

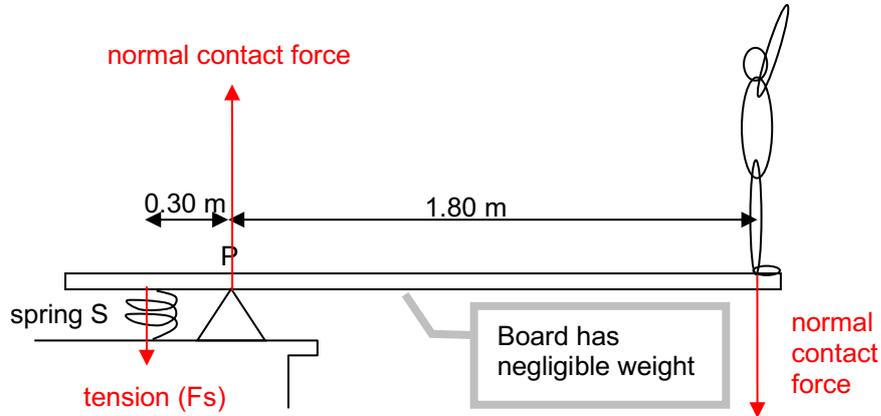


2023 Sec 3 Physics Moments Assignment 7.1 to 7.2

Answers

A7.1

1. (a)



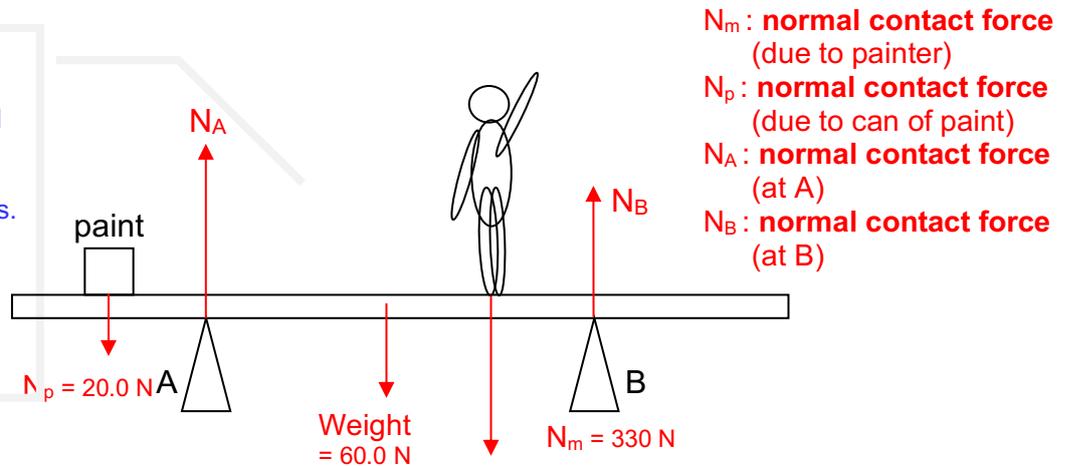
(b) Moment of weight of woman about P = $640 \text{ N} \times 1.80 \text{ m}$
 $= 1152 \text{ Nm} = \mathbf{1150 \text{ N m}}$ (3 s.f.) clockwise

(c) Since diving board is at rest, Principle of moments is applicable.

Take moments about P, Anticlockwise moment of F_s = clockwise moment of W
 $F_s \times 0.30 \text{ m} = 1152 \text{ Nm} \rightarrow F_s = \mathbf{3800 \text{ N}}$ (2 s.f.)

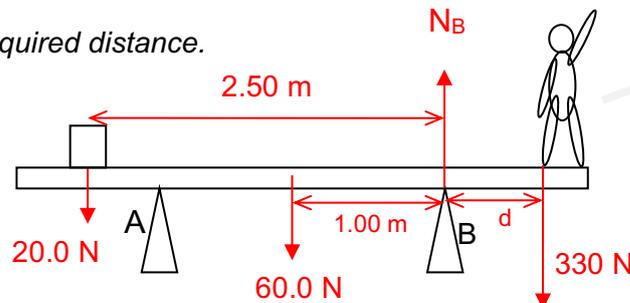
2 (a)

Note: forces acting on the plank due to the can of paint and the painter are normal contact forces, **NOT** weights. The weights act on the respective objects. Note the points where these forces act.



(b) (i) The normal contact force at A is 0 N because trestle A is no longer in physical contact with the plank OR trestle A just lost contact with the plank

(ii) Let d be required distance.



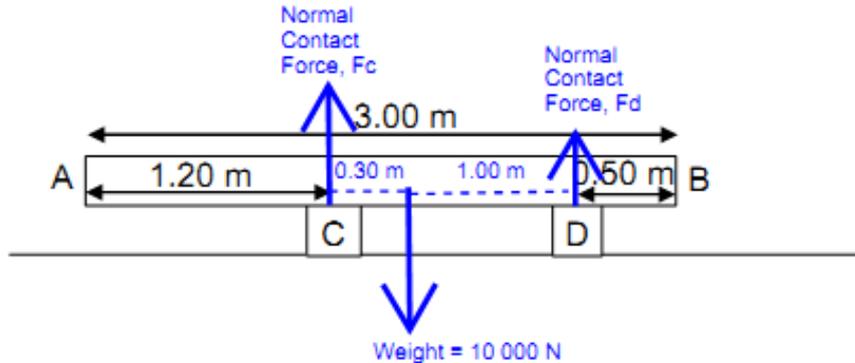
Note: It is advisable to redraw the diagram with only the relevant information, with new position of painter, and $N_A = 0$.

Take moments about B, clockwise moments = anticlockwise moments
 $330 \text{ N} \times d = (20.0 \text{ N} \times 2.50 \text{ m}) + (60.0 \text{ N} \times 1.00 \text{ m})$
 $d = \mathbf{0.33 \text{ m}}$ (2 s.f.)

- (iii) If he were to stand at the right hand end of the plank, the clockwise moment about B due to his weight will be larger than the total anticlockwise moments due to the weight of the plank and the weight of the can of paint.
(Or *there will be a net clockwise moment about B.*)

The plank will rotate clockwise and topple over.

3(a)



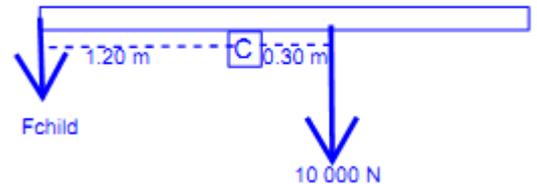
Note: *It is advisable to calculate & label the required distances on the diagram. The uniform stone slab means its CG is at its mid-point (1.50 m).*

- (b) Take moments about D, clockwise moments = anticlockwise moments
 $F_c \times (3.00 - 1.20 - 0.50) \text{ m} = 10\,000 \text{ N} \times 1.00 \text{ m}$
 $F_c = 7692.3 \approx \mathbf{7690 \text{ N}}$ (3 s.f.)
 Since $F_c + F_d = 10\,000 \text{ N}$ (since net force = 0)
 $F_d = 10\,000 - 7692.3 = 2307.7 \approx \mathbf{2310 \text{ N}}$ (3 s.f.)

Note: *It is advisable to always redraw the diagram with only the relevant information.*

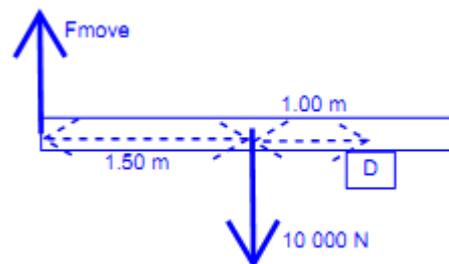
- (c) Just before stone topples anticlockwise about C, $F_d = 0 \text{ N}$
 Let $F_{\text{child}} = \text{total weight of } n \text{ children}$
 $= n(mg) = n(480 \text{ N})$

Take moments about C,
 $F_{\text{child}} \times 1.20 \text{ m} = 10\,000 \times 0.30 \text{ m}$
 $480n = 2500 \rightarrow n = 5.20$



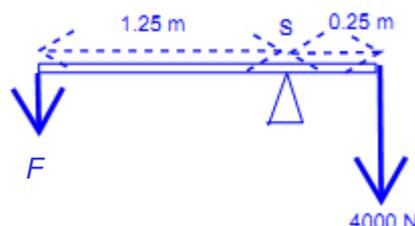
Minimum number of children = **6**

- (d) To allow C to be moved, plank pivots about D, $F_c = 0 \text{ N}$
 Take moments about D,
 $F_{\text{move}} \times (1.50 + 1.00) \text{ m} = 10\,000 \text{ N} \times 1.00 \text{ m}$
 $F_{\text{move}} = \mathbf{4000 \text{ N}}$



- (e) *By Newton's 3rd law of motion, an upward force F_{move} on stone slab at A by the lever at Y means an equal downward force 4000 N on the lever at Y by the stone slab*

Take moments about S,
 $F \times 1.25 \text{ m} = 4000 \text{ N} \times 0.25 \text{ m}$
 $F = \mathbf{800 \text{ N}}$



A7.2

1. (a)

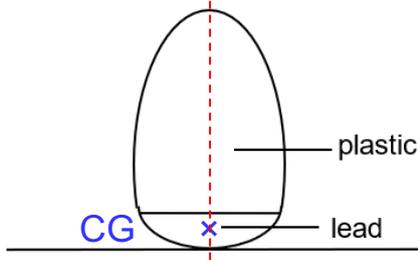


Fig. 1.1

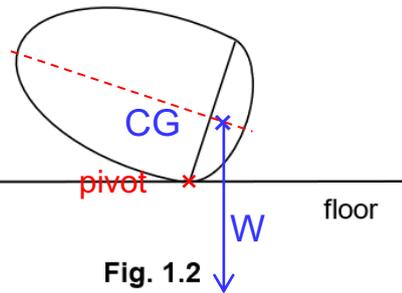


Fig. 1.2

(b) (i) In Fig. 1.2, the toy rotates in the clockwise direction.

The weight W produces a clockwise moment about the pivot shown. This will cause the toy to rotate clockwise towards its original position.

(ii) The final position of the toy is its original position in Fig 1.1.

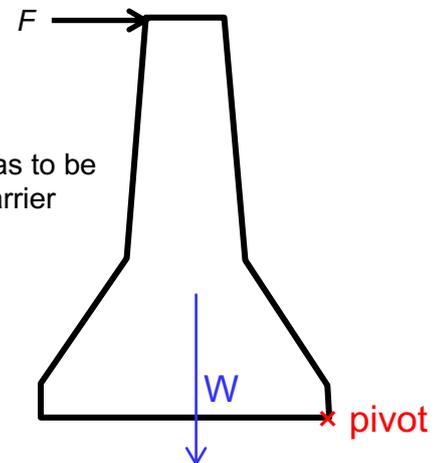
The toy will finally come to rest in a position where its weight acts through the pivot and there is no net force and no net moment acting on the toy, when it is in the position in Fig. 1.1.

2(a) The centre of gravity of Y is lower than that of X, since Y is filled with water in its lower half. Hence Y is more stable.

(b) The weight of Y is larger than X, the anticlockwise moment about the pivot due to the weight of Y is greater.

To rotate the barrier, the clockwise moment due to the force F has to be larger than the anticlockwise moment due to the weight of the barrier about the pivot.

Hence, Y requires a larger initial force F to start rotating it.



Challenging question

- The bucket is supported such that it can rotate about a pivot (a horizontal axis).
- As the water fills up the bucket, its CG rises.
- When its CG rises above its pivot, it has unstable equilibrium.
- As it rocks slightly as water fills up, this would cause it topple over easily, pouring down all its water.
- OR the bucket may be designed such that its CG is off-centre, so it will topple when its CG rises above its pivot (with rising level of water).