

8.1 Gas models and absolute temperature

Name: _____ Class: _____ Date: _____

Total: 10 marks

KEY WORDS absolute temperature • ideal gas

Objective

Gas models and absolute temperature. Supported HL concept preparation; original classroom practice, not an official IB paper or assessed learner work.

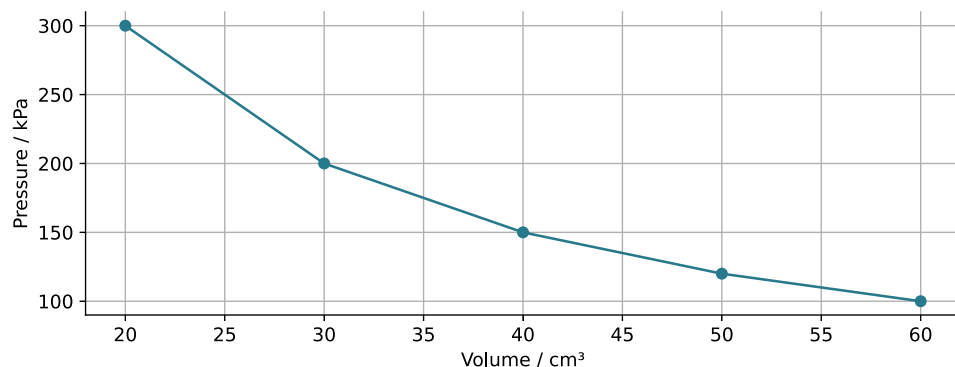
1 Key knowledge and worked examples

■ What would explain this observation?

- A sealed gas container changes pressure when heated. Celsius ratios cannot predict the pressure change because the gas model uses **absolute temperature**.
- Start with a prediction. State the quantities or features you would compare, then decide what evidence could distinguish two explanations.

■ Build the model

- In a gas model, particles move randomly and pressure results from momentum transfer at walls. The **ideal gas** equation connects pressure, volume, amount and absolute temperature.
- absolute temperature: Temperature on the kelvin scale; ideal gas: A gas model with specified simplifying assumptions.



■ Choose evidence that can test it

- At fixed amount and volume, pressure is proportional to kelvin temperature. At fixed temperature and amount, pressure is inversely proportional to volume. State which quantities are fixed before choosing a relationship.
- Use approved apparatus with a temperature range and pressure limit set by the teacher. Allow thermal equilibrium and record pressure against kelvin temperature. Never heat an improvised sealed vessel.

■ Work from known quantities

- State the known values and their units. Choose the relation because its assumptions fit this case, then rearrange before substitution.
- Known: pressure is 100 kPa at 300 K, with fixed volume and amount. At 330 K, $p_2/p_1 = T_2/T_1$. $p_2 = p_1 T_2/T_1 = 100 \times 330/300 = 110$ kPa. A 30 °C rise is a 30 K change, but the temperature ratio must use kelvin.

Example:

At fixed volume, pressure is 120 kPa at 300 K. Find pressure at 350 K. Use the same sequence: known quantities → model → relation → substitution → unit and interpretation.

■ Check the conclusion and its limits

- An ideal gas is a model with conditions of validity. Celsius zero is not zero molecular motion, and internal energy is not determined by pressure alone.
- Return to the original observation. Explain what the result supports, which conditions it assumes, and one way to test a competing explanation.

Warn:

A gas pressure ratio can always use Celsius temperatures. This claim is false: An ideal gas is a model with conditions of validity. Celsius zero is not zero molecular motion, and internal energy is not determined by pressure alone.

Key:

Gas models and absolute temperature: At fixed amount and volume, pressure is proportional to kelvin temperature. At fixed temperature and amount, pressure is inversely proportional to volume. State which quantities are fixed before choosing a relationship.

2 Practice

2.1 Which scale belongs in a gas-law temperature ratio? Choose one answer.

- **A** Celsius
- **B** Kelvin
- **C** Either scale without conversion

[1]

2.2 At fixed volume, pressure is 120 kPa at 300 K. Find pressure at 350 K. Show the relation, substitution and units.

[2]

2.3 Decide whether this claim is true and justify: A gas pressure ratio can always use Celsius temperatures.

[2]

2.4 Temperature on the kelvin scale: write the technical term.

[1]

3 Exam-style questions

3.1 An ideal gas changes from 300 K, 100 kPa, V to 450 K and $2V$ at fixed amount. Find pressure. Explain why using only a temperature ratio would fail.

[4]

Solutions

2.1 B At fixed amount and volume, pressure is proportional to kelvin temperature. At fixed temperature and amount, pressure is inversely proportional to volume. State which quantities are fixed before choosing a relationship.

2.2 At fixed V, n : $p_2 = p_1 T_2 / T_1 = (120 \text{ kPa}) \times 350 / 300 = 140 \text{ kPa}$.

2.3 False. An ideal gas is a model with conditions of validity. Celsius zero is not zero molecular motion, and internal energy is not determined by pressure alone.

2.4 absolute temperature. absolute temperature means Temperature on the kelvin scale.

3.1 Combined relation $p_2 = p_1 (T_2 / T_1) (V_1 / V_2) = 75 \text{ kPa}$. Volume also changes; the fixed-volume formula does not apply. Use absolute temperature.