

Heat, work and engines on PV diagrams

AP Physics 2 (algebra-based) · Lab answers

The volume is proportional to the kelvin temperature, so the line of best fit passes close to the origin. The work done by the gas is of the order of one joule, which is only about 29% of the heat supplied; the other 71% raises the internal energy of the air.

Level: AP Physics 2 (algebra-based) · **Curriculum:** AP P2 Unit 9

Question 1 Constant pressure

The plunger moves freely, so the gas pressure always equals the atmospheric pressure outside. A change at constant pressure is an **isobaric process**.

Question 2 The graph

The points lie close to a straight line that rises as T increases. **V is proportional to T (kelvin)**, so the line extrapolates to the origin.

Question 3 Gradient

Gradient = $(58.4 - 50.0)/(343 - 293) = 8.4/50 = \mathbf{0.168 \text{ mL/K}}$.

Question 4 Absolute zero

$V = 0$ when $T = 293 - 50.0/0.168 = 293 - 298 = \mathbf{-4.62 \text{ K}}$, which is $-278 \text{ }^\circ\text{C}$ and close to the accepted value of $-273 \text{ }^\circ\text{C}$.

Question 5 Amount of air

$n = (1.01 \times 10^5 \times 50.0 \times 10^{-6})/(8.31 \times 293) = \mathbf{2.07 \times 10^{-3} \text{ mol}}$.

Question 6 Work done

Work by the gas = $p\Delta V = 1.01 \times 10^5 \times (58.4 - 50.0) \times 10^{-6} = \mathbf{0.848 \text{ J}}$.

Question 7 Heat needed

$Q = 3.5 \times 2.07 \times 10^{-3} \times 8.31 \times 50 = \mathbf{3.02 \text{ J}}$. Fraction = $0.848/3.02 = \mathbf{0.28}$ (the theory gives $2/7 = 0.29$).