

Gas pressure, volume and the kelvin scale

Physics grades 9-10 (GCSE · IGCSE · O Level · Class 9-10) · Test answers (mark scheme)

Award each mark as shown. Accept any equivalent correct wording. Allow follow-through from a wrong earlier answer, and do not penalise sensible rounding to 2 or 3 significant figures. A missing unit costs at most one mark in the whole paper.

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

Question 1 Temperature scale (2 marks)

- a. $-273\text{ }^{\circ}\text{C}$.
- b. $37 + 273 = \mathbf{310\text{ K}}$.

Marking: 1 mark each part.

Question 2 How gas creates pressure (3 marks)

The particles move randomly at high speed. They collide with the walls and bounce back, which changes their momentum and so exerts a force. Very many collisions each second give a steady force on each unit of area, which is the pressure.

Marking: random motion / collisions with walls (1); each collision gives a force (1); many collisions give steady pressure = force per area (1).

Question 3 Pump (3 marks)

$$p_2 = p_1 V_1 / V_2 = 100 \times 250 / 40 = \mathbf{625\text{ kPa}}.$$

Marking: law used (1), substitution (1), answer with unit (1).

Question 4 Syringe and gauge (4 marks)

- a. $150 \times 30 = \mathbf{4500\text{ kPa cm}^3}$.
- b. $p = 4500 / 18 = \mathbf{250\text{ kPa}}$.
- c. The temperature (and the mass of gas).

Marking: (a) 1; (b) rearrangement 1, answer 1; (c) 1.

Question 5 Heating a cylinder (3 marks)

$$T_1 = 288\text{ K and } T_2 = 348\text{ K. } p_2 = 200 \times 348 / 288 = 241.7 = \mathbf{242\text{ kPa}}.$$

Marking: conversion to kelvin (1), substitution (1), answer (1).

Question 6 Pressure rise on heating (2 marks)

The particles gain kinetic energy and move faster, so they hit the walls harder. They also hit the walls more often because they travel faster across a fixed volume, so the force per unit area increases.

Marking: faster particles (1); harder and more frequent collisions (1).

Question 7 Lowest temperature (2 marks)

At $-273\text{ }^{\circ}\text{C}$ (0 K) the particles have the lowest possible kinetic energy, so their motion cannot slow down any further. There is no lower energy state, so no lower temperature exists.

Marking: particles have minimum energy (1); cannot lose any more (1).

Question 8 Condition for Boyle's law (1 mark)

Constant temperature (or a fixed mass of gas).

Marking: 1 mark for either condition.