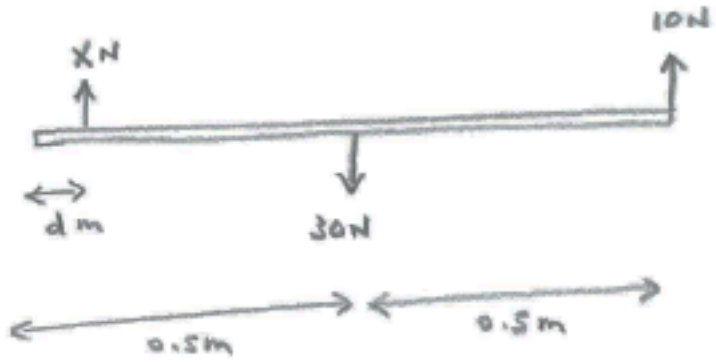
Moments - Exercises (4 pages; 11/3/17)

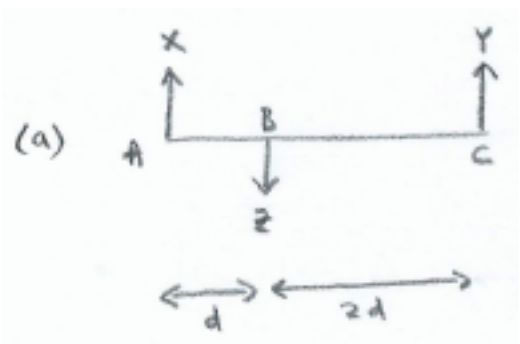
(1) Vertical forces of X, 30 and 10 N are applied to a light rod of length 1 m, as shown in the diagram. The force of X N is applied at a distance of d m from the left-hand end, and the force of 30N is applied at the mid-point of the rod.

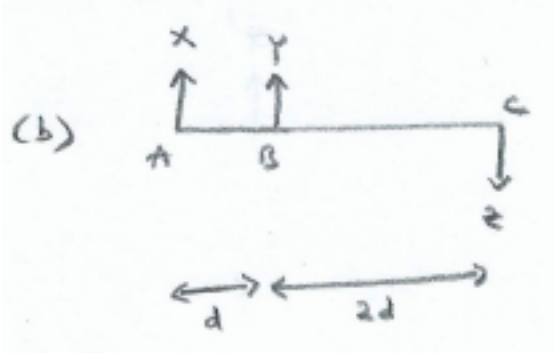


(a) What values must X and d have in order for the rod to be in equilbrium?

(b) The force of X N is removed, and the forces of 30N and 10N are to be replaced with a single force having the same effect as these two forces. What is the size and line of action of this single force?

(2) (i) Which of the following systems of forces could be in equilbrium? (with X, Y and Z > 0)



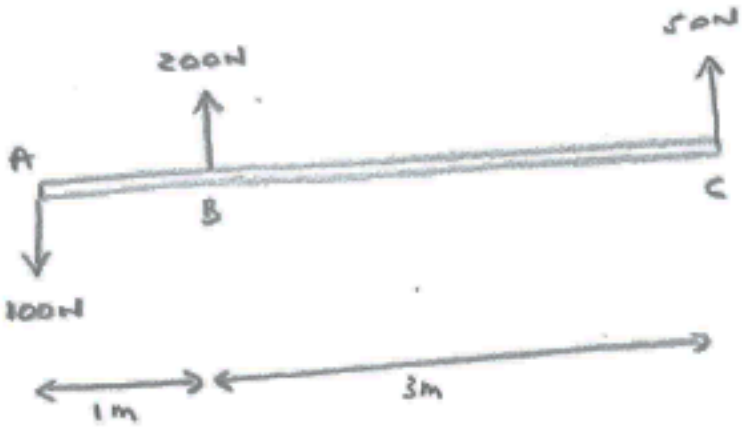


(ii) Assuming that $X + Y = Z$, show that the total moments about A, B and C are equal, in both of the cases in (i).

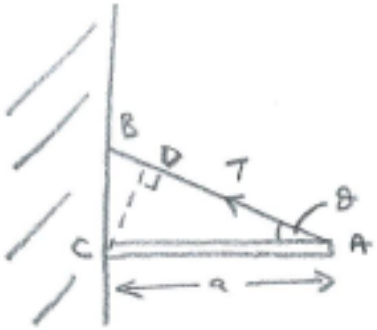
(3) Forces are applied to a light rod, as shown in the diagram.

(a) Find the magnitude and line of action of the additional force that would be needed in order for the rod to be in equilibrium.

(b) Find the magnitude and line of action of the single force that has the same effect as the forces in the diagram.



(4)



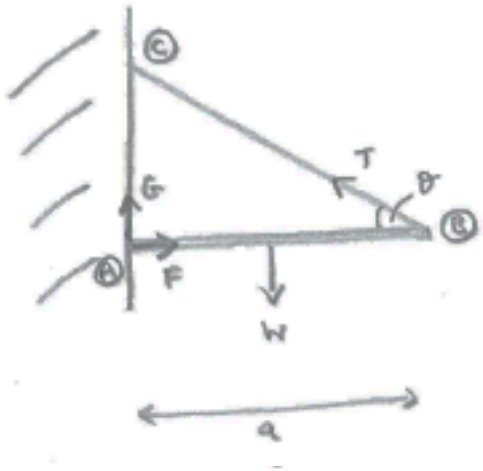
Show that the moment of T about C is the same:

(i) if T is multiplied by CD

(ii) T is resolved into horizontal & vertical components at A

(iii) T is resolved into horizontal & vertical components at B

(5) Alternative Moments Methods



A rod AB is attached to a wall at A, and held in a horizontal position by a rope BC.

Show that, as an alternative to resolving forces horizontally and vertically, and taking moments about A, it is also possible to:

(a) resolve forces horizontally and take moments about A & B,

or (b) take moments about A, B & C;

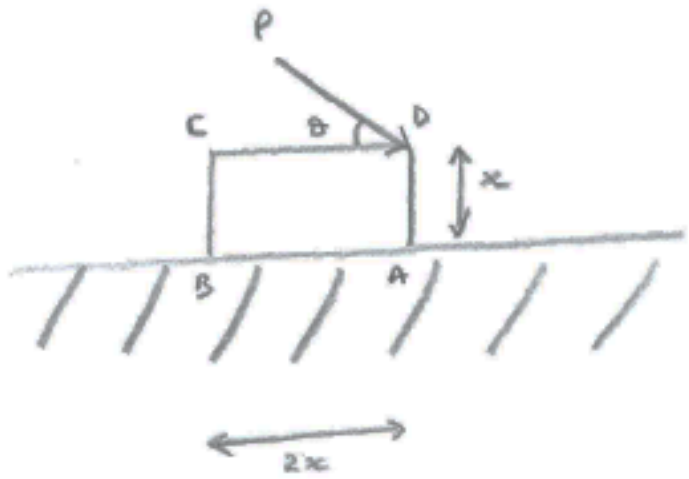
but that it is not possible to do the following:

(c) resolve forces vertically and take moments about A & B,

or (d) take moments about A, B & the midpoint of AB

(6) Referring to the diagram below, about which point should moments be taken, in order to find F in terms of W?

(7) A uniform block of mass m rests on a table, and a force P is applied at D, as shown in the diagram. The block has length $2x$ and height x. The coefficient of friction between the block and the table is μ.



(i) If the block is on the point of sliding, find an expression for P.

(ii) If instead the block is on the point of toppling, find an expression for P.

(iii) If the block is to topple before it slides, find a condition on μ.