Kelvin temperature and molecular motion

Student activity • observation and reasoning

YEAR 11 / LESSON 76 / PHYSICS + SCIENCE (DOUBLE AWARD)

The question

Why must gas-temperature ratios use kelvin?

Convert temperatures and compare ideal-gas particle models without treating Celsius zero as zero molecular energy.

Equipment

- Booklet, ruler and calculator

Desk-based models and calculations only. No cryogenic liquids, dry ice or heated gas vessels are used.

Course coverage: Shared Physics / Double Award: 5.16–5.19. Absolute zero, kelvin and average molecular kinetic energy.

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 Celsius and kelvin scales side by side. Use the IGCSE approximation T/K = θ/°C + 273 and label 0 K as approximately −273 °C.

2. Convert −20 °C, 0 °C, 27 °C and 127 °C to kelvin. Check that the unit symbol K has no degree sign.

3. Compare the average kinetic energies of ideal-gas molecules at 300 K and 600 K. Explain why doubling kelvin temperature doubles average kinetic energy.

4. Correct the claim that a gas at 20 °C has twice the average molecular kinetic energy of one at 10 °C. Compare 293 K with 283 K instead.

5. Draw velocity arrows of varied lengths in a gas model, then a hotter model with a greater average speed. Explain that not every molecule has the same speed.

6. Describe absolute zero as the lower limit of thermodynamic temperature. State the limits of the simple classical gas model rather than claiming that all microscopic motion in real matter literally vanishes.

Cleanup

- Retain conversions and return calculators.

Record your evidence

Blank spaces are for your own work

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Reference and task data

The exact offset is 273.15; use 273 consistently for these specified school calculations. In the classical ideal-gas model average translational kinetic energy is proportional to kelvin temperature. Doubling average kinetic energy does not double typical speed.

Temperature / °C	Conversion	Temperature / K
−20		
0		
27		
127		

Show your calculations, labelled model or correction here.

Explain and evaluate

Use evidence and show calculation steps where relevant

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1. Convert 27 °C to K using 273.

2. Convert 127 °C to K.

3. What is the approximate Celsius value of 0 K?

4. Compare average kinetic energy at 600 K and 300 K.

5. Is 20 °C twice 10 °C on the absolute scale?

6. Do all gas molecules have one speed?