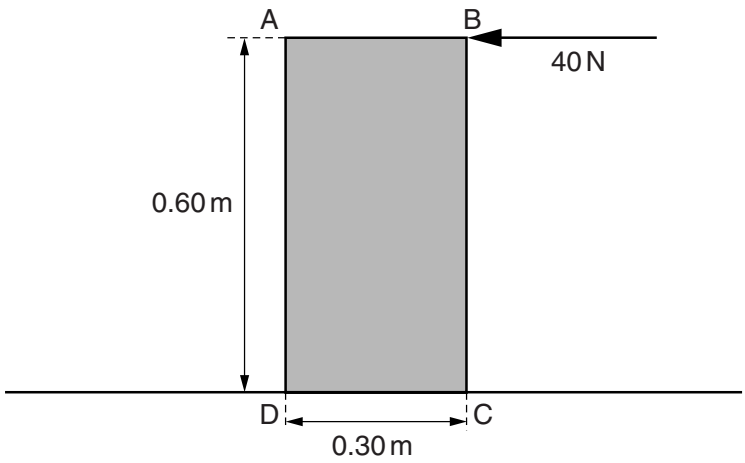
Moments 2

1) Fig. 2.1 shows a uniform, rectangular slab of concrete ABCD standing upright on the ground. The slab has height 0.60 m, width 0.30 m and mass 18 kg. A force of 40 N acts horizontally to the left at B.



(i) On Fig. 2.1, draw and label an arrow to show the weight *W* of the slab acting at its centre of mass. [1]

(ii) Calculate

1. the moment of the 40 N force about point D,

moment = ...

2. the moment of *W* about point D.

moment = ...
[3]

(iii) The ground is rough so that the slab does not slide.

State and explain what happens to the slab as the horizontal force at B is gradually increased.

.....

.....

.....[2]

2) **(a) (i)** Write down the names of **three** man-made devices in everyday use that depend, for their action, upon the moments of forces.

1. .....

2. .....

3. .....

[2]

(ii) Fig. 3.1 shows a uniform rod AB acted upon by three equal forces *F*.

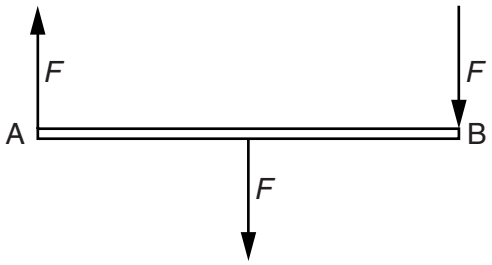


Fig. 3.1

State **two** reasons why the rod is **not** in equilibrium.

1. .....

2. .....

[2]

(b) Fig. 3.2 shows a uniform rod PQ, supported at its centre and held in a horizontal position. The length of PQ is 1.00 m.

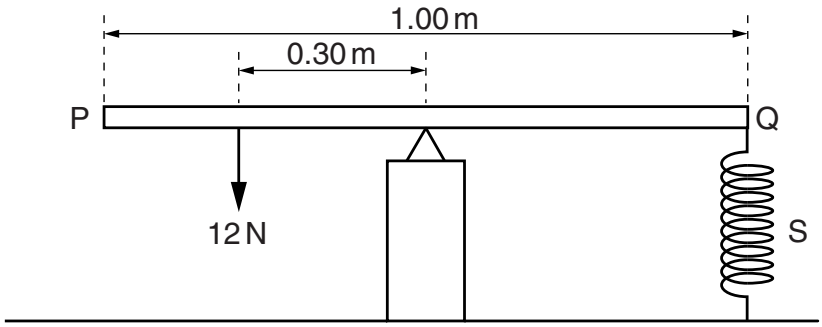


Fig. 3.2

A force of 12 N acts at a distance of 0.30 m from the support. A spring S, fixed at its lower end, is attached to the rod at Q.

(i) Calculate the force exerted on PQ by the spring.

force = ... [2]

(ii) Explain why it is not necessary to know the weight of PQ.

.....

..... [1]

[Total: 7]

3) Fig. 2.1 shows a mobile bird sculpture that has been created by an artist.

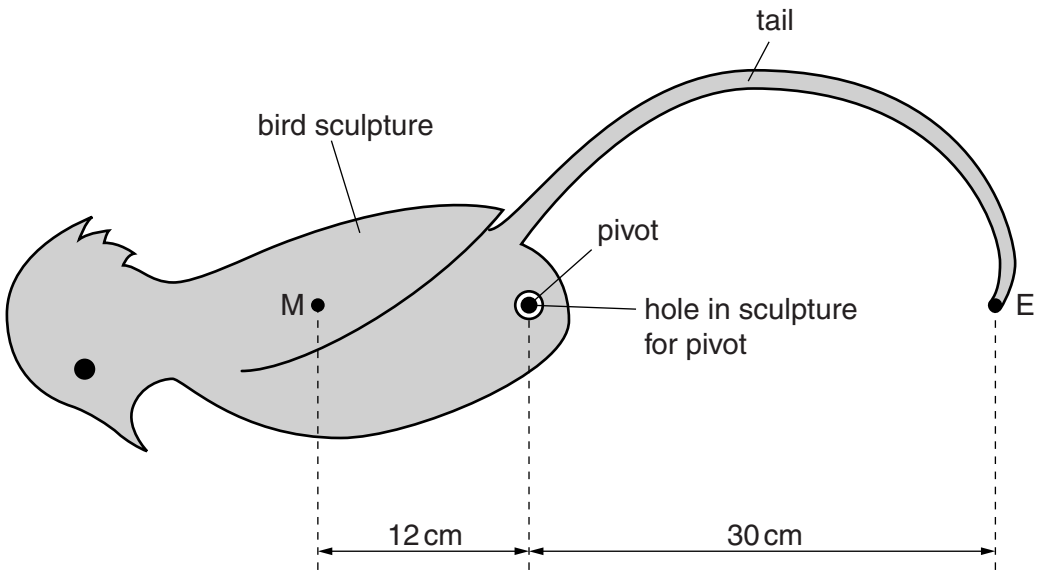


Fig. 2.1

M is the centre of mass of the bird sculpture, including its tail (but not including the counter-weight that will be added later). The mass of the bird and tail is 1.5 kg.

The bird sculpture is placed on a pivot.

The artist adds the counter-weight at the end E of the tail so that the bird remains stationary in the position shown.

(a) Calculate the mass of the counter-weight.

mass = ... [2]

(b) The centre of mass of the sculpture with counter-weight is at the pivot.

Calculate the upward force acting at the pivot.

force = ... [1]

(c) The sculpture is rotated clockwise to the position shown in Fig. 2.2. It is held still, then carefully released.

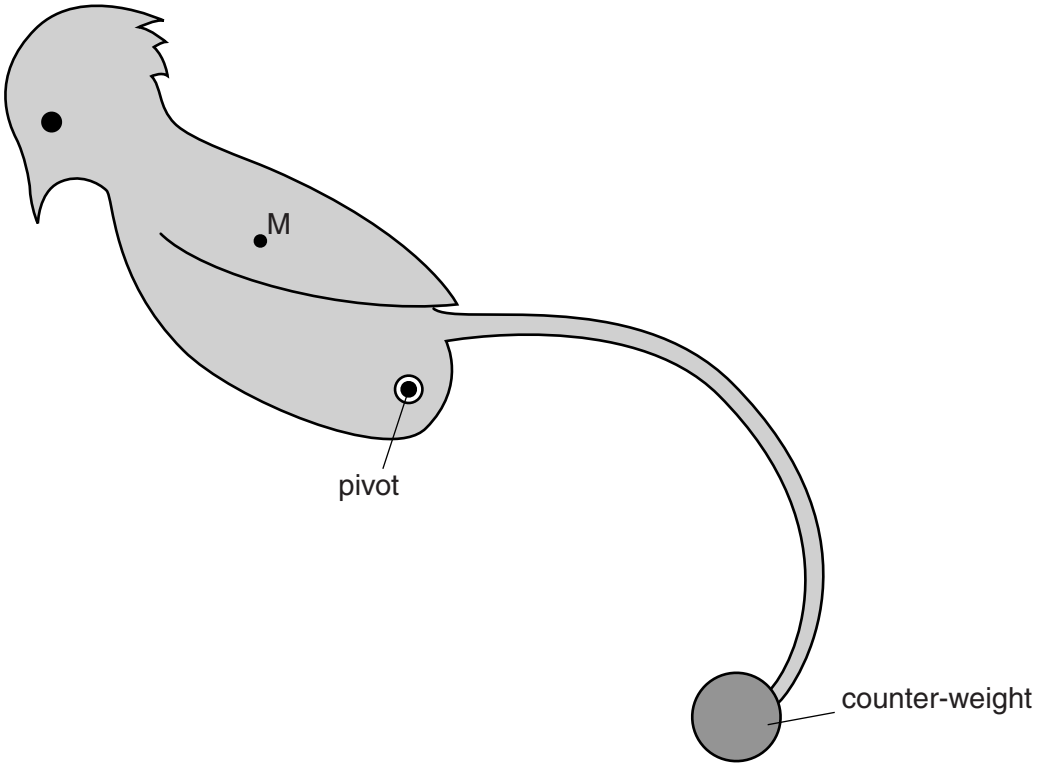


Fig. 2.2

(i) State whether the sculpture will stay in that position, rotate further clockwise or rotate back anticlockwise.

.....

.....

(ii) Explain your answer to **(i)**.

.....

.....

.....

.....

[3]

[Total: 6]

4) **(a)** Complete the following statement:

The moment of a force about a point is .....

multiplied by .....[1]

(b) Fig. 3.1 shows a uniform iron bar B of weight 30 N and length 1.40 m. The bar is being used to lift one edge of a concrete slab S. A stone, placed 0.20 m from one end of B, acts as a pivot. A force of 40 N pushing down at the other end of B is just enough to lift the slab and hold it as shown.

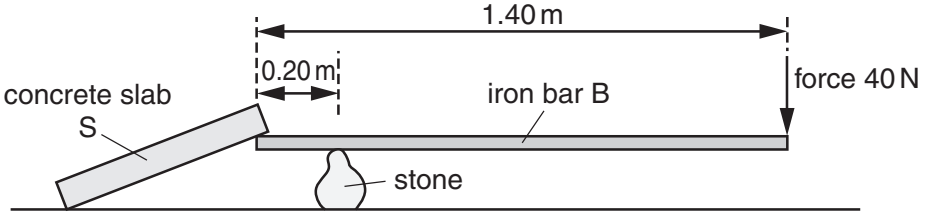


Fig. 3.1

(i) On Fig. 3.1, draw an arrow to show the weight of bar B acting from its centre of mass. [1]

(ii) State the distance *d* of the centre of mass of bar B from the pivot.

d = ...[1]

(iii) Calculate the total clockwise moment, about the pivot, of the forces acting on bar B.

total clockwise moment = ...[3]

(iv) Calculate the downward force which the slab S exerts on the end of bar B.

force = ...[2]

(v) Suggest a change to the arrangement in Fig. 3.1 that would reduce the force required to lift the slab.

.....

.....[1]

[Total: 9]

5) Fig. 2.1 shows an irregularly shaped piece of card.

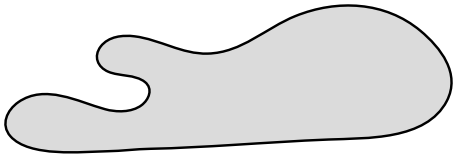


Fig. 2.1

A student is asked to find the centre of mass of the card. The student is provided with a clamp and stand, a small mass attached to a thin string and a long pin.

(a) Describe the procedure for finding the centre of mass of the card. You may draw a diagram.

.....

.....

.....

.....

.....[3]

(b) What simple test can be carried out to confirm that the centre of mass has been found?

.....

.....[1]

[Total: 4]