

Mechanics 3 – Centre of Mass and Tilting

Please **complete** this homework by _____. Start it early. If you can't do a question you will then have time to ask your teacher for help or go to a drop in session.

Section 1 – Review of previous topics. Please complete all questions.

1.

A particle moves in a straight line from A to B. The particle starts from rest at A and accelerates at 2ms^{-2} until it reaches a speed of 8ms^{-1} at B.

- (a) Find how long it takes to travel from A to B
- (b) Find the distance AB

2.

Exam Question January 2006

A stone is thrown vertically upwards with speed 16 m s^{-1} from a point h metres above the ground. The stone hits the ground 4 s later. Find

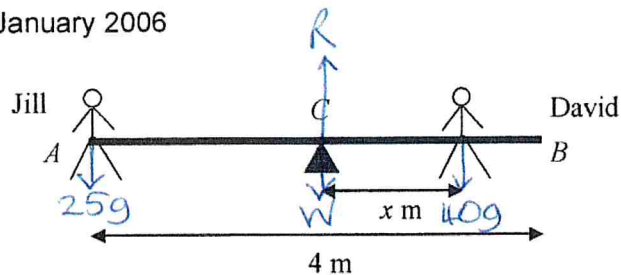
- (a) the value of h , (3)
- (b) the speed of the stone as it hits the ground. (3)

3.

A uniform beam AB of mass 6 kg and length 4m rests on a pivot at the point C where $AC = 2.5\text{m}$. A block of mass m kg is placed on the rod at the point B so that the rod is in equilibrium. Find the mass of the block and the magnitude of the reaction at the support.

4.

Exam Question January 2006



A seesaw in a playground consists of a beam AB of length 4 m which is supported by a smooth pivot at its centre C . Jill has mass 25 kg and sits on the end A . David has mass 40 kg and sits at a distance x metres from C . The beam is initially modelled as a uniform rod. Using this model,

- (a) find the value of x for which the seesaw can rest in equilibrium in a horizontal position. (3)
- (b) State what is implied by the modelling assumption that the beam is uniform. (1)

David realises that the beam is not uniform as he finds he must sit at a distance 1.4 m from C for the seesaw to rest horizontally in equilibrium. The beam is now modelled as a non-uniform rod of mass 15 kg. Using this model,

- (c) find the distance of the centre of mass of the beam from C .

Section 2 – Consolidation of this week’s topic. Please complete all questions.

1.

A uniform rod of length 4m weighs 50 N. 1 m of the rod lies on a horizontal table and the rest lies over the edge.

- a Where does the reaction act when the rod is about to tilt?
- b What downward force must be applied to the end of the rod to stop it from tilting?
- c What is the reaction of the table on the rod when it is about to tilt?

2.

A uniform plank, AB, of mass 28 kg and length 9 m, lies on a horizontal roof in a direction at right angles to the edge of the roof. The end B projects 2m over the edge. A man of mass 70 kg walks out along the plank.

a Find how far along the plank he can walk without causing the plank to tip up.

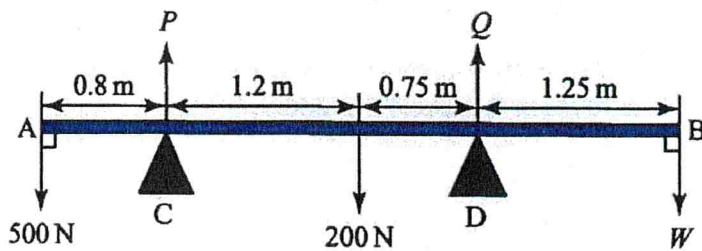
b Find also the mass which must be placed on the end A so that the man can reach B without upsetting the plank.

3

A uniform beam AB, of length 4m and weight 200 N, rests in equilibrium on supports C and D as shown in the diagram. A 500 N weight is attached at A and a weight W is attached at B.

a Find the largest possible value of W , for which the beam remains in equilibrium.

b Find the smallest possible value of W for which the beam remains in equilibrium.



4.

A uniform beam AB, of length 2.2m and mass 150 kg is supported in a horizontal position by two supports at C and D where $AC = 0.75\text{m}$ and $AD = 1.5\text{m}$

a Find, in terms of g , the force exerted by each support.

b Find the mass of the heaviest man who can sit at

i End A ii End B of the beam without it tilting.

