

Gas particles, pressure and heat conduction

AP Physics 2 (algebra-based) · Test

Name: _____ Date: _____ Class: _____ Mark: ____ / 20

This test covers kinetic theory, the ideal gas law and conduction for AP Physics 2. Show all working with units, use T in kelvin and take $R = 8.31 \text{ J/(mol}\cdot\text{K)}$, $k_B = 1.38 \times 10^{-23} \text{ J/K}$ and $N_A = 6.02 \times 10^{23} \text{ mol}^{-1}$. Some parts ask for a short explanation in complete sentences.

Level: AP Physics 2 (algebra-based) · **Curriculum:** AP P2 Unit 9

Time: 45 minutes · 8 questions · Total: 20 marks · Calculator allowed

Question 1 Kinetic model (2 marks)

- State two assumptions of the ideal gas model. (1 mark)
- Explain how particle collisions produce the pressure on a wall. (1 mark)

Question 2 Particles in a tank (3 marks)

A 4.0 L tank holds an ideal gas at $1.5 \times 10^5 \text{ Pa}$ and 300 K.

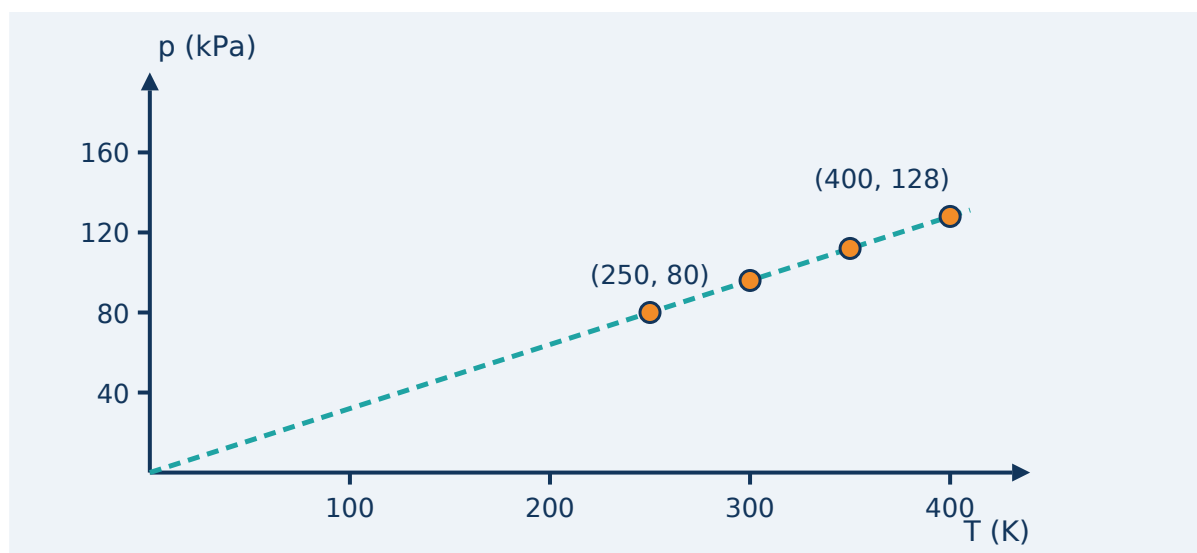
- Calculate the amount of gas in moles. (2 marks)
- Calculate the number of molecules. (1 mark)

Question 3 Temperature and speed (2 marks)

A gas is heated from 27 °C to 327 °C.

- Calculate the ratio of the new average kinetic energy to the old. (1 mark)
- Calculate the ratio of the new v_{rms} to the old. (1 mark)

Question 4 A pressure graph (3 marks)

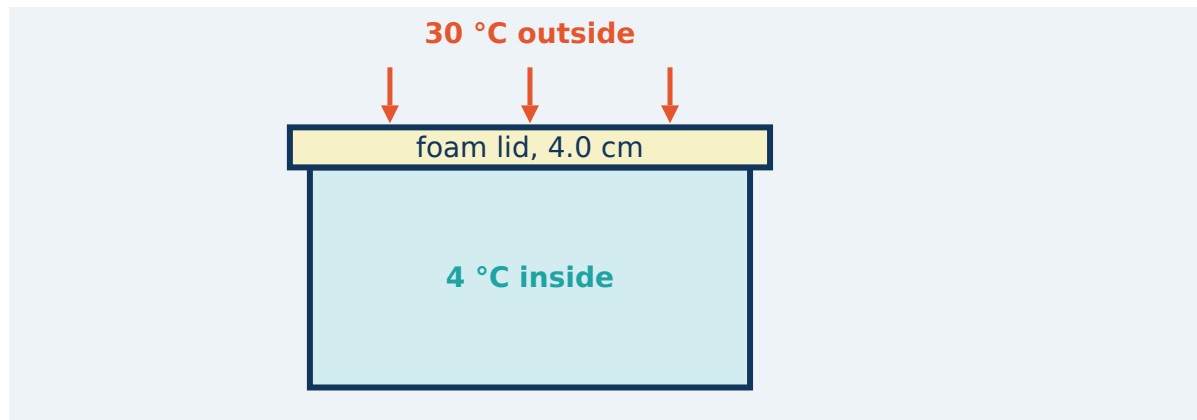


Pressure of a fixed amount of gas in a rigid vessel.

A fixed amount of gas in a rigid 5.0 L vessel gives the graph.

- Explain why the line passes through the origin. (1 mark)
- Calculate the gradient in Pa/K. (1 mark)
- Use the gradient to find the amount of gas. (1 mark)

Question 5 A cool box lid (3 marks)



Heat leaks mostly through the lid.

The foam lid has $k = 0.033 \text{ W/(m}\cdot\text{K)}$, area 0.30 m^2 and thickness 4.0 cm . The inside is at $4 \text{ }^\circ\text{C}$ and the outside at $30 \text{ }^\circ\text{C}$.

- Calculate the heat flow rate through the lid. (2 marks)
- State the effect on the rate of doubling the lid thickness. (1 mark)

Question 6 Metal and wood (3 marks)

Two door handles, one of steel and one of wood, are both at $15 \text{ }^\circ\text{C}$. Your hand is at $33 \text{ }^\circ\text{C}$.

- Explain why the steel handle feels colder. (2 marks)
- State which material has the larger thermal conductivity. (1 mark)

Question 7 Faulty reasoning (2 marks)

A student states that when a gas is heated from 20 °C to 40 °C its v_{rms} doubles because 40 is twice 20.

- a. Explain the error. (1 mark)
- b. Calculate the true ratio of the speeds. (1 mark)

Question 8 Compressing air (2 marks)

A sealed syringe of air is slowly compressed to half its volume. The temperature stays constant.

- a. State the new pressure in terms of the old. (1 mark)
- b. Explain this result in terms of collisions with the walls. (1 mark)