

Gas pressure, volume and the kelvin scale

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

Model answers use the sample table. Your own numbers will differ slightly, but $p \times V$ should stay constant within a few percent. Notice how the straight line through the origin on the p against $1/V$ graph is stronger evidence than a single curve.

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

Question 1 Checking the products

$30 \times 168 = 5040 \text{ kPa cm}^3$. Mean = $(5050 + 5040 + 5040 + 5050 + 5020) / 5 = 25\,200 / 5 =$
5040 kPa cm³.

Question 2 Spread of the data

Largest difference = $5040 - 5020 = 20$ (or $5050 - 5040 = 10$). $20 / 5040 \times 100 =$ **0.4 %**.
The product is constant within experimental error.

Question 3 Graph shape

p against V is a downward curve (a hyperbola). **p against $1/V$ is a straight line through the origin**, because $p = \text{constant} \times (1/V)$.

Question 4 Gradient

Gradient = $(251 - 101) / (0.0500 - 0.0200) = 150 / 0.0300 = 5000 \text{ kPa cm}^3$. It represents the constant value of **$p \times V$** (about 5000 kPa cm^3).

Question 5 Prediction

$p = 5040 / 15 =$ **336 kPa**.

Question 6 Control of temperature

Compressing gas does work on it and warms it. A fast push would raise the temperature and break the condition of constant temperature. Waiting lets the gas **cool back to room temperature**.

Question 7 Source of error

The real volume is $V + 2$, so the true product is $p(V + 2)$. **The recorded product pV is**

smaller than the real one and is not exactly constant; the effect is largest at small V. A graph of p against $1 / (V + 2)$ would be straighter.

Question 8 Conclusion and improvement

Pressure is inversely proportional to volume for a fixed mass of gas at constant temperature, since $p \times V$ stays constant within 0.4 %. Improvement: use a longer waiting time, a larger range of volumes, or repeat each reading and average.