AQA, Edexcel, OCR

A Level

A Level Physics

Ideal gases

Name:

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Total Marks: /30

1. Real gases have complex behaviours which are difficult to model accurately. One simplified model is the kinetic theory, according to which macroscopic properties temperature and pressure can be calculated from simple assumptions about the microscopic behaviour of atoms and molecules.

Total for Question 1: 9

(a) Calculate the molar mass of N_2O. [1]

(b) State three assumptions of the kinetic theory of gases. [3]

(c) Explain why a gas exerts a pressure. [2]

(d) Explain how you would go about calculating the value of absolute zero using a water bath. [3]

2. A box whose sides all measure 0.4 m contains one molecule of mass 7.6×10^{-26} kg bouncing elastically between opposite walls at 800 ms^{-1}.

Total for Question 2: 12

(a) State Boyle's Law. [1]

(b) What is the change of momentum when the molecule collides with a wall? [2]

(c) How many collisions occur with a given face in a period of 1.0 s? [1]

(d) Calculate the average pressure on a single face. [3]

(e) When placed on the weighing scales, a different, sealed box measures 100 N. It contains methane (CH_4) at a pressure of 20 kPa and temperature of 25°C. Given that the box alone has a mass of 10 kg, calculate the volume of the box. [5]

3. This question is about the speed with which particles in an ideal gas move and about how this affects different particles' energies.

Total for Question 3: 9

(a) A box containing fifty helium molecules measures $2.0 \times 0.5 \times 2.0$ m. If the r.m.s. speed of the particles is 1500 ms^{-1}, calculate the pressure inside the box. [3]

(b) Using the ideal gas law ($pV = NkT$) and the equation for the r.m.s. speed of a molecule, show that the kinetic energy of a particle is given by $\frac{3}{2}kT$. [3]

(c) What effect will doubling the absolute temperature of an ideal gas have on its internal energy? Justify your answer. [3]