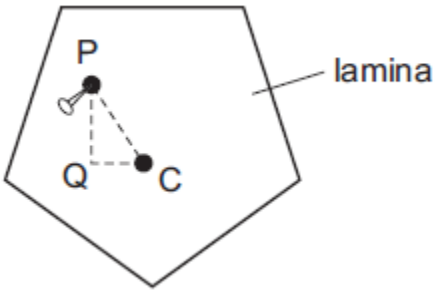
NAME: .....

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.

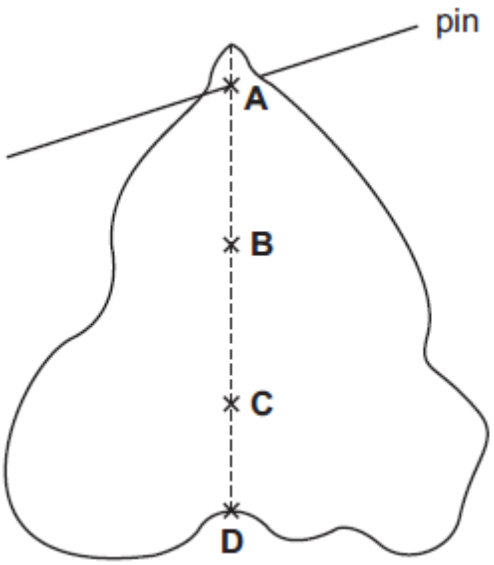
PC = 0.50 m
PQ = 0.40 m
QC = 0.30 m



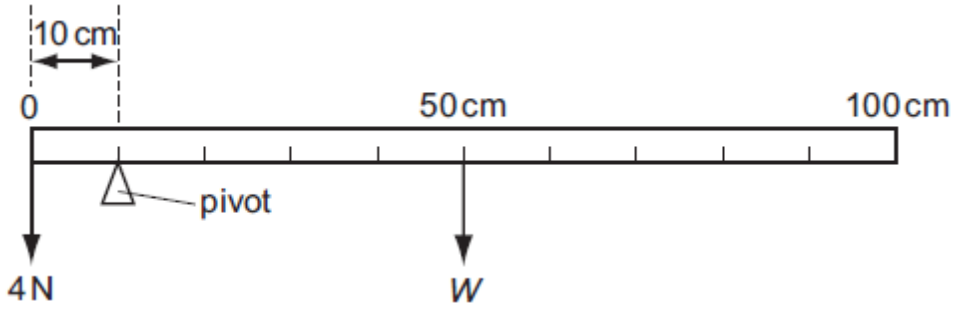
The lamina is displaced to the position shown.
What is the moment that will cause the lamina to swing?

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?

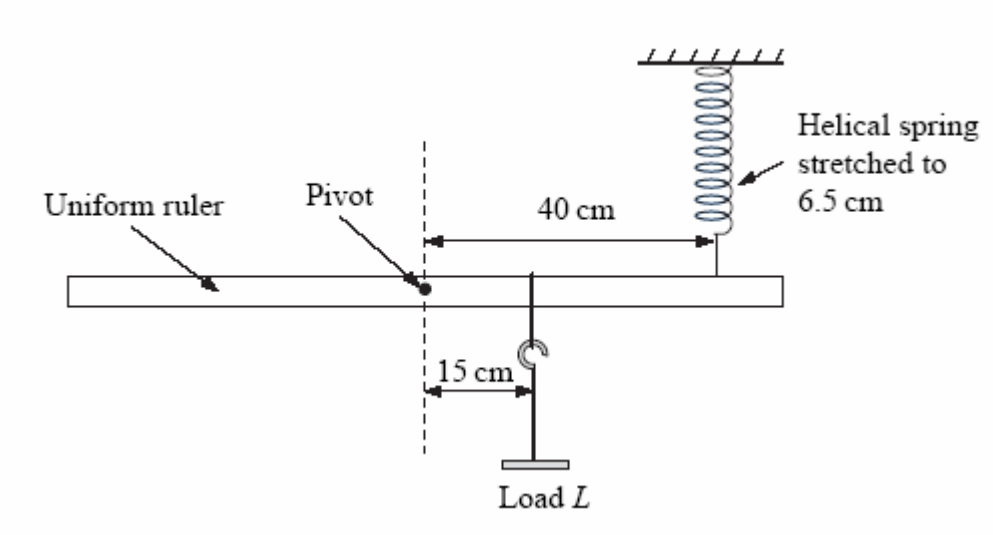
..... (1)

(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.

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..... (3)

[Total 6m]

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

1. .....

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2. .....

.....[2]

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

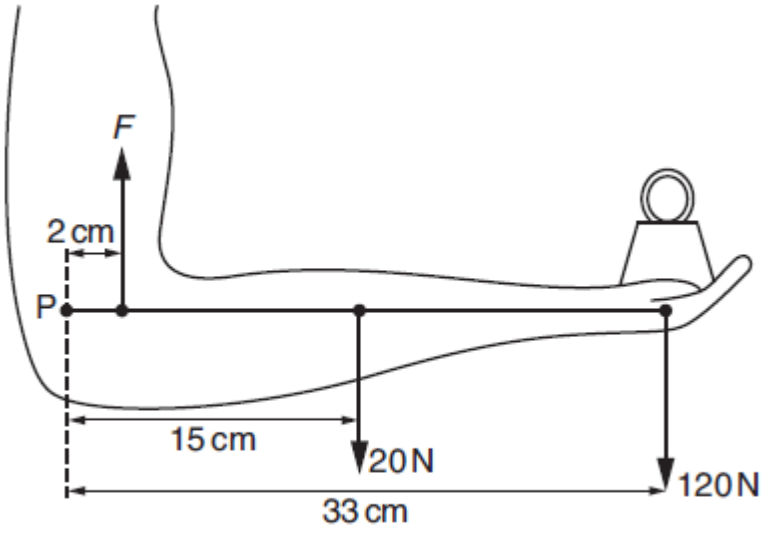


Fig. 3.1

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.

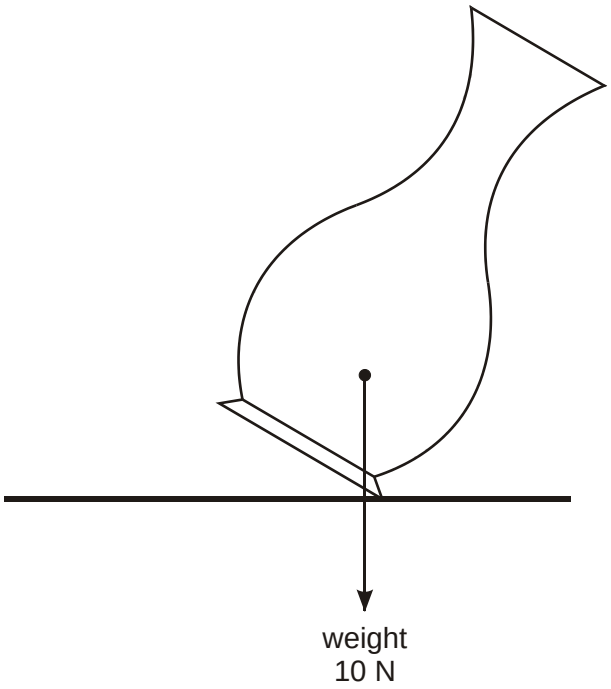
force = ...

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.

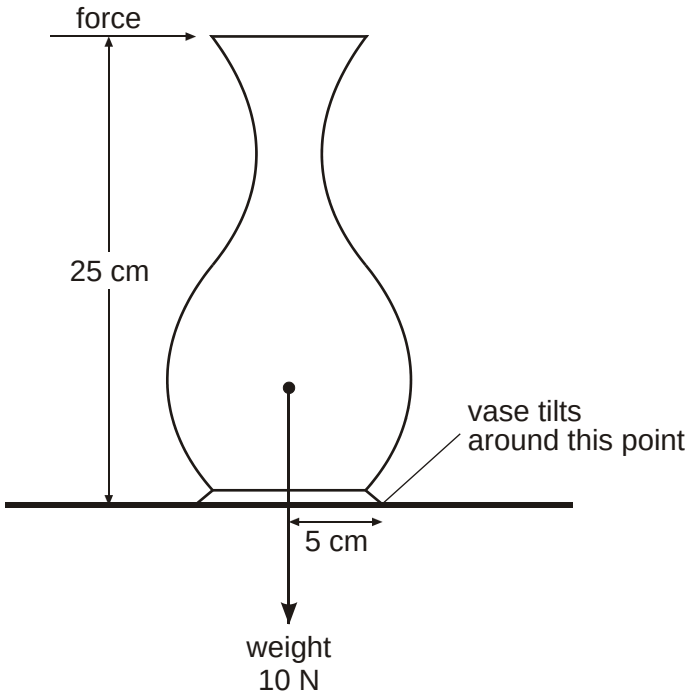
Explain why, in terms of moments.

….……

….……

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.

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.....

.....

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

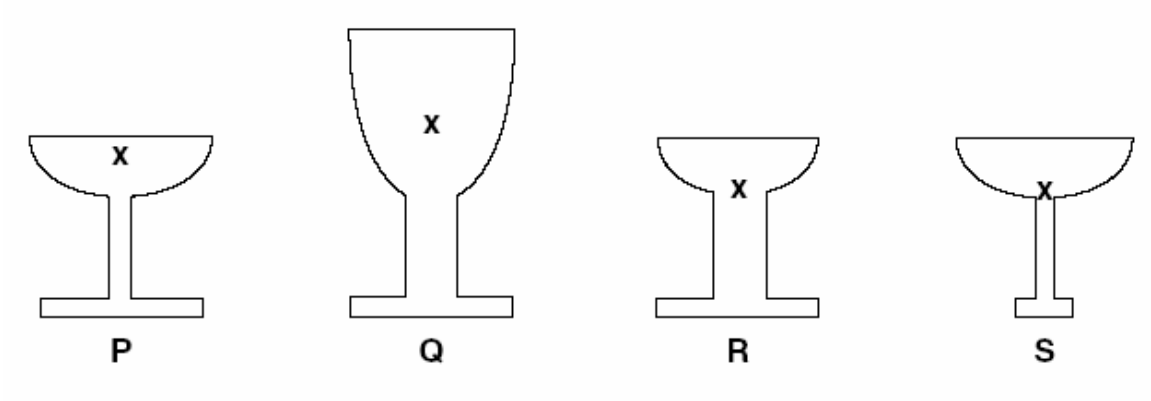
Maximum 5 marks

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.

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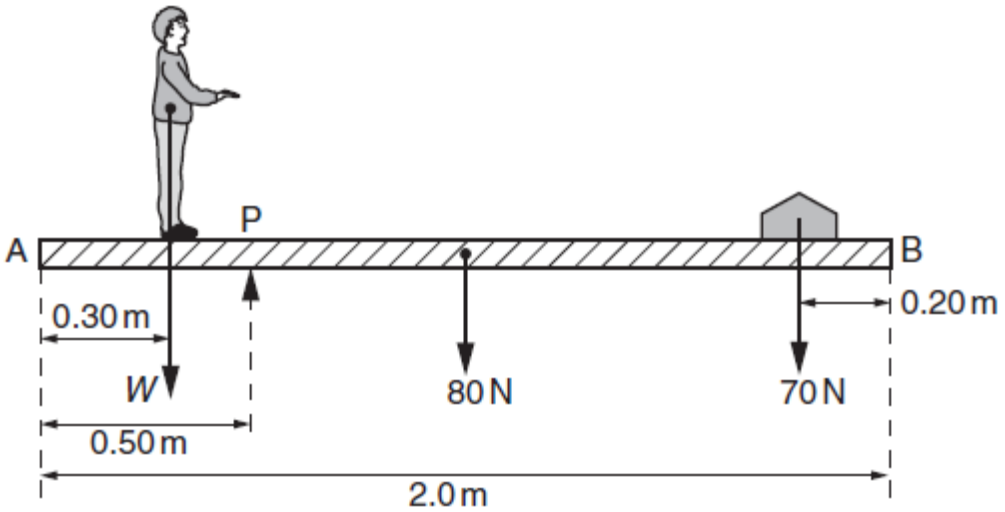
..... [3]

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]