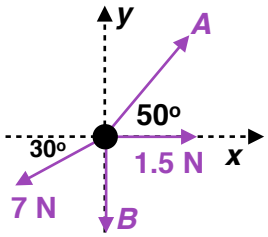
Turning Effect of a Force

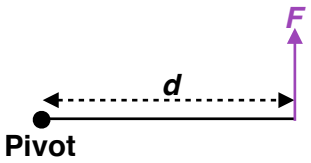
Starter

1. **(Review of last lesson)** Given that the particle is in equilibrium, find the magnitude of the forces A and B.



Notes

The ***moment*** of a force is its ***turning effect*** about a ***pivot***.



$\text{Moment} = F \times d$ where F is the force and d is the ***perpendicular distance*** from the force to the pivot

N.B. The units of moments is Newton metres i.e. Nm

To find the resultant moment about a point

- Find the sum of the clockwise and anticlockwise moments separately
- The resultant is the difference between the two sums, in the direction of the larger

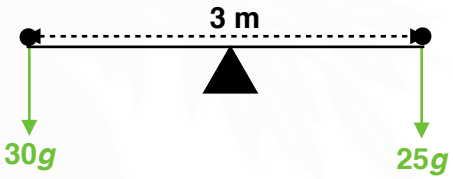
N.B. 'Light rod' means the mass of the rod is not taken into account

E.g. 1 Two children sit on a light horizontal see-saw of length 3 m, pivoted at its centre. One child of mass 30 kg, sits on one end, and the other child, whose mass is 25 kg, sits on the other end. Find the overall turning effect about the centre of the see-saw.

Working:

↻ about centre: $25g \times 1.5$
↺ about centre: $30g \times 1.5$
Resultant turning effect:

$$30g \times 1.5 - 25g \times 1.5 = 5g \times 1.5$$
$$= 73.5 \text{ Nm}$$



N.B. The normal reaction force at the pivot acts directly upwards. Since the moment is taken about the pivot, its turning force is zero since the distance is zero.

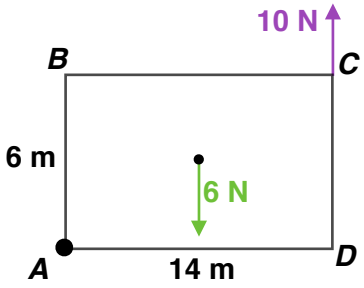
Centre of mass

When the rod or lamina has a mass, the force from the weight now acts as a turning force.

Uniform ***rod*** — ***1-dimensional*** object	***E.g.*** see-saw; centre of mass is the midpoint
Uniform ***lamina*** — ***2-dimensional*** object	***E.g.*** door in the shape of a rectangle; centre of mass is at the centre of the shape (e.g. for a rectangle, it is the point of intersection of the diagonals)

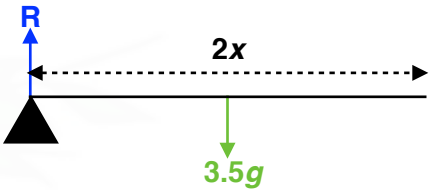
E.g. 2 A uniform rod, AB, has mass 4.7 kg and length 6.8 m. The rod is pivoted about A and a particle of mass 0.75 kg is placed on the rod 1.1 m from B. Find the sum of the moments about A of the forces acting on the rod when the rod is horizontal.

E.g. 3 A uniform rectangular lamina $ABCD$ of weight 6 N is pivoted at point A and acted on by a vertical force of 10 N at point C.
Find the sum of the moments about A.



E.g. 4 A uniform rod of mass 3.5 kg is pivoted about one of its ends. When the rod is horizontal, there is a moment of 205.8 Nm about the pivot. Assuming that the only forces acting on the rod are its weight and the reaction at the pivot, find the rod's length.

Working: Let the length of the rod be $2x$…

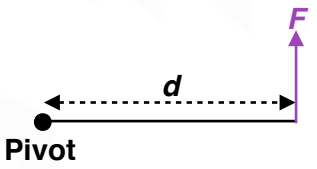


Video: Moment of a force

Solutions to Starter and E.g.s

Exercise
p507 22A Qu 1i, 2i, 3i, 4i, 5-8

Summary
The ***moment*** of a force is its ***turning effect*** about a ***pivot***.
Moment $= F \times d$ where F is the force
and d is the ***perpendicular distance***
from the force to the pivot



N.B. The units of moments is Newton metres i.e. Nm

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