Pressure and temperature at fixed volume

Student activity • observation and reasoning

YEAR 11 / LESSON 78 / PHYSICS + SCIENCE (DOUBLE AWARD)

The question

Why does heating a fixed volume of gas increase its pressure?

Use a particle explanation and an ideal data set with kelvin temperature and absolute pressure.

Equipment

- Booklet, graph paper and calculator

Desk-based data work only. Never heat a sealed container for this activity. No flame, hot-water bath or pressurised apparatus is used.

Course coverage: Shared Physics / Double Award: 5.20, 5.21. Fixed-volume gas; $p_1/T_1 = p_2/T_2$.

Plan, model or apparatus sketch

Draw the particle, pressure or magnetic-field model and label directions and quantities.

Method and reasoning

Read the whole sequence before starting

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1. Draw a sealed rigid container with a fixed number of gas particles. Compare colder and warmer models with varied particle speeds and the same volume.

2. Explain how greater average molecular speed changes collisions with the walls and increases average pressure. Keep the particle number fixed.

3. Use invented practice temperatures 250, 300, 350 and 400 K with absolute pressures 80, 96, 112 and 128 kPa. Calculate p/T for each pair.

4. Plot p against T in kelvin and describe the ideal proportional relationship. Mark an extrapolation towards 0 K with a dashed line and explain why real gases may condense before that region.

5. Calculate pressure after warming a fixed-volume practice gas from 27 °C and 100 kPa to 87 °C. Convert both temperatures using the stated 273 approximation before taking the ratio.

6. Correct calculations that use Celsius ratios or gauge pressure. Explain why changing the container volume or allowing a gas leak invalidates this simple comparison.

Cleanup

- Retain graphs and corrected calculations.

Record your evidence

Blank spaces are for your own work

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Reference and task data

Practice p/T = 0.32 kPa K^{-1}. For 27 °C to 87 °C, use 300 K to 360 K and obtain 120 kPa absolute. Extrapolation is a model, not a safe or achievable instruction to cool a real gas to absolute zero.

T / K	p / kPa absolute	p/T / kPa K^{-1}
250	80	
300	96	
350	112	
400	128	

Show your calculations, labelled model or correction here.

Explain and evaluate

Use evidence and show calculation steps where relevant

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1. What remains fixed?

2. Why does pressure rise on heating?

3. Find p/T from 96 kPa and 300 K.

4. Convert 87 °C to K.

5. Find the final practice pressure.

6. Why is a straight extrapolation not proof of real-gas behaviour to 0 K?