InkPhysics

QUESTION WORKBOOK

Fluids: pressure, upthrust and viscosity

Materials · Year 12

CIE 4.3 · OCR A 3.2.4

12 questions · 32 marks

NAVY SCREEN EDITION

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SECTION A · Warm-up

A1 State the equation for the pressure due to a column of fluid, defining each symbol, and state one quantity the pressure does not depend on. [2]

A2 Calculate the pressure due to the water at the bottom of a swimming pool 2.5 m deep (density of water 1000 kg m^{-3}). [2]

A3 State what is meant by upthrust and give its size in terms of the fluid displaced. [2]

SECTION B · Standard

B1 A stone of volume 3.0×10^{-4} m^3 is fully submerged in water. Calculate the upthrust on it. [3]

B2 A submarine cruises 30 m below the surface of sea water of density 1025 kg m^{-3}. Calculate the pressure due to the water at this depth, and state what must be added to find the total pressure on the hull. [3]

B3 Explain, in terms of pressure, why the upthrust on a submerged object acts upwards. [2]

B4 An iceberg of density 920 kg m^{-3} floats in fresh water of density 1000 kg m^{-3}. Calculate the fraction of its volume below the surface. [3]

B5 State the conditions under which Stokes' law applies to the drag on a moving sphere. [2]

SECTION C · Stretch

C1 A sphere of radius 1.5 mm moves at 0.12 m s^{-1} through oil of viscosity 0.25 Pa s. Calculate the viscous drag on it. [3]

C2 A small sphere falls through glycerol of viscosity 0.85 Pa s. Its weight exceeds the upthrust on it by 1.8×10^{-4} N, and its radius is 1.0 mm. Calculate its terminal velocity. [4]

C3 Estimate the depth of fresh water that produces a pressure equal to one atmosphere (1.01×10^{5} Pa), and comment on what this means for a diver at 20 m. [3]

C4 A student measures the viscosity of syrup by timing a ball bearing falling between two marks. Explain why the marks must be placed well below the surface, and why the temperature must be recorded. [3]