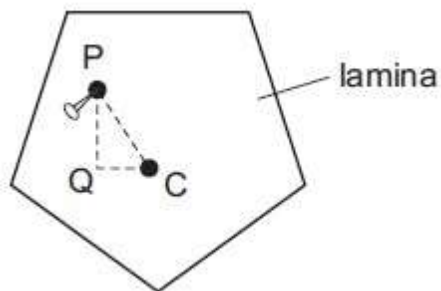


NAME: .....

**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.

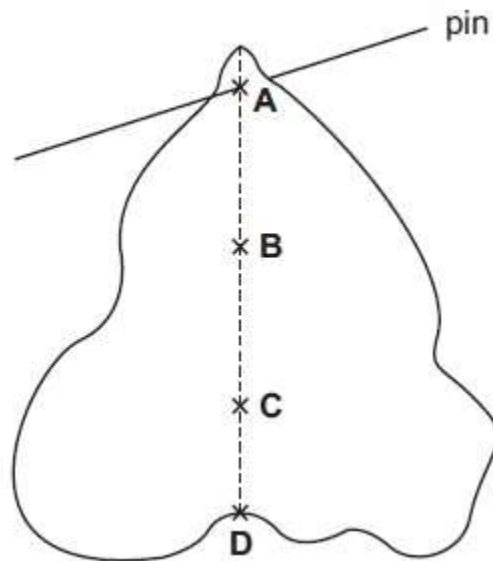
- PC = 0.50 m
- PQ = 0.40 m
- QC = 0.30 m



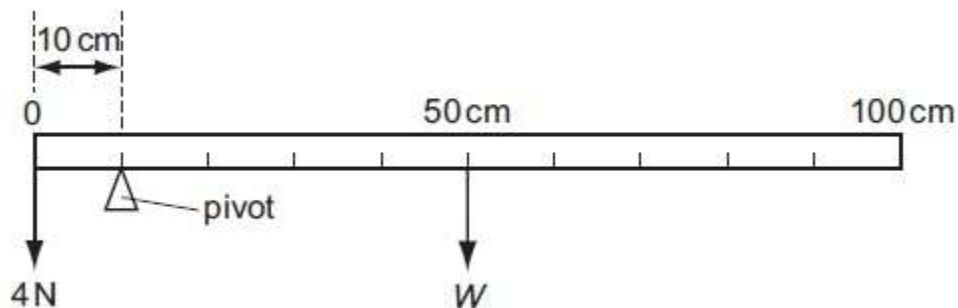
The lamina is displaced to the position shown.  
What is the moment that will cause the lamina to swing?

- 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?

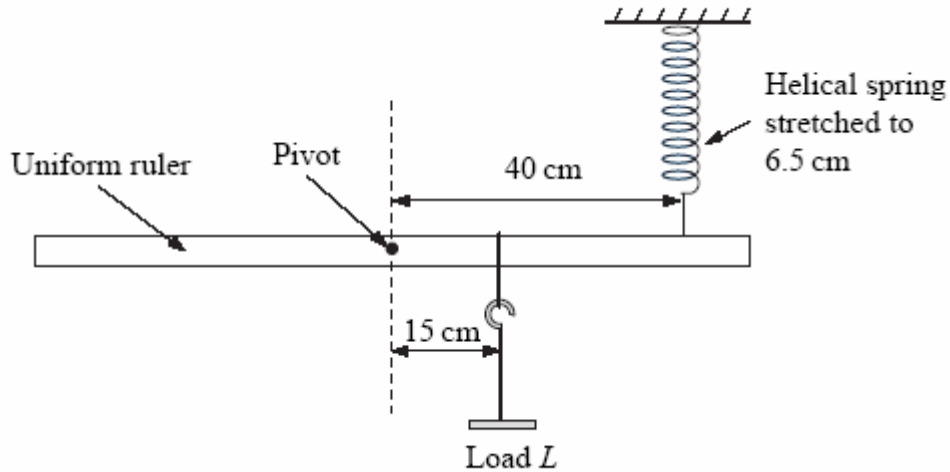
..... (1)

(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.

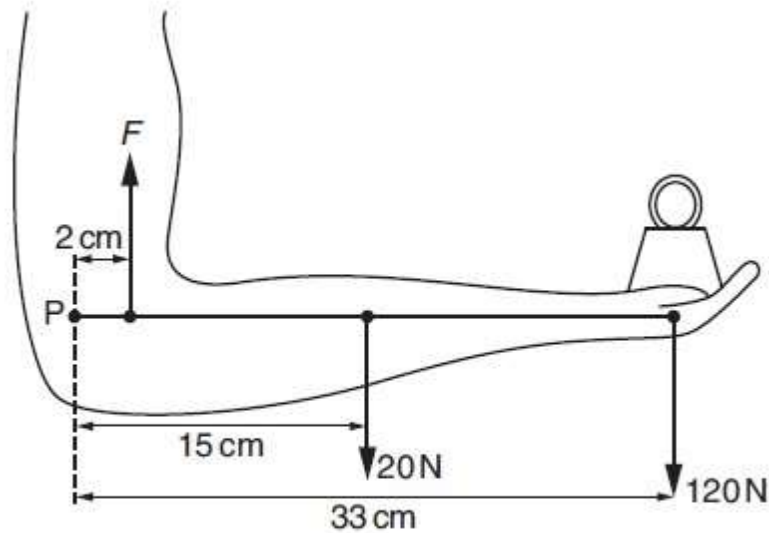


Fig. 3.1

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.

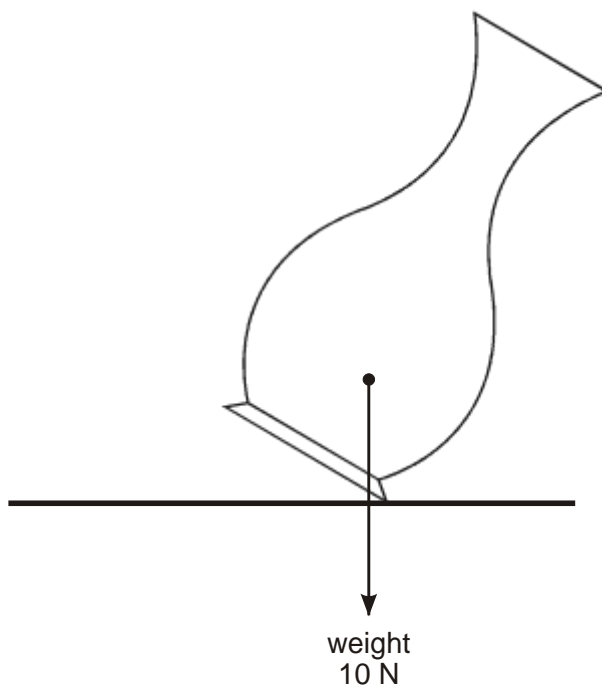
force = .....

direction = .....[2]

[Total: 7]

6.

(a)



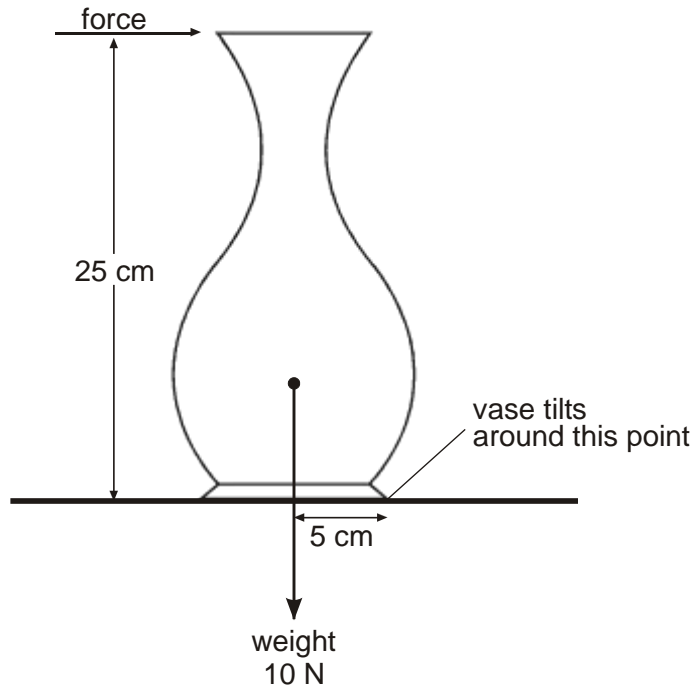
A vase is held at an angle as shown in the diagram above. When it is released it falls back on its base.

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

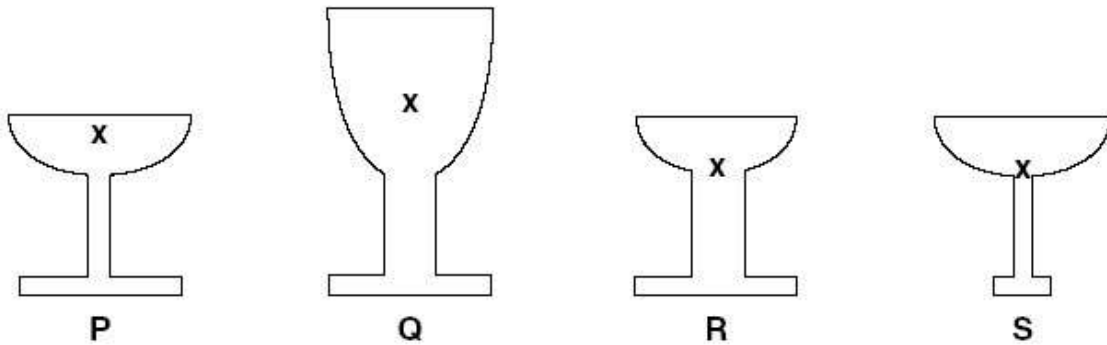
7. (a) An athlete wins a trophy for completing a 200 m race in a time of 25 s. Calculate the average speed of the athlete.



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.

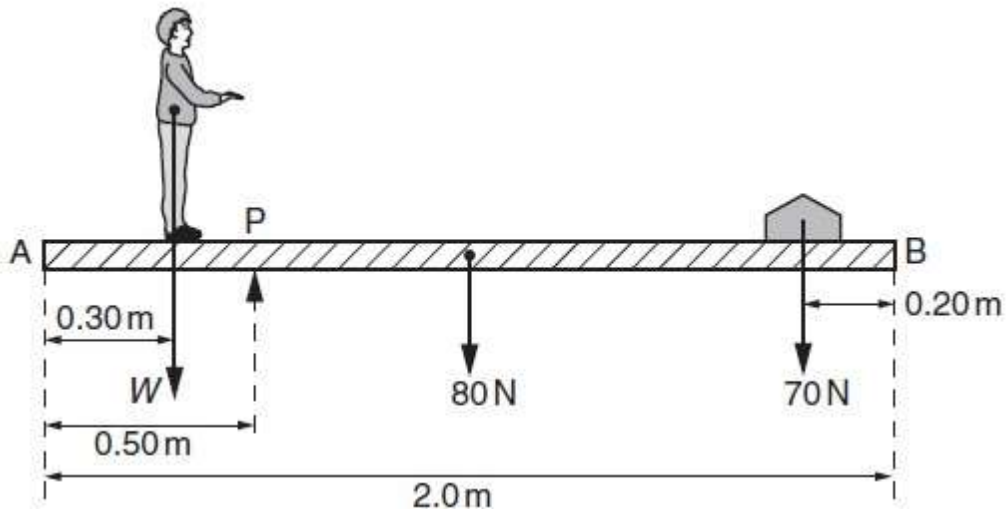


State and explain which trophy would be the most stable.

.....  
.....  
.....

[3]

8. A student is being weighed. The student, of weight  $W$ , stands 0.30 m from end A of a uniform 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.

$W = \dots\dots\dots$  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]