



QUESTION WORKBOOK

Molecular kinetic theory

Thermal physics · Year 13

AQA 3.6.2.3 · CIE 15.3 · OCR A 5.1.4

10 questions · 30 marks

PRINT EDITION

SECTION A · Warm-up

A1 State three assumptions of the kinetic theory model of an ideal gas. [2]

A2 Calculate the average kinetic energy of a gas molecule at 300 K, using mean KE = $(3/2)kT$ ($k = 1.38 \times 10^{-23} \text{ J K}^{-1}$). [2]

A3 State the kinetic theory equation relating pressure, volume and molecular speed. [2]

SECTION B · Standard

B1 Calculate the average kinetic energy of a gas molecule at 400 K. [3]

- B2** A nitrogen molecule has a mass of 4.7×10^{-26} kg. Calculate its root-mean-square speed at 300 K, using $\frac{1}{2}m(c_{\text{rms}})^2 = \frac{3}{2}kT$. [4]

- B3** A gas of density 1.2 kg m^{-3} has molecules with an rms speed of 500 m s^{-1} . Calculate its pressure, using $p = \frac{1}{3}\rho(c_{\text{rms}})^2$. [3]

- B4** At the same temperature, explain which has the greater root-mean-square speed: a light molecule or a heavy one. [3]

SECTION C · Stretch

- C1** An oxygen molecule has a mass of 5.3×10^{-26} kg. Calculate its root-mean-square speed at 290 K. [4]

- C2** A gas is at 300 K. Calculate the temperature to which it must be raised to double the root-mean-square speed of its molecules. [4]

- C3** Explain how the kinetic theory model accounts for the pressure a gas exerts on its container. [3]