p (kPa)	$p \times V$ (kPa cm ³)	$1 / V$ (cm ⁻³)
50	101	5050	0.0200
40	126	5040	0.0250
30	168	5040	0.0333
25	202	5050	0.0400
20	251	5020	0.0500

Analysis questions

Question 1 Checking the products

Verify the $p \times V$ value for the 30 cm³ reading and calculate the mean of the five values.

Question 2 Spread of the data

Calculate the largest difference from the mean as a percentage of the mean.

Question 3 Graph shape

Describe the graph of p against V and the graph of p against $1/V$ that you expect.

Question 4 Gradient

Calculate the gradient of the p against $1/V$ line using the first and last points. State what it represents.

Question 5 Prediction

Use the mean value of $p \times V$ to predict the pressure at 15 cm^3 .

Question 6 Control of temperature

Explain why the plunger is pushed slowly and why you wait before reading.

Question 7 Source of error

The tube and gauge contain about 2 cm^3 of extra air that is not read on the syringe scale. Explain how this affects the $p \times V$ values.

Question 8 Conclusion and improvement

State your conclusion and suggest one improvement.