InkPhysics

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

NAVY SCREEN EDITION

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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 ($k = 1.38 \times 10^{-23}$ 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 $\frac{1}{2}m(c_{rms})^2 = (3/2)kT$. [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 $p = \frac{1}{3}\rho(c_{rms})^2$. [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]