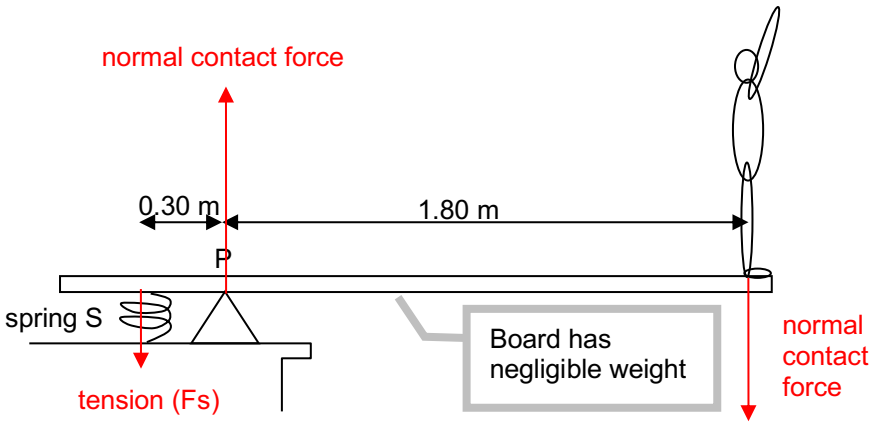
2025 Sec 3 Physics Moments Assignment 7.1 & 7.2

Answers

A7.1

1. (a)

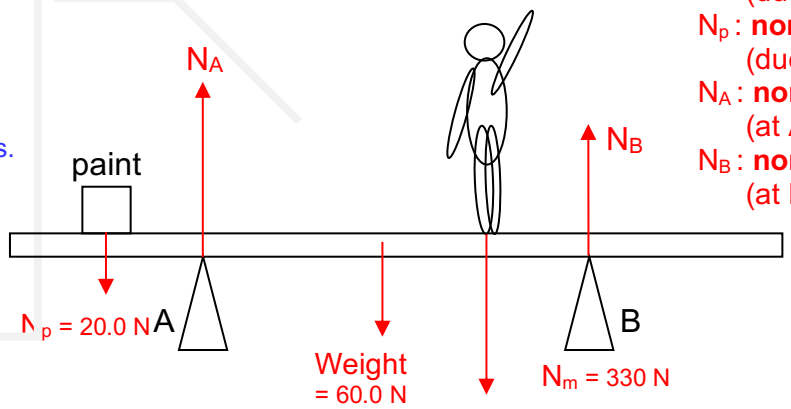


(b) Moment of weight of woman about F = 640 N × 1.80 m
=1152 Nm =**1150 N m** (3 s.f.) clockwise

(c) *Since diving board is at rest, Principle of moments is applicable.*
Take moments about P, Anticlockwise moment of Fs = clockwise moment of W
Fs × 0.30 m = 1152 Nm ➔ Fs = **3800 N** (2 s.f.)

2 (a)

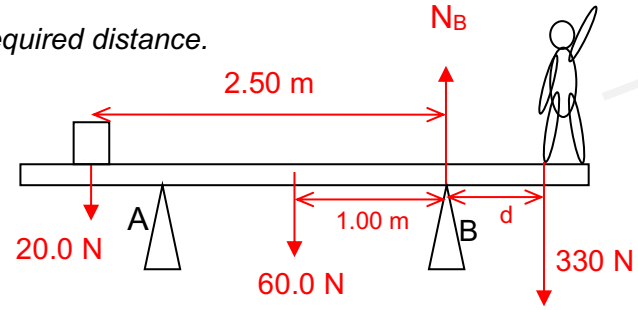
Note: forces acting on the plank due to the can of paint and the painter are normal contact forces, **NOT** weights. The weights act on the respective objects. Note the points where these forces act.



N_m : **normal contact force** (due to painter)
N_p : **normal contact force** (due to can of paint)
N_A : **normal contact force** (at A)
N_B : **normal contact force** (at B)

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

(ii) *Let d be required distance.*



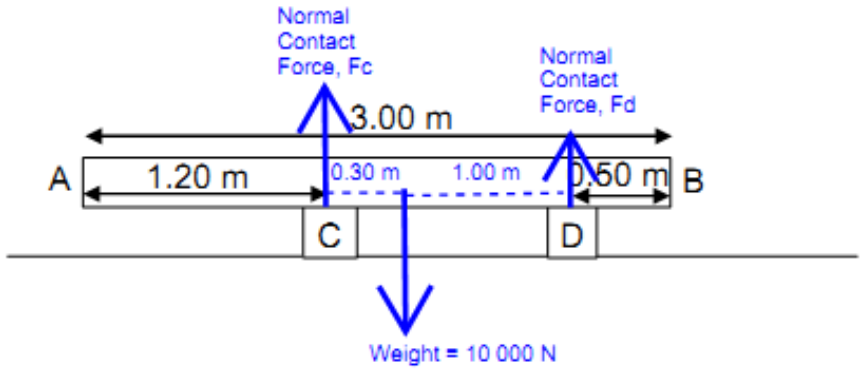
Note: It is advisable to redraw the diagram with only the relevant information, with new position of painter, and N_A = 0.

Take moments about B, clockwise moments = anticlockwise moments
330 N × d = (20.0 N × 2.50 m) + (60.0 N × 1.00 m)
d = **0.33 m** (2 s.f.)

(iii) If he were to stand at the right hand end of the plank, the <u>clockwise moment about B due to his weight will be larger than the total anticlockwise moments</u> 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 <u>rotate clockwise and topple over</u>.

3(a)



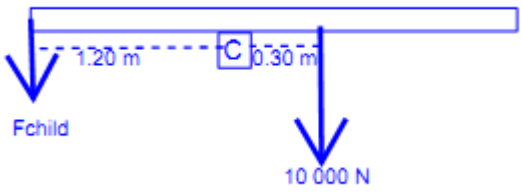
Note: *It is advisable to calculate & label the required distances on the diagram.*
The <u>uniform</u> stone slab means it s CG is at its mid-point (1.50 m).

(b) Take moments about D, clockwise moments = anticlockwise moments
$Fc \times (3.00-1.20-0.50)m = 10\,000\ N \times 1.00\ m$
$Fc = 7692.3 \approx$ **7690 N** (3 s.f.)

Since $Fc + Fd = 10\,000\ N$ (since net force = 0)
$Fd = 10\,000 - 7692.3 = 2307.7 \approx$ **2310 N** (3 s.f.)

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

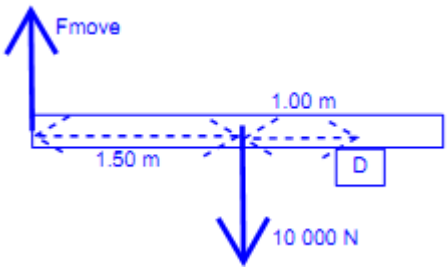
(c) Just before stone topples anticlockwise about C, Fd = 0 N
Let Fchild = total weight of n children
= n (mg) = n (480 N)
Take moments about C,
Fchild × 1.20 m = 10 000 × 0.30 m
480 n = 2500 ➔ n = 5.20



Minimum number of children = **6**

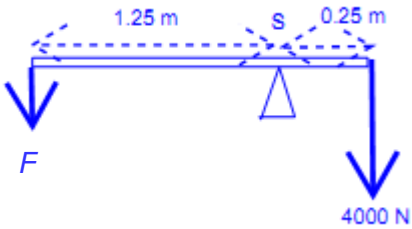
(d) To allow C to be moved,
plank pivots about D, Fc = 0 N

Take moments about D,
Fmove × (1.50+1.00) m = 10 000 N × 1.00 m
Fmove = **4000 N**



(e) *By Newton's 3rd law of motion,*
an upward force Fmove 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 × 1.25 m = 4000 N × 0.25 m
F = **800 N**



A7.2

1. (a)

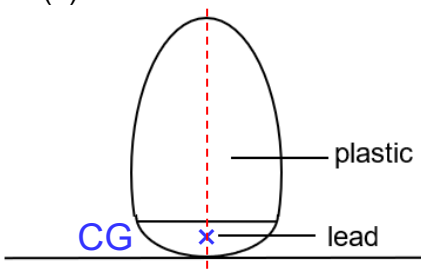


Fig. 1.1

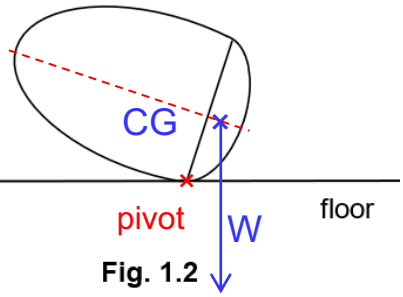


Fig. 1.2

(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.

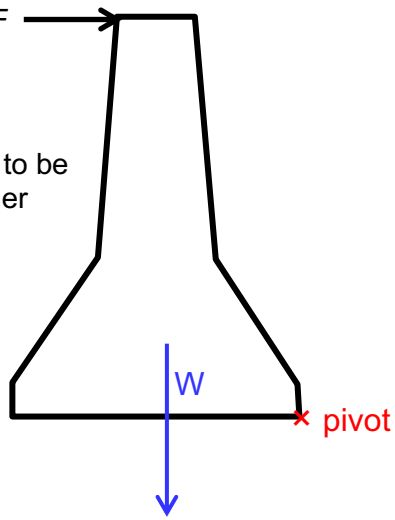
The toy will finally come to rest in a position where its weight acts through the pivot and there is no net force and no net moment acting on the toy, when it is in the position in Fig. 1.1.

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 centre of gravity or CG initially falls and then rises.
- When its CG rises above its pivot, it has unstable equilibrium.
- As it rocks slightly as it fills up with water, this would cause it topple over easily, pouring down water until the CG is below the pivot again.
- 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).