inkPhysics

ANSWER BOOK

Ideal gases and the gas laws

Thermal physics · Year 13

AQA 3.6.2.2 · CIE 14.2, 15.1, 15.2 · OCR A 5.1.4

10 questions · 30 marks

NAVY EDITION

SECTION A · Warm-up

A1 At constant temperature, the pressure of a fixed mass of gas is inversely proportional to its volume (pV = constant). [2]

A2 $p = nRT/V = (2.0 \times 8.31 \times 300)/0.05 = 9.972 \times 10^4$ Pa. [2]

A3 For a fixed volume of gas, pressure falls linearly as temperature falls. Extending the straight line back to zero pressure gives the temperature at which molecular motion would cease, -273°C, which is absolute zero (0 K). [2]

SECTION B · Standard

B1 $p_1V_1 = p_2V_2$, so $p_2 = (1.0 \times 10^5 \times 0.020)/0.005 = 4.0 \times 10^5$ Pa. [3]

B2 $V = nRT/p = (0.50 \times 8.31 \times 300)/(2.0 \times 10^5) = 6.23 \times 10^{-3}$ m^3. [4]

B3 $p = NkT/V = (3.0 \times 10^{23} \times 1.38 \times 10^{-23} \times 290)/0.010 = 1.20 \times 10^5$ Pa. [3]

B4 At constant pressure V/T is constant: $V_2 = V_1T_2/T_1 = 0.010 \times 400/300 = 0.0133$ m^3. [3]

SECTION C · Stretch

C1 $W = p\Delta V = 2.0 \times 10^5 \times (0.015 - 0.010) = 1000$ J. [4]

C2 From $pV = NkT$: $N = pV/(kT) = (1.0 \times 10^5 \times 0.024)/(1.38 \times 10^{-23} \times 300) = 5.80 \times 10^{23}$ molecules. [4]

C3 At low pressure and high temperature (and low density), when the molecules are far apart. Then intermolecular forces are negligible and the molecules' own volume is tiny compared with the container, as the ideal-gas model assumes. [3]