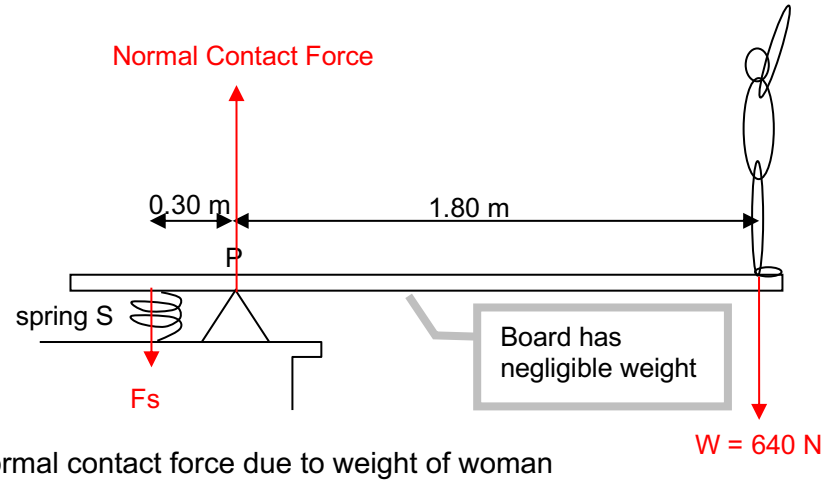
2020 Sec 3 Physics Moments Assignment 4.1 to 4.2

Answers

AS4.1

1. (a)



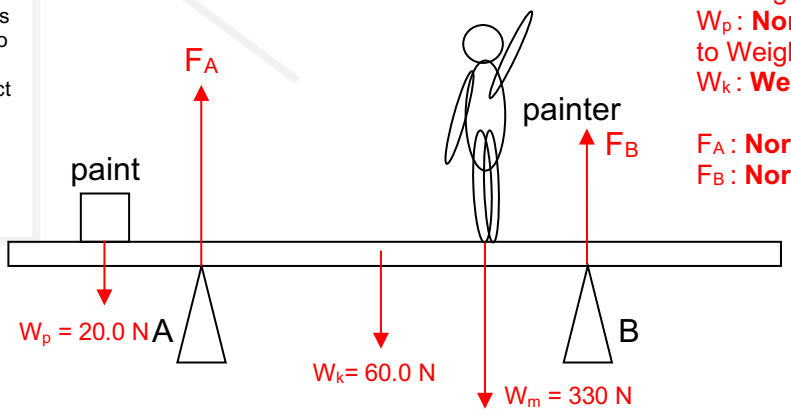
W = normal contact force due to weight of woman
F_s = tension in spring

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

(c) Since diving board is at rest, principle of moments holds.
Taking moments about P,
ACW Moment of Fs = CW Moment of W
Fs (0.30) = 1152; Fs = 3840 N

2 (a)

T should use this example to point out that the forces acting on the plank due to the can of paint and the painter are normal contact forces, not the weights. The weights act on the respective objects. Note also the point where the forces act.

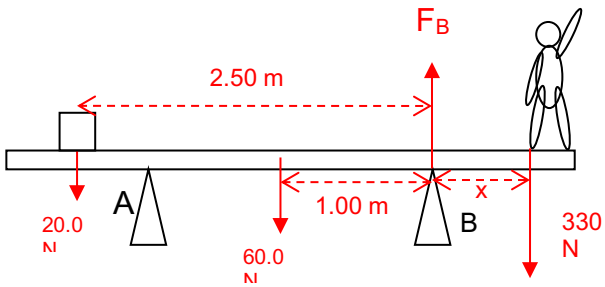


W_m : **Normal contact force** due to Weight of painter
W_p : **Normal contact force** due to Weight of paint
W_k : **Weight of plank**

F_A : **Normal contact force** at A
F_B : **Normal contact force** at B

(b) (i) Reaction force at A is **0** N because **trestle A is no longer in physical contact with the plank / when trestle A is about to lose contact with the plank**

(ii)



T should encourage students to draw another sketch of the scenario with the necessary information so that it is easier for them to focus on the question.

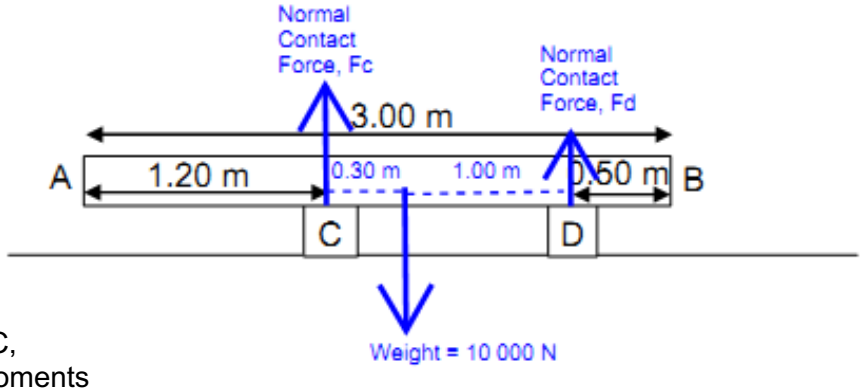
By principle of moments, Taking moments about B,
(20.0)(2.50) + (60.0)(1.00) = 330x
x = 0.333 m (3 s.f.)

(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 paint. The plank will rotate clockwise and topple over.

[1]

AS4.2

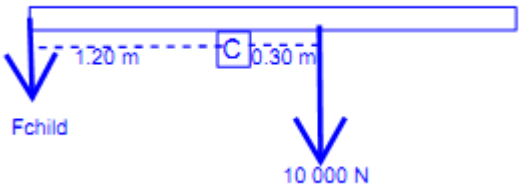
1. (a)



(b) Taking moments about C,
CW moments = ACW moments
(10 000)(0.30) = Fd (1.30)
Fd = 2308 N = 2310 N (3 s.f.)

Since Fc+Fd = 10 000 N
Fc = 7690 N (3 s.f.)

(c) Just before stone topples, Fd = 0 N

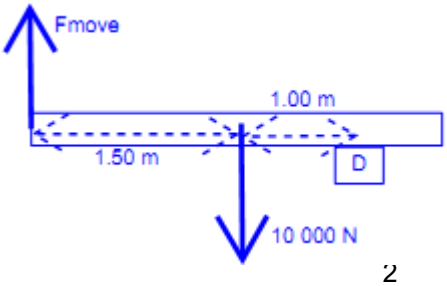


Taking moments about C,
CW moments = ACW moments
(10 000)(0.3) = Fchild (1.20)
Fchild = 2500 N

Since mass of one child = 48 kg, Weight of one child = 480 N

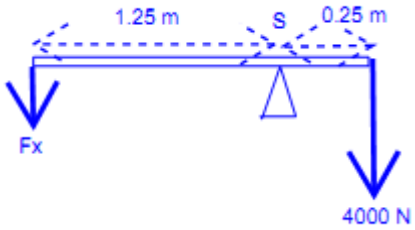
Therefore, number of children = 2500 / 480 = 5.2
Minimum number of children to topple plank = 6

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



Taking moments about D,
CW moments = ACW moments
Fmove (1.50+1.00) = 10 000 (1.00)
Fmove = 4000 N

(e) The small plank has to exert 4000 N upwards at Y on the big plank. This means that on the small plank, the big plank exerts 4000 N downwards.
Considering small plank,
taking moments about S,
CW moments = ACW moments
4000 (0.25) = Fx (1.25)
Fx = 800 N



2. (a)

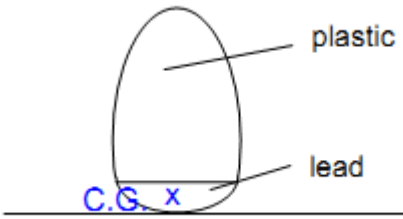


Fig. 2.1

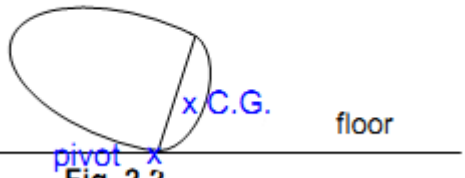


Fig. 2.2

(b) (i) The C.G. is to the right of the pivot and therefore, the weight will provide a clockwise moment, which will cause the toy to rotate clockwise towards its original position.

(ii) The final position of the toy will be as seen in Fig 2.1. The toy will eventually come to rest at an equilibrium position where its weight acts through the pivot and there is no net force and no net moment acting on the toy. This is achieved at a position of stable equilibrium, as in Fig. 2.1.

3. (a) The C.G. is unchanged for X and Y, hence both X and Y will have the **same** angle of tilt.

(b) Y requires a larger force to topple it about the pivot (that is at the bottom right corner of the barrier).
To topple the barrier, the clockwise moment due to force F has to be larger than the anticlockwise moment due to the weight of barrier about the pivot. Since the weight of Y is larger than X, the anticlockwise moment about the pivot due to the weight is greater for Y. Hence, Y requires a larger force to topple it.

4.
- 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.

The End