

AS Physics 9702

Unit 4 · Forces, density and pressure

Original worksheet

Name: _____ Date: _____

Suggested marks: 73. Work through the questions over more than one study session if needed. Use additional paper for extended working and graph paper where requested.

Show equations, substitutions, units and reasoning. Use the constants specified in each question. The questions are original practice, not an official Cambridge examination or mark scheme.

Scope: Cambridge International AS Physics 9702, 2025–2027 learning outcomes. The published 2028–2030 AS scope has been checked separately and is substantively unchanged. Version: 11 October 2026.

U4-Q1 · 6 marks

(a) Explain how to locate the centre of gravity of an irregular thin card using a clamp, pin and plumb line. (b) A 24.0 N force acts 0.300 m from a pivot, at 40.0° to the lever. Calculate its moment magnitude. (c) State the moment of a force whose line of action passes through the pivot.

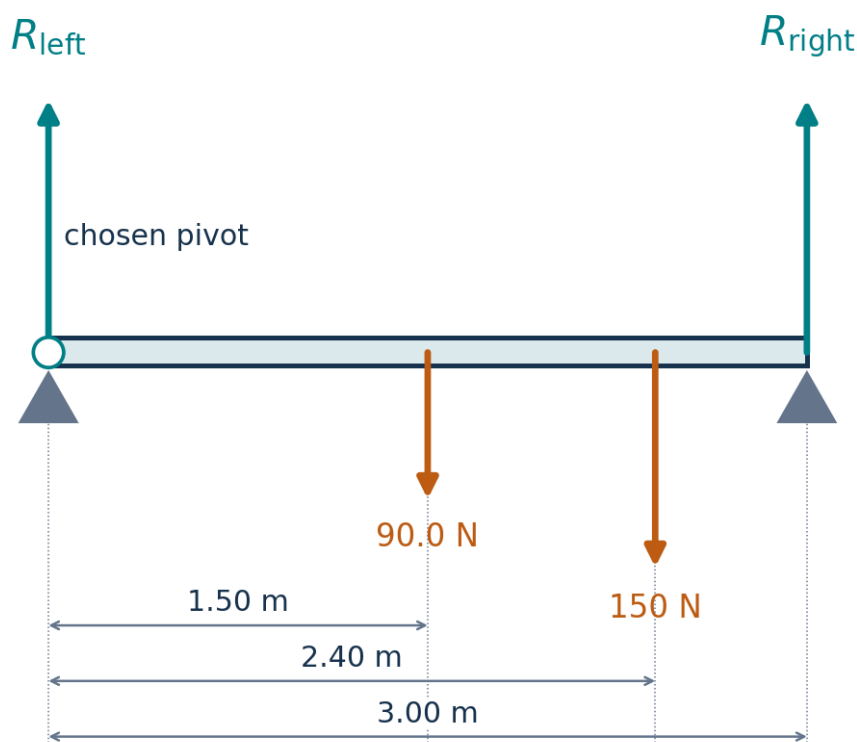
U4-Q2 · 6 marks

Two parallel forces, each 35.0 N, act in opposite directions along lines separated by 0.240 m. (a) Explain why they form a couple. (b) Calculate resultant force and torque. (c) Show that calculating moments about the midpoint gives the same torque. (d) What changes if the lines of action coincide?

U4-Q3 · 7 marks

A uniform horizontal beam is 3.00 m long and weighs 90.0 N. It is supported at its two ends. An additional 150 N load acts 2.40 m from the left end. (a) State both conditions for equilibrium. (b) Find the support reactions. (c) Explain why the beam's weight is placed at 1.50 m in the calculation.

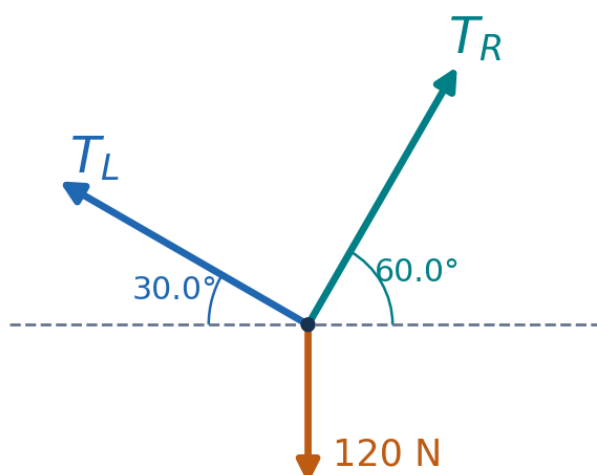
Figure for U4-Q3

Uniform beam in equilibrium

U4-Q4 · 8 marks

A 120 N load hangs from a small knot connected to two light cables. The left cable rises at 30.0° above the horizontal; the right cable rises at 60.0° . (a) Find both tensions. (b) Describe a closed vector triangle for the three forces. (c) Explain why a triangle made from three arbitrary force magnitudes does not alone establish equilibrium.

Figure for U4-Q4

Forces at the knot**Construct the force triangle**

Construction space

Force-arrow lengths are schematic.

U4-Q5 · 6 marks

An irregular solid has mass 156 g. Water in a measuring cylinder rises from 42.0 cm³ to 62.0 cm³ when it is fully immersed. (a) Calculate density in kg m⁻³. (b) Give two precautions that improve the volume measurement. (c) Explain why an attached air bubble would bias the density result.

U4-Q6 · 5 marks

A machine foot exerts a uniform normal force of 720 N on a rectangular pad measuring 12.0 cm by 8.00 cm. Find the mean pressure in Pa. If each side length is doubled while force remains unchanged, what is the new pressure? Explain the area dependence.

U4-Q7 · 7 marks

Using an imaginary stationary fluid column of area A , height Δh and density ρ , derive $\Delta p = \rho g \Delta h$. Identify the forces and give two assumptions. Explain why the result does not depend on the column area.

U4-Q8 · 7 marks

A liquid has density 850 kg m⁻³. Take $g = 9.81 \text{ m s}^{-2}$ and surface pressure 101 kPa. (a) Find gauge and absolute pressure at depth 3.20 m. (b) State the gradient and intercept of an absolute-pressure versus depth graph. (c) Would a wider container change the pressure at the same depth?

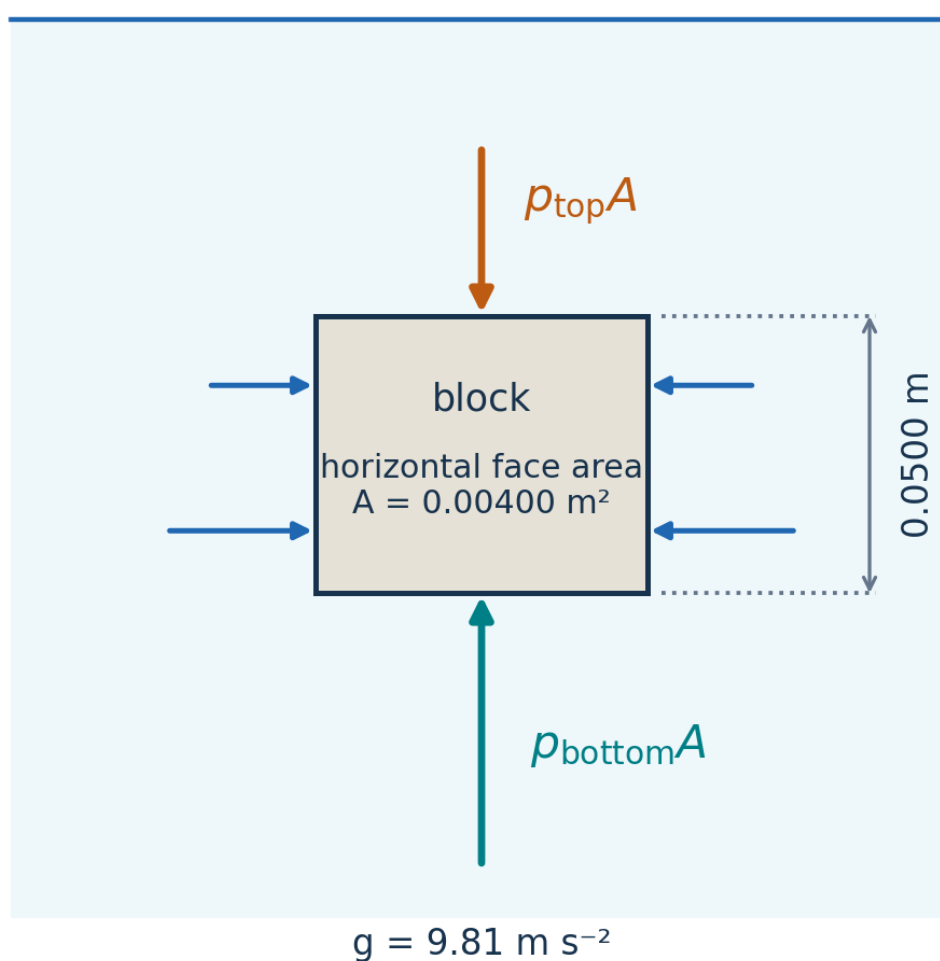
U4-Q9 · 8 marks

A block has horizontal area 0.00400 m^2 and height 0.0500 m . It is fully immersed in water of density 1000 kg m^{-3} . Use $g = 9.81 \text{ m s}^{-2}$. (a) Find the pressure difference between its lower and upper faces. (b) Calculate upthrust from pressure forces and independently from displaced volume. (c) Explain whether lowering the rigid block another metre changes its upthrust.

Figure for U4-Q9

Pressure forces on a submerged block

Water: $\rho = 1000 \text{ kg m}^{-3}$



Arrows show forces; pressure is a scalar.

U4-Q10 · 7 marks

A 0.350 kg object of volume $1.50 \times 10^{-4} \text{ m}^3$ hangs at rest from a string while fully immersed in a liquid of density 800 kg m^{-3} . Take $g = 9.81 \text{ m s}^{-2}$. (a) Find upthrust and string tension. (b) A different uniform block of density 600 kg m^{-3} floats freely in water of density 1000 kg m^{-3} . Find the fraction of its volume submerged.

U4-Q11 · 3 marks

Diagnostic multiple choice. Which condition alone guarantees complete equilibrium of a rigid body? A: Zero resultant force. B: Zero resultant moment about one chosen point. C: Zero resultant force and zero resultant moment. D: Two equal and opposite parallel forces with separated lines of action. Choose one and explain the distractors.

U4-Q12 · 3 marks

Diagnostic multiple choice. A rigid sealed object is fully immersed in a liquid of constant density and moved deeper without changing its volume. What happens? A: Pressure and upthrust both increase. B: Pressure increases but upthrust stays the same. C: Pressure stays the same but upthrust increases. D: Both pressure and upthrust stay the same. Choose one and explain the distractors.

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