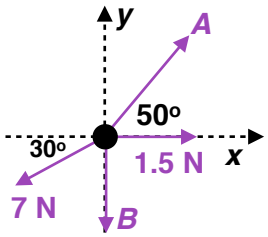
Turning Effect of a Force

Starter

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



Working:

$R(\rightarrow)$: $A\cos 50 + 1.5 = 7\cos 30$

$$A = \frac{7\cos 30 - 1.5}{\cos 50}$$

$$A = 7.10 \text{ N (3 s.f.)}$$

$R(\uparrow)$: $B + 7\sin 30 = 7.10\sin 40$

$$B = 7.10\sin 40 - 7\sin 30$$

$$B = 1.94 \text{ N}$$

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:

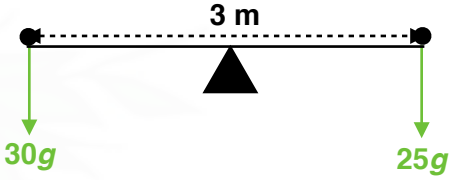
↻ about centre: $25g \times 1.5$

↺ about centre: $30g \times 1.5$

Resultant turning effect:

$30g \times 1.5 - 25g \times 1.5 = 5g \times 1.5$

$= 73.5$ Nm



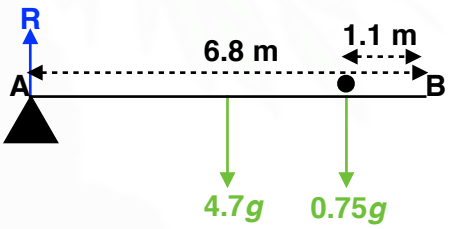
E.g. 2 A uniform rod, AB, has mass 4.7 kg and length 6.8 m. The rod is pivoted about A and a particle of mass 0.75 kg is placed on the rod 1.1 m from B. Find the sum of the moments about A of the forces acting on the rod when the rod is horizontal.

Working:

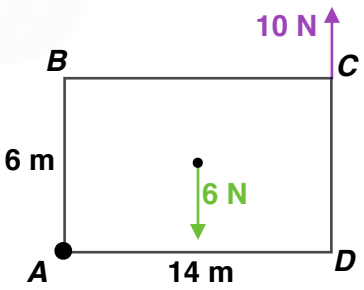
↻ about A: $4.7g \times 3.4 + 0.75g \times 5.7$

Sum of moments $= 198.499$ Nm

N.B. The normal reaction, R, at the pivot does not affect the turning force.



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.



Working:

Moments $= 10 \times 14 - 6 \times 7$

$= 98$ Nm anticlockwise

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.

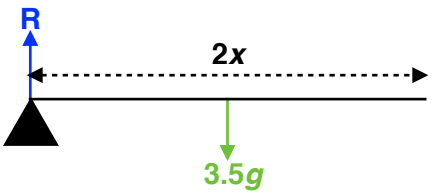
Working: ***Uniform rod $\Rightarrow$ centre of mass at midpoint***

Let the length of the rod be $2x$

Moments about the pivot:

$$3.5g \times x = 205.8$$
$$x = 6$$

So the length of the rod is 12 m



Video: Moment of a force

Solutions to Starter and E.g.s

Exercise

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