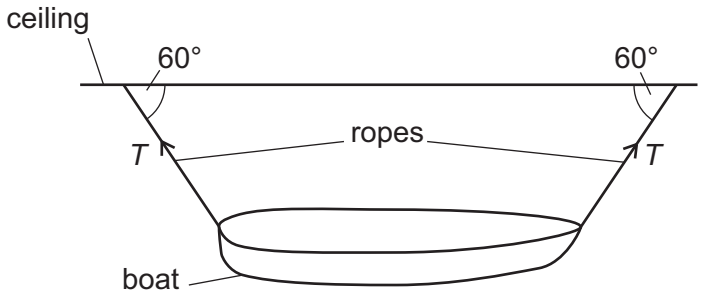
1 The diagram shows a boat stored in a shed. The boat is suspended from the ceiling of the shed by two ropes.



The tension T in each of the ropes is 75 N.

(a) Draw a vector diagram to determine the resultant of the forces exerted by the two ropes on the boat. State the scale you used.

scale = ...

magnitude of resultant force = ...

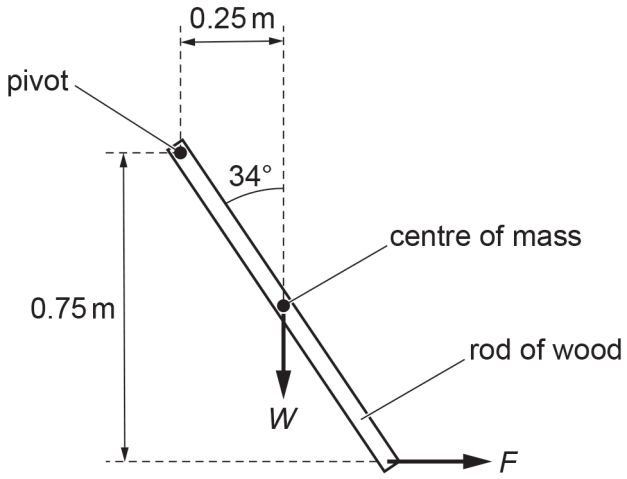
direction of resultant force = ... [4]

(b) Determine the mass of the boat.

mass = ... [1]

[Total: 5]

2 The diagram shows a uniform rod of wood suspended from a pivot.



(not to scale)

The rod is held stationary by a horizontal force *F* acting as shown.
The mass of the rod is 0.080 kg.

(a) Calculate the weight *W* of the rod.

weight = ... [1]

(b) Calculate the moment of *W* about the pivot.

moment = ... [2]

(c) Calculate the moment of *F* about the pivot.

moment = ... [1]

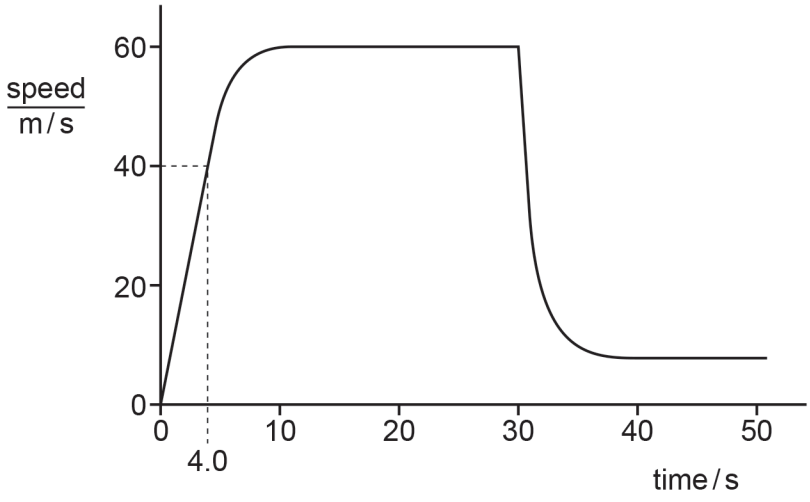
(d) Calculate the force *F*.

force = ... [2]

[Total: 6]

3 A sky-diver jumps out of a hot-air balloon, which is 4000 m above the ground. At time = 30 s, she opens her parachute.

The graph is the speed-time graph of her fall.



Describe, in terms of the forces acting on the sky-diver, her motion between leaving the balloon and opening her parachute.

.....

.....

.....

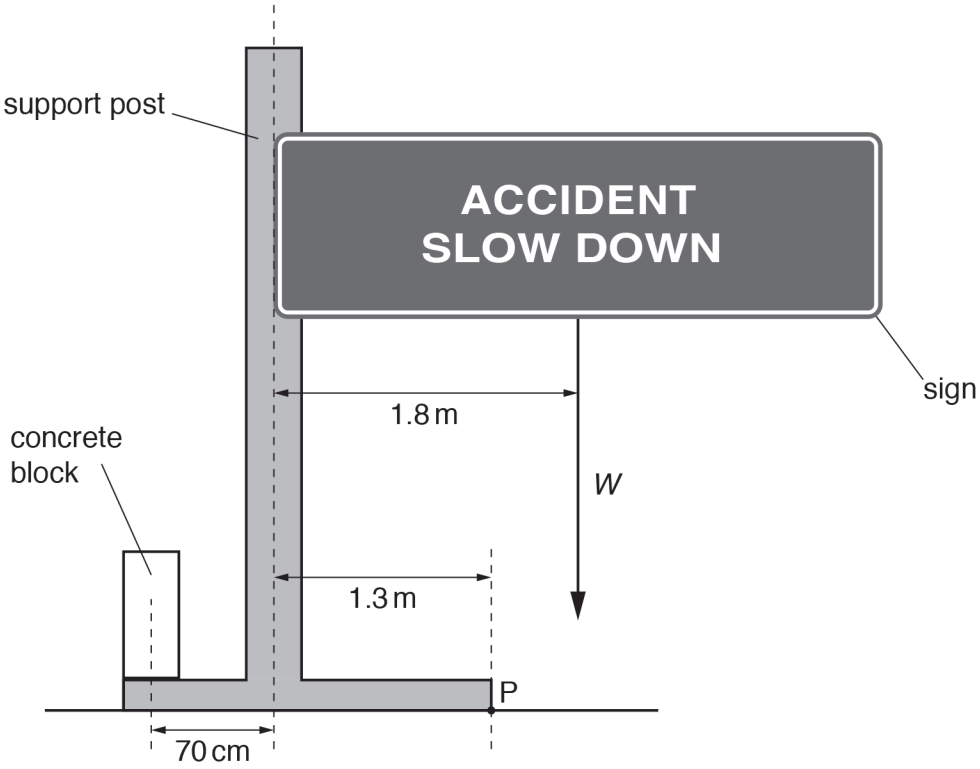
.....

.....

..... [4]

[Total: 4]

4 The diagram shows a sign that extends over a road.



The mass of the sign is 3.4×10^3 kg.

(a) Calculate the weight *W* of the sign.

W = ... [2]

(b) The weight of the sign acts at a horizontal distance of 1.8 m from the centre of the support post and it produces a turning effect about point P.

Point P is a horizontal distance of 1.3 m from the centre of the support post.

(i) Calculate the moment about P due to the weight of the sign.

moment = ... [3]

(ii) A concrete block is positioned on the other side of the support post with its centre of mass a horizontal distance of 70 cm from the centre of the support post.

State what is meant by *centre of mass*.

.....

..... [1]

(iii) The weight of the concrete block produces a moment about point P that exactly cancels the moment caused by the weight *W*.

Calculate the weight of the concrete block.

weight = ... [2]

(c) The concrete block is removed. The sign and support post rotate about point P in a clockwise direction.

State and explain what happens to the moment about point P due to the weight of the sign as it rotates.

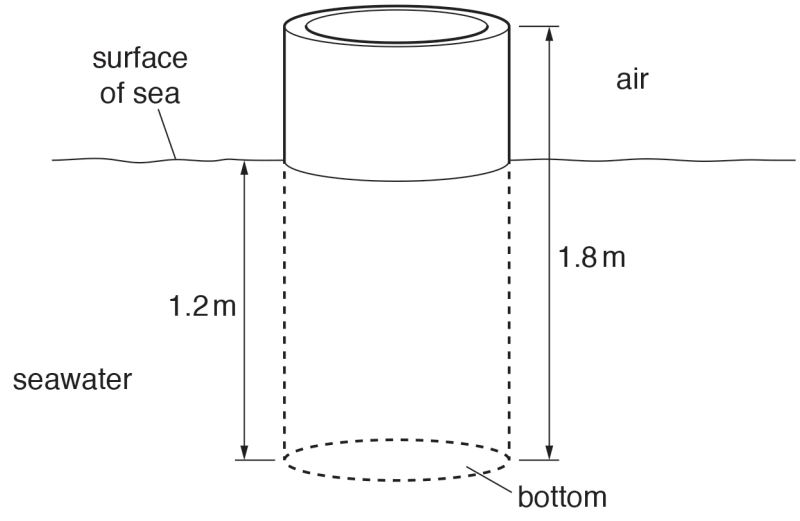
.....

.....

..... [2]

[Total: 10]

5 The diagram shows a hollow metal cylinder containing air, floating in the sea.



(a) The density of the metal used to make the cylinder is greater than the density of seawater.

Explain why the cylinder floats.

.....

..... [1]

(b) The cylinder has a length of 1.8 m. It floats with 1.2 m submerged in the sea. The bottom of the cylinder has an area of cross-section of 0.80 m^2.

The density of seawater is 1020 kg / m^3.

Calculate the force exerted on the bottom of the cylinder due to the depth of the seawater.

force = ... [4]

(c) Deduce the weight of the cylinder. Explain your answer.

weight = ...

explanation .....

..... [2]

[Total: 7]

6 A rectangular container has a base of dimensions 0.12 m × 0.16 m. The container is filled with a liquid. The mass of the liquid in the container is 4.8 kg.

(a) Calculate

(i) the weight of liquid in the container,

weight = ... [1]

(ii) the pressure due to the liquid on the base of the container.

pressure = ... [2]

(b) Explain why the total pressure on the base of the container is greater than the value calculated in **(a)(ii)**.

.....

..... [1]

(c) The depth of liquid in the container is 0.32 m.

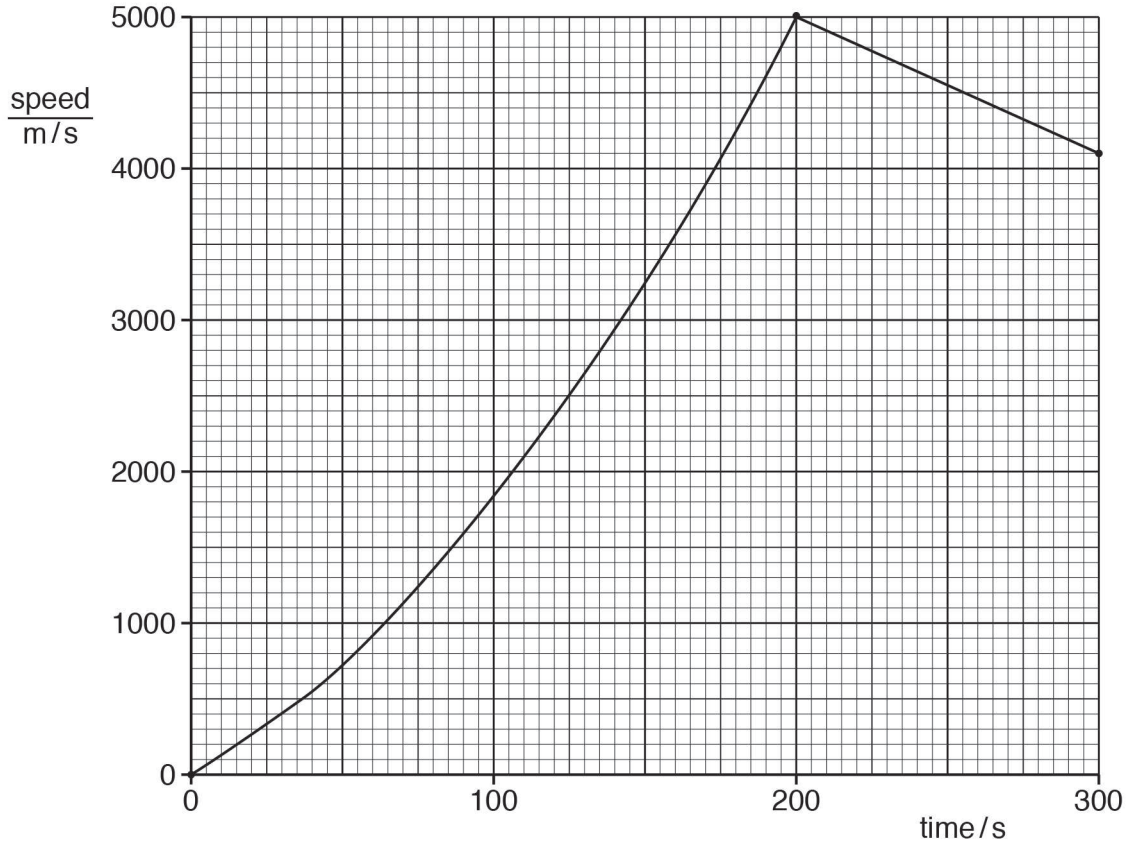
Calculate the density of the liquid.

density = ... [2]

[Total: 6]

7 There is no atmosphere on the Moon.

A space probe is launched from the surface of the Moon. The graph is a speed-time graph of the space probe.



(a) Between time = 0 and time = 150 s, the acceleration of the space probe changes.

Without calculation, state how the graph shows this.

.....

..... [1]

(b) Between time = 0 and time = 150 s, the thrust exerted on the space probe by the motor remains constant.

State one possible reason why the acceleration changes in the way shown in the speed-time graph.

.....

..... [1]

[Total: 2]