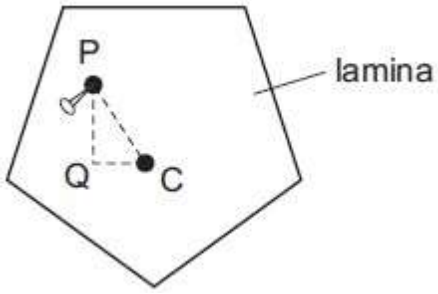
NAME: .....

EQUILIBRIUM AND CENTRE OF GRAVITY

1. A flat lamina is freely suspended from point P.
The weight of the lamina is 2.0 N and the centre of mass is at C.

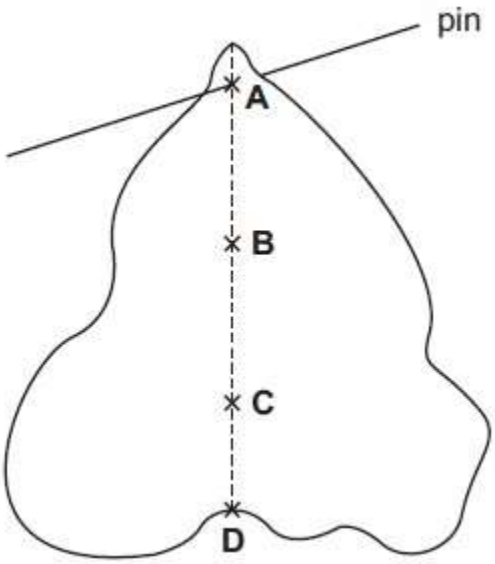
PC = 0.50 m
PQ = 0.40 m
QC = 0.30 m



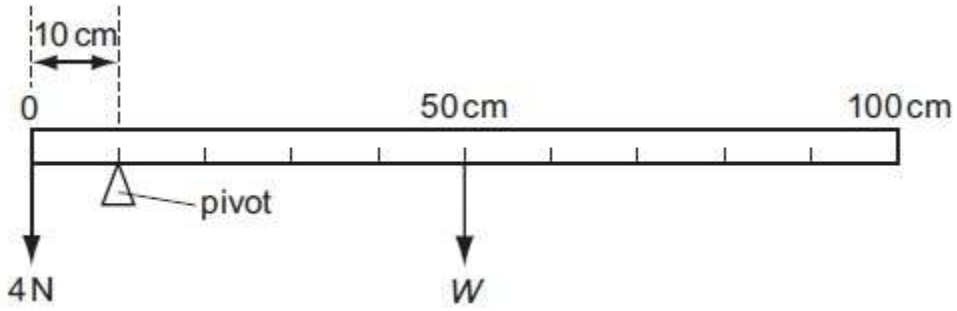
The lamina is displaced to the position shown.
What is the moment that will cause the lamina to swing?

A 0.60 N m clockwise
B 0.80 N m anticlockwise
C 1.0 N m clockwise
D 1.0 N m anticlockwise

2. A piece of uniform card is suspended freely from a horizontal pin.
At which of the points shown is its centre of gravity?



3. A uniform metre rule is balanced by a 4 N weight as shown in the diagram.



What is the weight W of the metre rule?

A 1 N
B 4 N
C 16 N
D 40 N

4. (a) Masses are hung from the end of a helical spring and the following results are obtained.

Mass/g	0	50	100	150	200	250
Length of spring/cm		5.0	6.0	7.0	8.0	9.0

(i) What is the length of the unstretched spring?

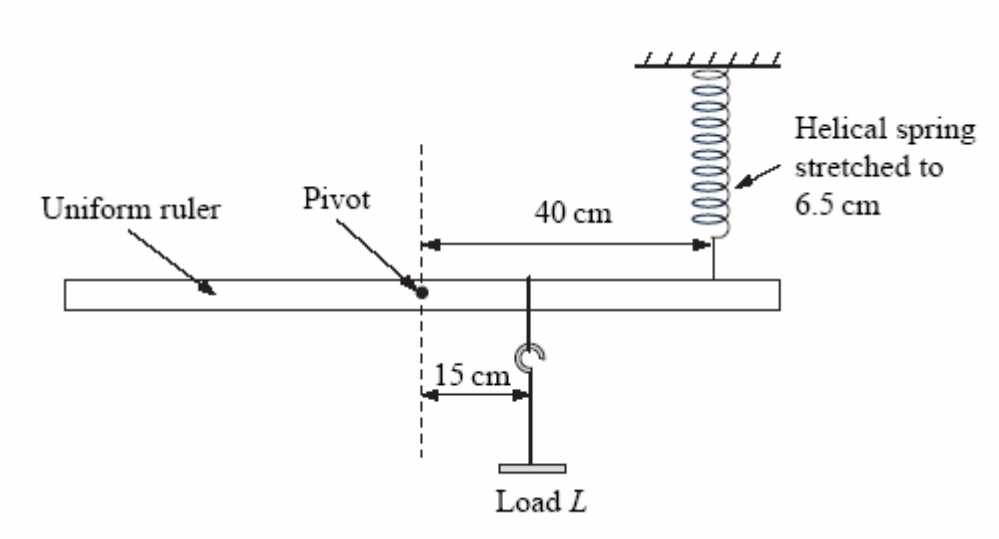
..... (1)

(ii) What force is needed to stretch the spring to a length of 6.5 cm?

.....

..... (2)

(b) A uniform ruler is pivoted at its centre of mass. The same spring is attached to a point 40 cm from the pivot as shown. A load L is hung on the ruler at a point 15 cm from the pivot. This stretches the spring to a length of 6.5 cm. The ruler remains horizontal.



Use the information provided to calculate the mass of the load L.

.....

.....

.....

..... (3)

[Total 6m]

5. (a) State the two conditions required for the equilibrium of a body acted upon by a number of forces.

1. .....

.....

2. .....

.....[2]

(b) Fig. 3.1 shows a diagram of an arm with the hand holding a weight of 120 N.

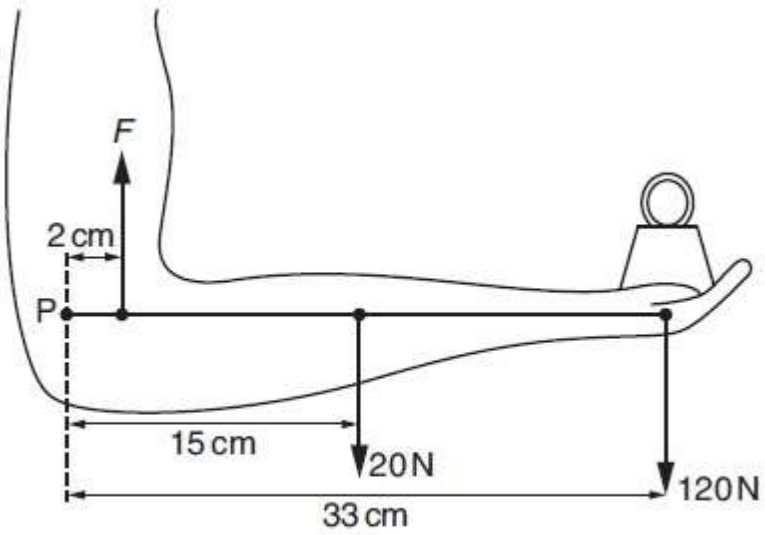


Fig. 3.1

The 20 N force is the weight of the forearm, acting at its centre of mass. F is the force in the muscle of the upper arm. P is the point in the elbow about which the arm pivots. The distances of the forces from point P are shown.

(i) By taking moments about point P, calculate the force **F**.

force *F* = ...[3]

(ii) A force acts on the forearm at point P. Calculate this force and state its direction.

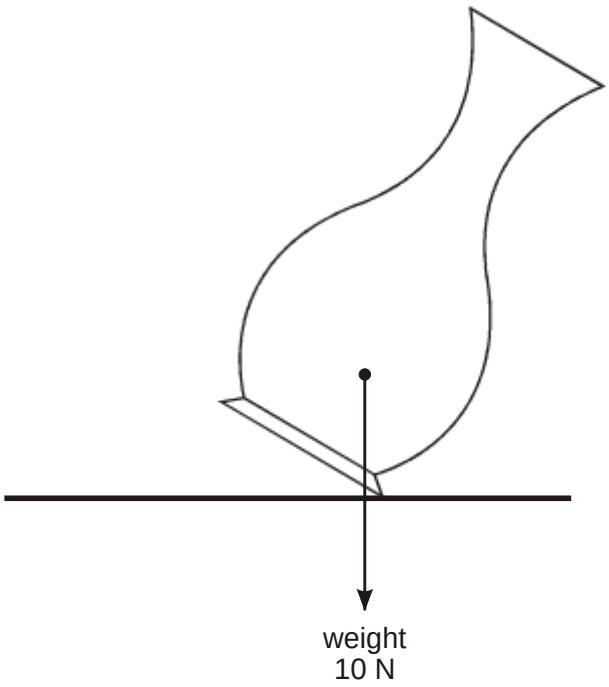
force = ...

direction = ...[2]

[Total: 7]

6.

(a)



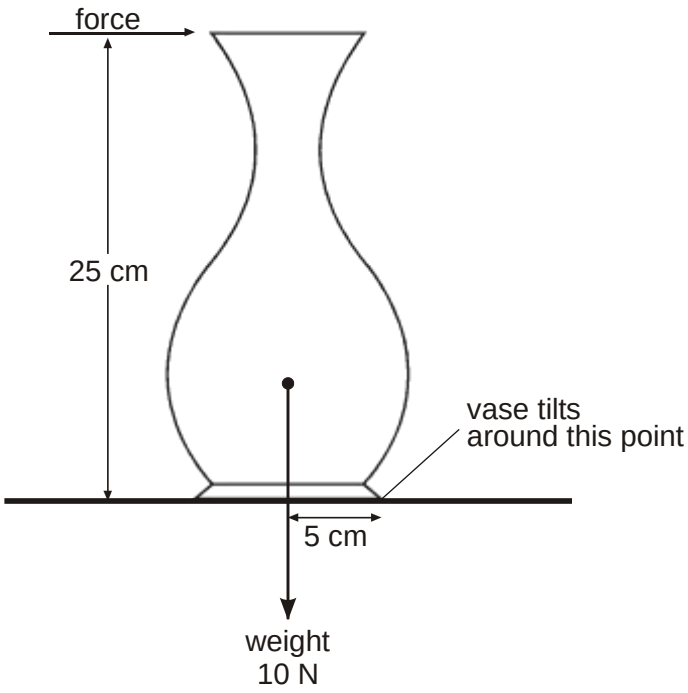
A vase is held at an angle as shown in the diagram above. When it is released it falls back on its base.

Explain why, in terms of moments.

……
……

1 mark

(b)



In the diagram above, the top of the vase is being given a push.
The force is just large enough to make the vase start to tilt.

(i) Calculate the size of the force. Show your working and give the correct unit.

.....

.....

.....

.....
.....

3 marks

(ii) If the base of the vase were wider, a larger force would be needed to make the vase start to tilt. Explain why, in terms of moments.

.....
.....

1 mark

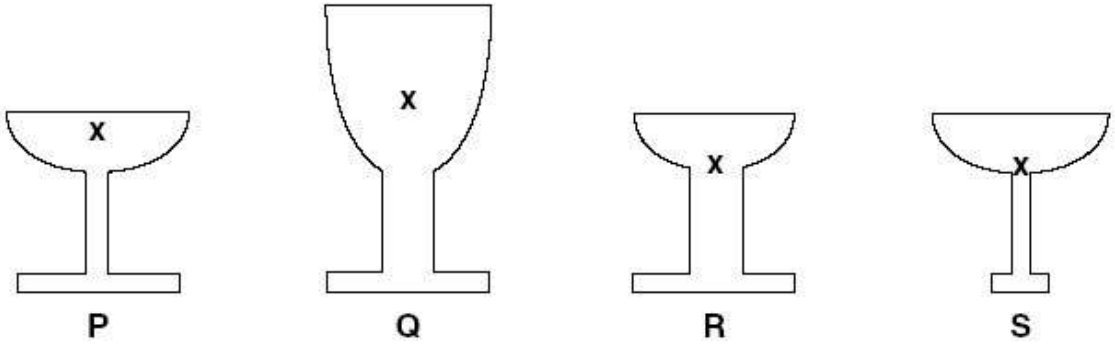
Maximum 5 marks

7. (a) An athlete wins a trophy for completing a 200 m race in a time of 25 s. Calculate the average speed of the athlete.

Show your working and state the unit.

speed = ... [3]

(b) Fig. 5.1 shows four designs for the trophy, **P**, **Q**, **R** and **S**. The position of the centre of mass of each trophy is marked with an **X**.



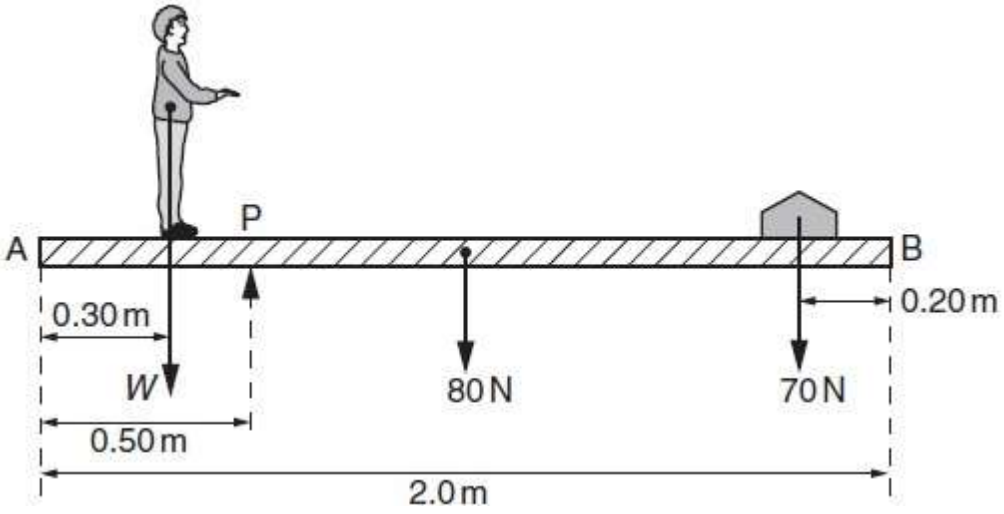
State and explain which trophy would be the most stable.

.....

.....

..... [3]

8. A student is being weighed. The student, of weight W, stands 0.30 m from end A of auniform plank AB, as shown in Figure below.



The plank has weight 80 N and length 2.0 m. A pivot P supports the plank and is 0.50 m from end A. A weight of 70 N is moved to balance the weight of the student. The plank is in equilibrium when the weight is 0.20 m from end B.

(i) State the two conditions necessary for the plank to be in equilibrium.

1

2

[2]

(ii) Determine the weight W of the student.

W = ... N [3]

(iii) If only the 70 N weight is moved, there is a maximum weight of student that can be determined using the arrangement shown in Fig. 3.1. State and explain one change that can be made to increase this maximum weight.

[2]