

Density, pressure, buoyancy and moving fluids

AP Physics 1 (algebra-based) · Lab answers

Sample values come from the data table. If your own results are slightly different, check that the line goes through the origin and that your gradient is close to $9.8 \times 10^3 \text{ N/m}^3$. Always show the method before the final number.

Level: AP Physics 1 (algebra-based) · **Curriculum:** AP P1 Unit 8

Question 1 Plot and describe

The points lie close to a straight line through the origin, so B is directly proportional to V : doubling the volume doubles the buoyant force. $B \propto V$.

Question 2 Gradient

Gradient = $0.49 / 50 = 9.8 \times 10^{-3} \text{ N/cm}^3$. Since $1 \text{ cm}^3 = 10^{-6} \text{ m}^3$, gradient = **$9.8 \times 10^3 \text{ N/m}^3$** .

Question 3 Density of water

The gradient equals ρg , so $\rho = 9.8 \times 10^3 / 9.81 = \textbf{9.99} \times \textbf{10}^2 \textbf{ kg/m}^3$ (about 1.0×10^3), within 0.1 % of the accepted value.

Question 4 Density of aluminium

$m = W_{\text{air}}/g = 1.32 / 9.81 = 0.1346 \text{ kg}$; $V = 5.0 \times 10^{-5} \text{ m}^3$; $\rho = 0.1346 / 5.0 \times 10^{-5} = \textbf{2.7} \times \textbf{10}^3 \textbf{ kg/m}^3$.

Question 5 Uncertainty

B is a difference of two readings, so its absolute uncertainty is $\pm 0.02 \text{ N}$. For 10 cm^3 : $0.02/0.10 = \textbf{20} \%$. For 50 cm^3 : $0.02/0.49 = \textbf{4} \%$. Larger objects give a better measurement.

Question 6 Effect of bubbles

Bubbles add displaced volume, so the upward force is larger and W_{water} is smaller. B is too large, so the calculated density of water is **too high**.

Question 7 Salt water prediction

$B = \rho V g = 1100 \times 5.0 \times 10^{-5} \times 9.81 = \textbf{0.54 N}$, which is 10 % larger than in fresh water.