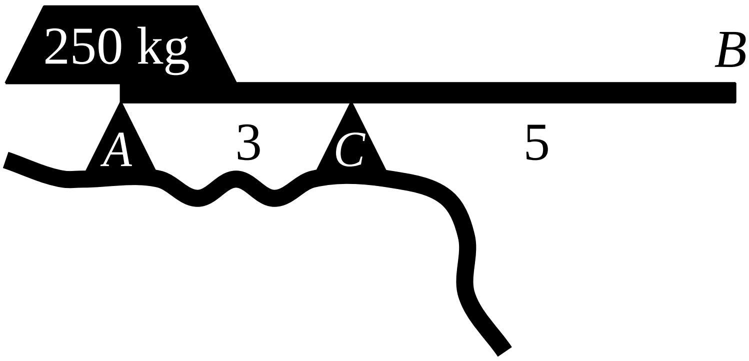
3.1 On the Edge Of Tipping

Example

A 250 kg mass is bolted onto the end of a uniform plank of wood *AB* of length 8 m and mass 45 kg.
The plank rests on two supports at *A* and *C* where *AC* = 3 m.
The plank is in equilibrium and horizontal.



Teaching Video : http://www.NumberWonder.co.uk/Video/v9069(3).mp4

(a) By taking moments about *A* determine the reaction force at *C*.

(b) By equating the total force upwards with the total force downward determine the reaction force at *A*.

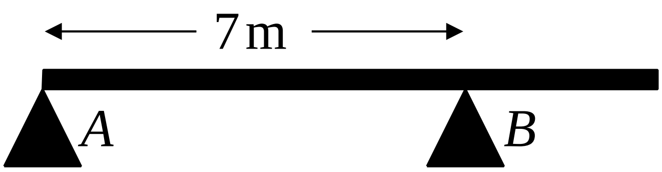
The plank of wood is being used as a diving board.

(c) By taking moments about *C*, determine the maximum mass that can be at *B* with the plank remaining in equilibrium ?

(d) In the light of your previous answers, what advice would you give regarding the safe use of this diving board ?

3.2 Exercise

Question 1



A uniform plank of mass 100 kg and length 10 m rests horizontally on two smooth supports, *A* and *B*, as shown. A man of mass 80 kg starts walking from one end of the plank, *A*, to the other end. When he is a distance *x* past *B* the plank starts to tip.

(i) Draw a diagram showing all significant forces on the plank when it is on the verge of tipping.

[2 marks]

(ii) When the plank is about to tip, what will be the reaction at *A* ?

[1 mark]

(iii) When the plank is about to tip, what will be the reaction at *B* ?

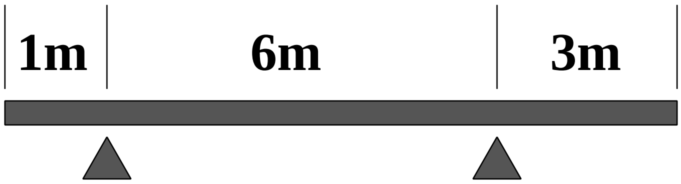
[1 mark]

(iv) Find the distance, *x*, the man can walk past *B* before the plank starts to tip.

[4 marks]

Question 2

A uniform rod of mass 14 kg rests on two supports as shown below.



(a) The reaction at the left hand support is 75 newtons.
What, in newtons, is the reaction at the other support ?

(b) A mass, *m*, is now placed an the right hand end of the rod, such that the rod is on the point of tipping about the right hand support.

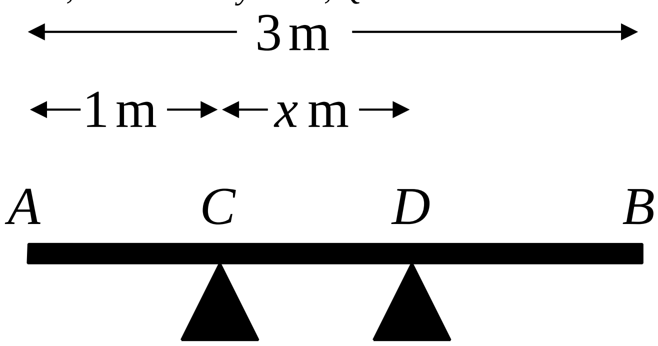
(i) What, now, is the reaction at the left hand support ?

(ii) What, in kg, is the mass, *m* ?

(iii) What, in N, is the reaction at the right hand support ?

Question 3

M1 Exam question, 12th January 2007, Q2



A uniform plank *AB* has weight 120 N and length 3 m.
The plank rests horizontally in equilibrium on two smooth supports *C* and *D*, where *AC* = 1 m and *CD* = x m.
The reaction of the support on the plank at *D* has magnitude 80 N.
Modelling the plank as a rod,

(a) show that $x = 0.75$

[3 marks]

A rock is now placed at *B* and the plank is on the point of tilting about *D*
Modelling the rock as a particle, find

(b) the weight of the rock

[4 marks]

(c) the magnitude of the reaction of the support on the plank at *D*

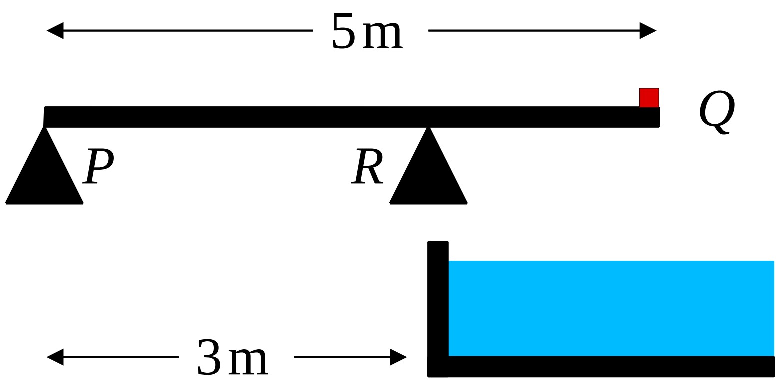
[2 marks]

(d) State how you have used the model of the rock as a particle

[1 mark]

Question 4

A-Level Examination Question from January 2019, IAL, M1, Q4



A boy sees a box on the end Q of a plank PQ which overhangs a swimming pool. The plank has mass 30 kg, is 5 m long and rests in a horizontal position on two bricks. The bricks are modelled as smooth supports, one acting on the plank at P and one acting on the plank at R, where PR is 3 m. The support at R is on the edge of the swimming pool, as shown. The boy has a mass 40 kg and the box has mass 2.5 kg. The plank is modelled as a uniform rod and the boy and the box as particles.

The boy steps on to the plank at P and begins to walk slowly along the plank towards the box.

(a) Find the distance he can walk along the plank from P before the plank starts to tilt.

[4 marks]

(b) State how you have used, in your working, the fact that the box is modelled as a particle.

[1 mark]

A rock of mass M kg is placed on the plank at P. The boy is then able to walk slowly along the plank to the box at the end Q without the plank tilting.
The rock is modelled as a particle.

(c) Find the smallest possible value of M.

[4 marks]