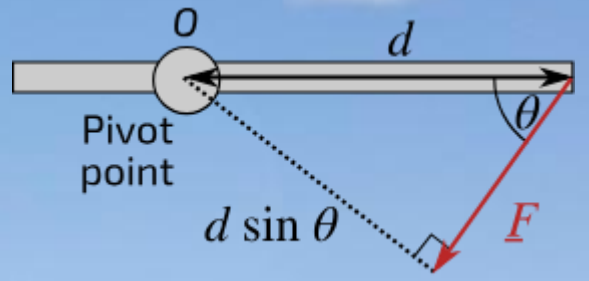
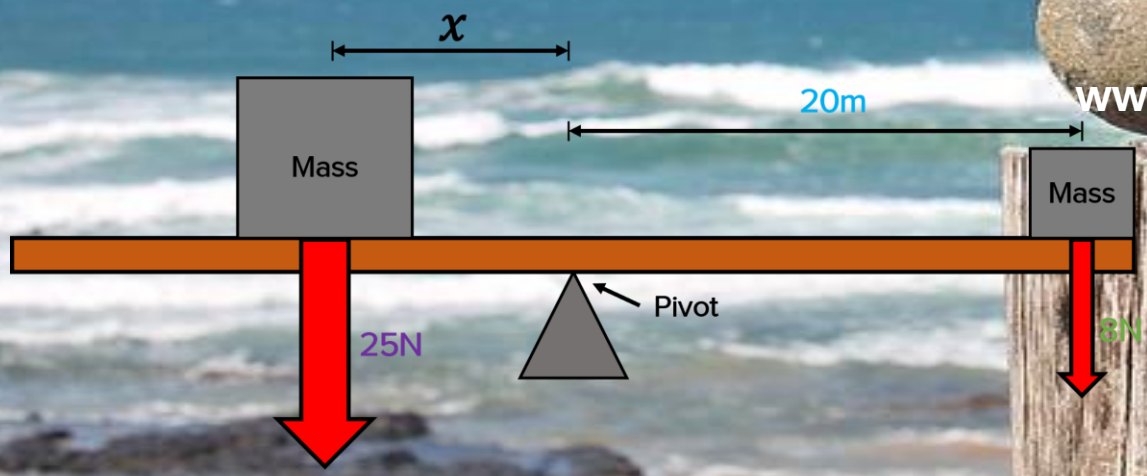
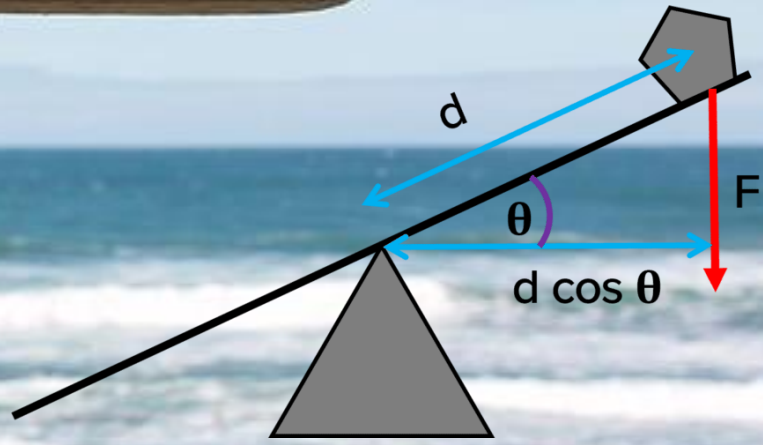


Moments

AS-Physics-Mechanics

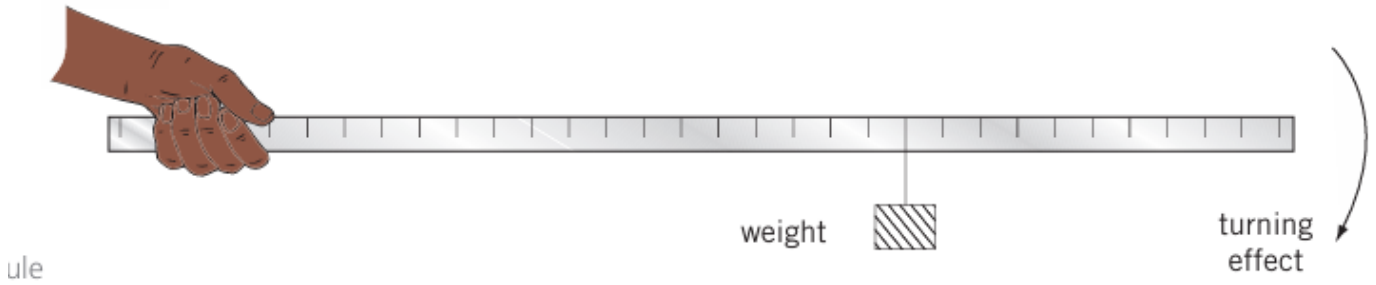




Moment of a force

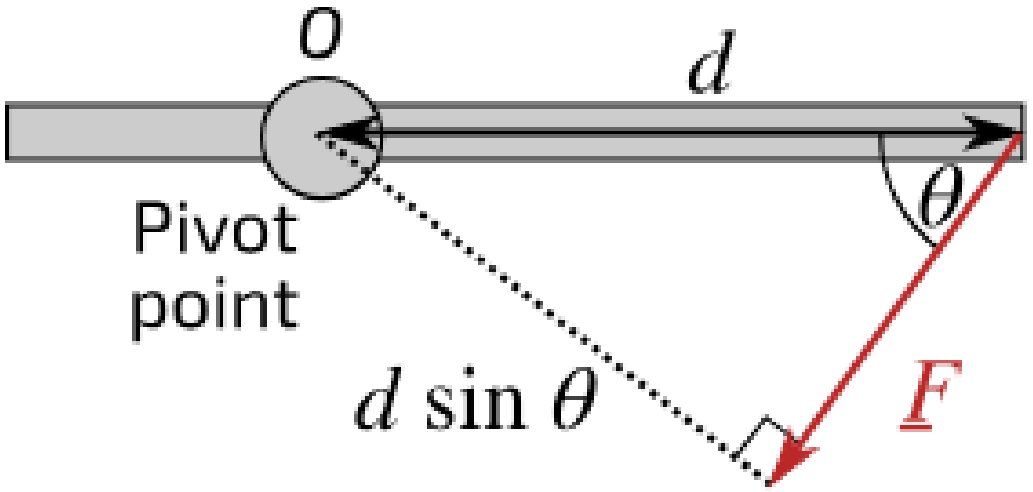
The tendency to cause rotation is called the moment of a force.

moment (Nm) = force (N) x perpendicular distance from the pivot to the line of action of the force (m)

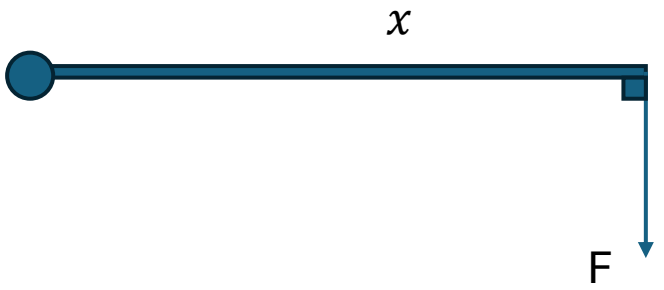


moment = Fx

The moment of a force



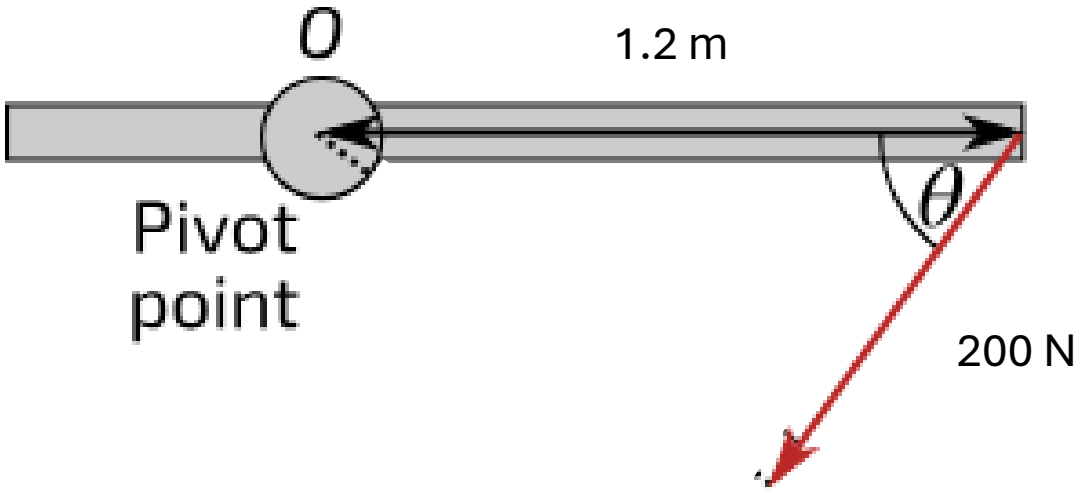
moment = $F \times d \sin\theta$



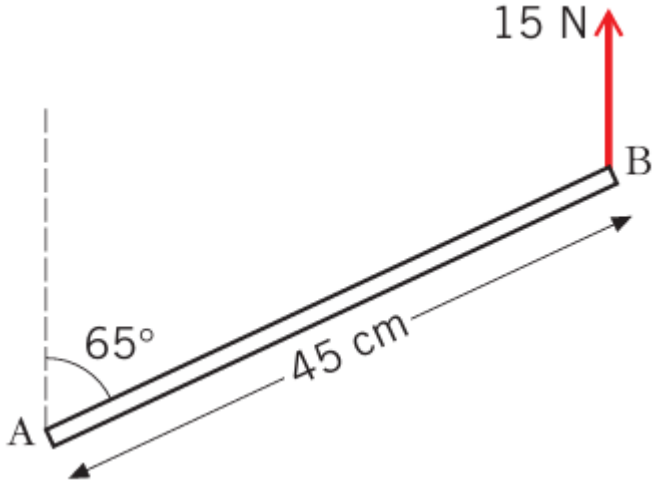
moment = $F \times x$

Concept Learning Questions.

1) Find the moment. ($\theta = 60^0$)

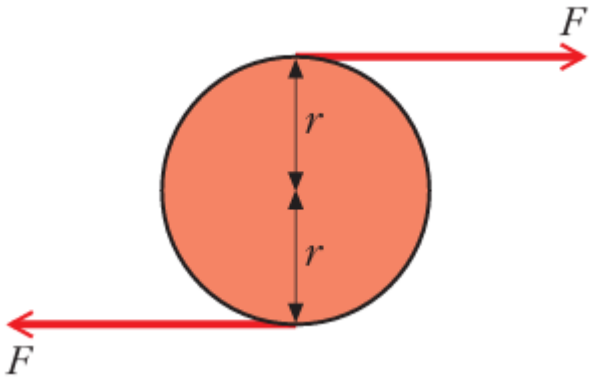


2) Find the moment.



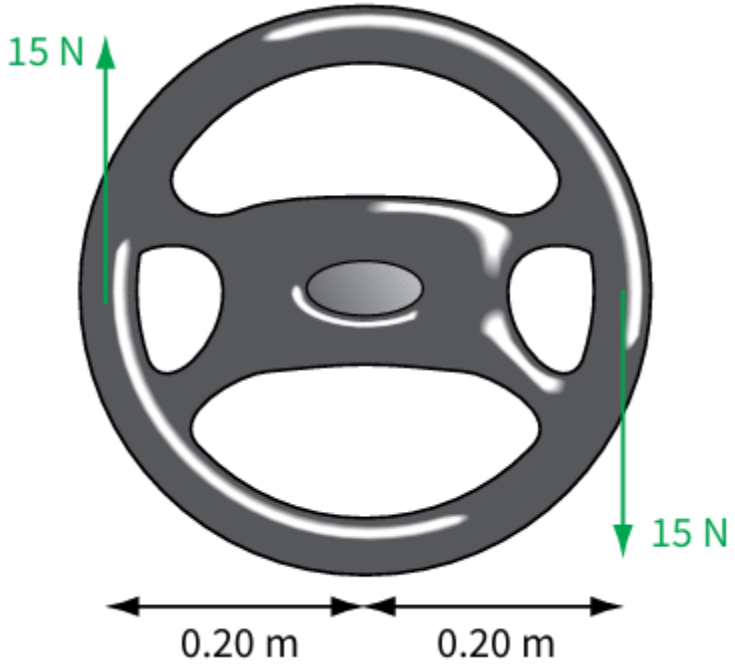
Couples

A couple consists of two forces, equal in magnitude but opposite in direction whose lines of action do not coincide.



The torque of a couple is the product of one of the forces and the perpendicular distance between the forces.

Extra Knowledge



To form a couple, the two forces must be:

- equal in magnitude
- parallel, but opposite in direction
- separated by a distance d.

Torque = 15 x 0.4 = 6 Nm

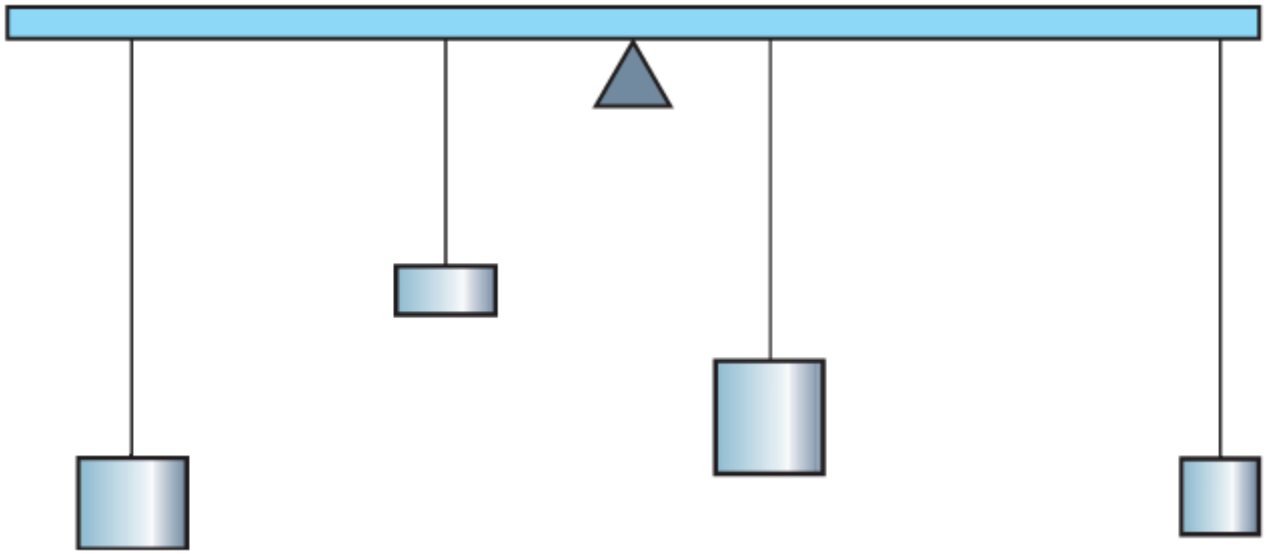
Concept Learning Questions.

1) Calculate the torque produced by two forces, each of magnitude 30 N, acting in opposite directions with their lines of action separated by a distance of 25 cm.

2) The torque produced by a person using a screwdriver is 0.18 N m. This torque is applied to the handle of diameter 4.0 cm. Calculate the force applied to the handle.

Principle of moments

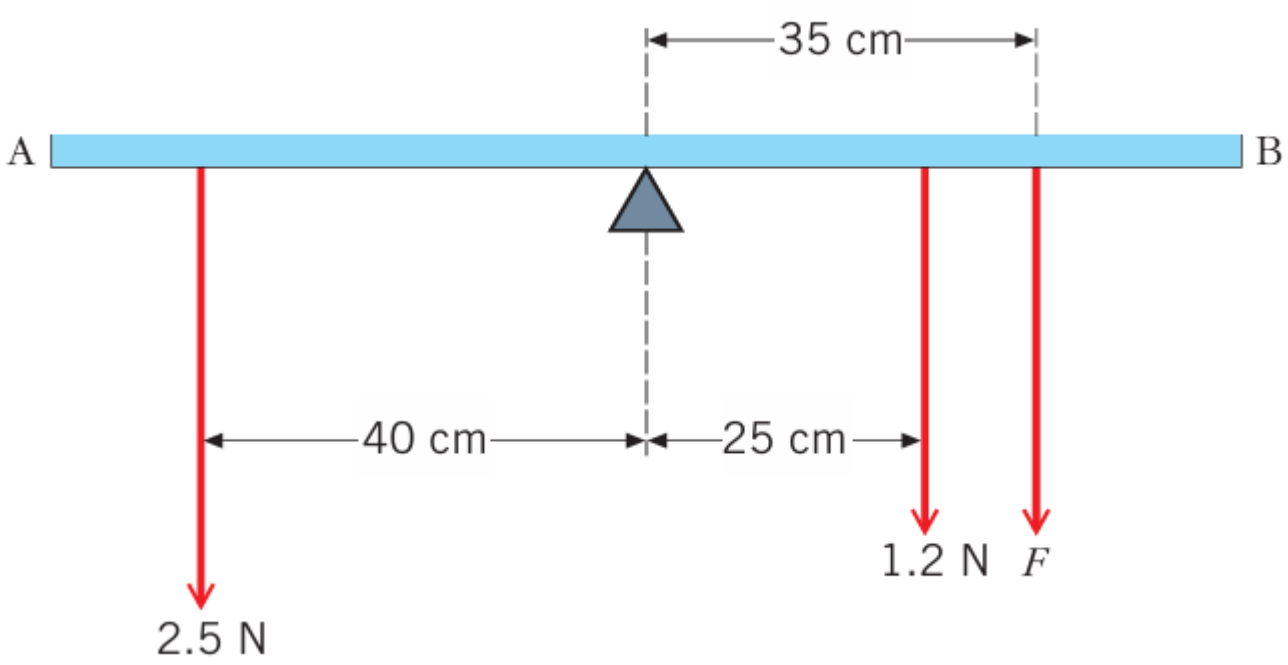
Principle of moments



When a body has no tendency to change its speed of rotation, it is said to be in rotational equilibrium.

The principle of moments states that, for a body to be in rotational equilibrium, the sum of the clockwise moments about any point must equal the sum of the anticlockwise moments about that same point.

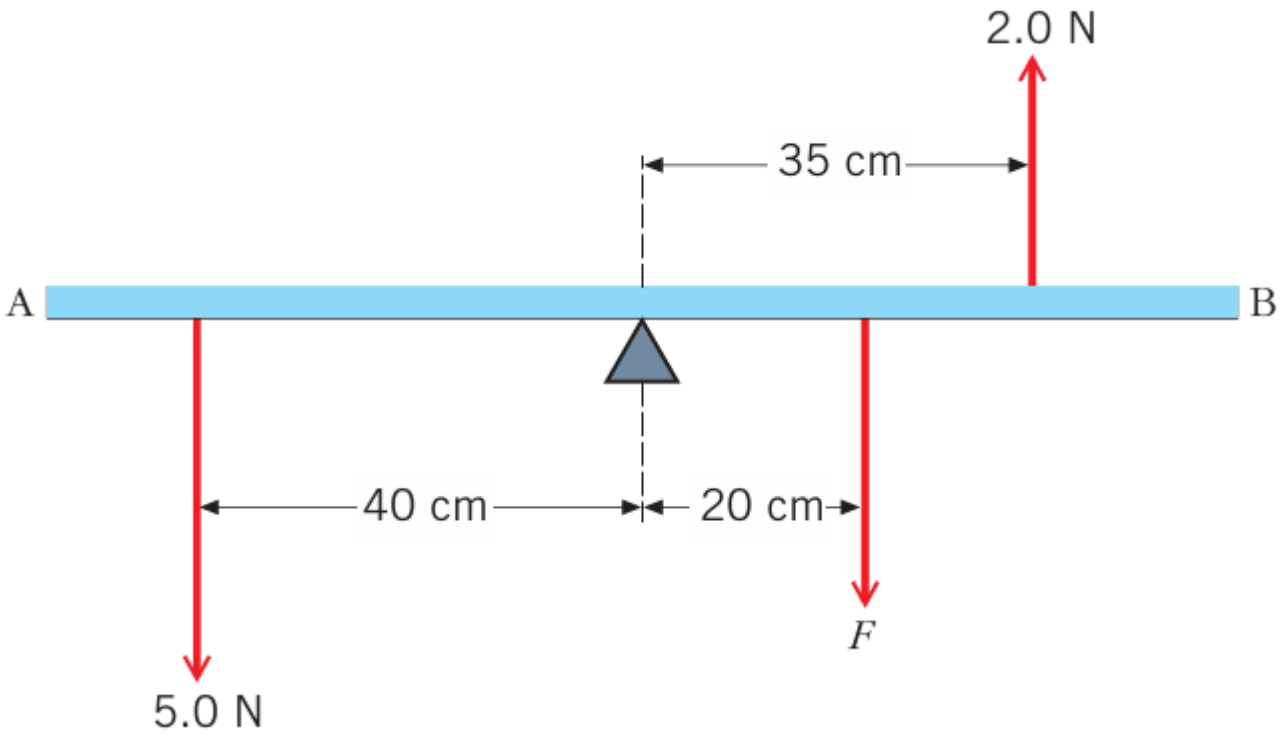
Concept Learning Questions.



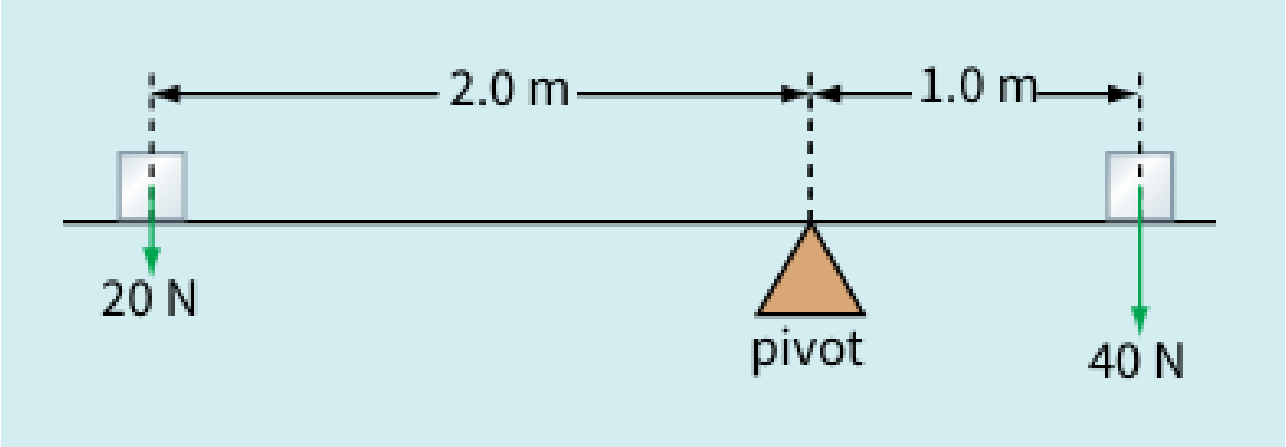
1) Some weights are hung from a light rod AB as shown in the figure.
The rod is pivoted. Calculate the magnitude of the force F required to balance the rod horizontally.

Concept Learning Questions.

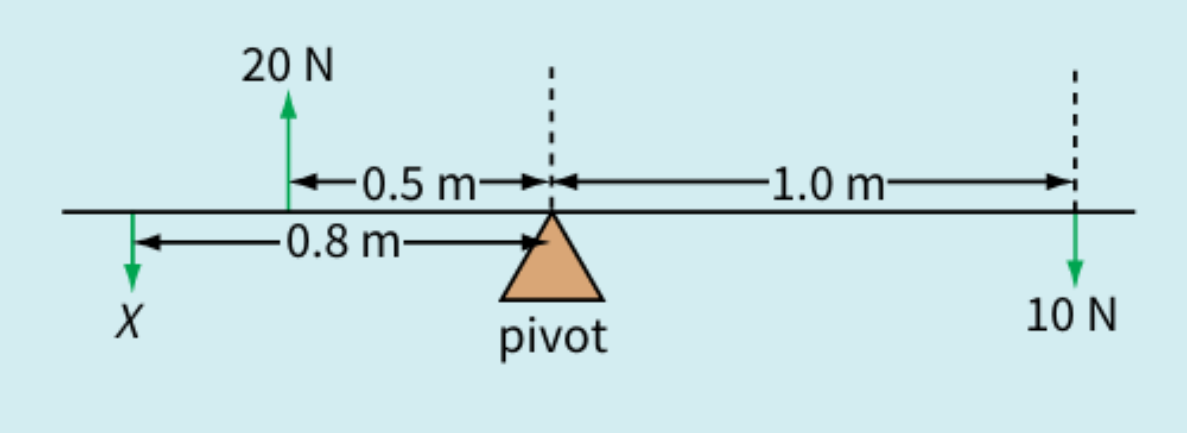
2) Some weights are hung from a light rod AB as shown in the following figure. The rod is pivoted. Calculate the magnitude of the force F required to balance the rod horizontally.

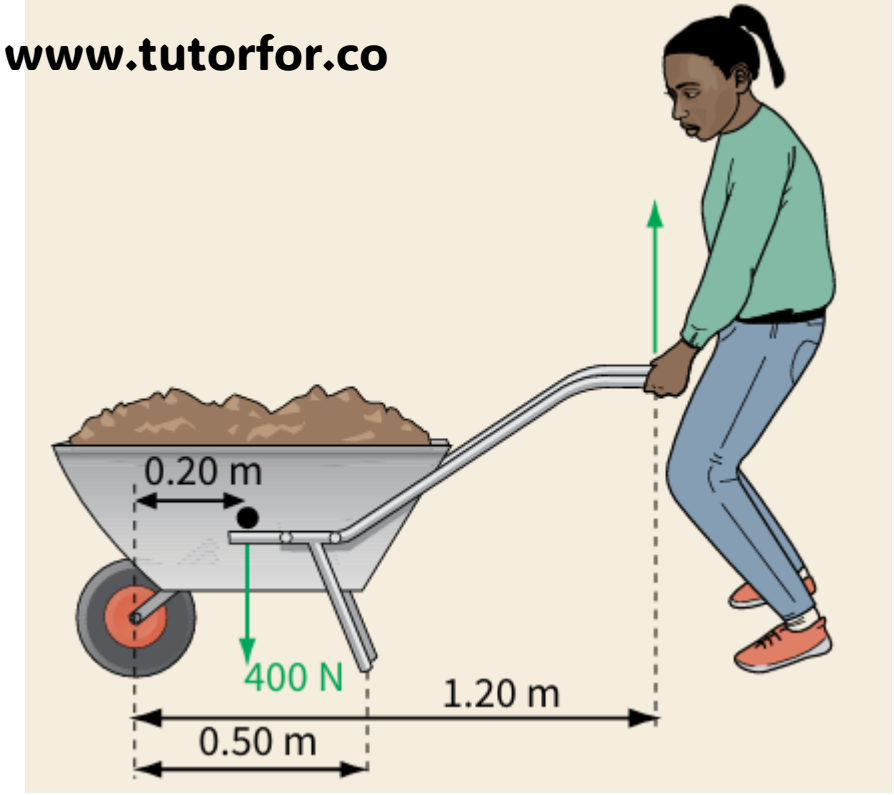


3) Is the see-saw shown in the following figure in equilibrium (balanced), or will it start to rotate?



4) The beam shown in the following figure is in equilibrium. Determine the force X.



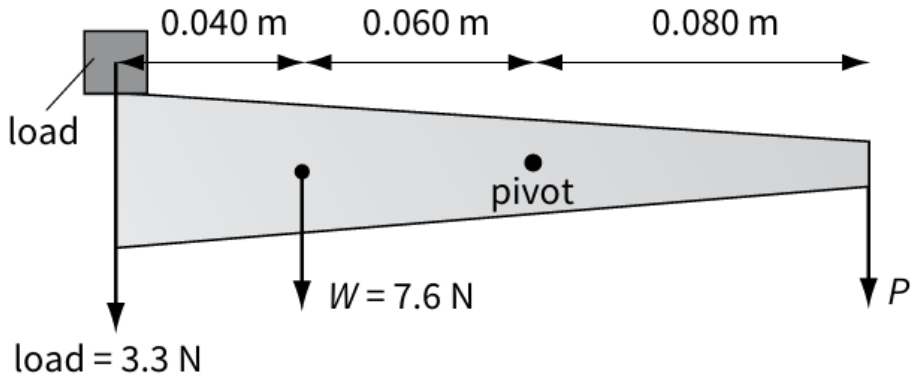


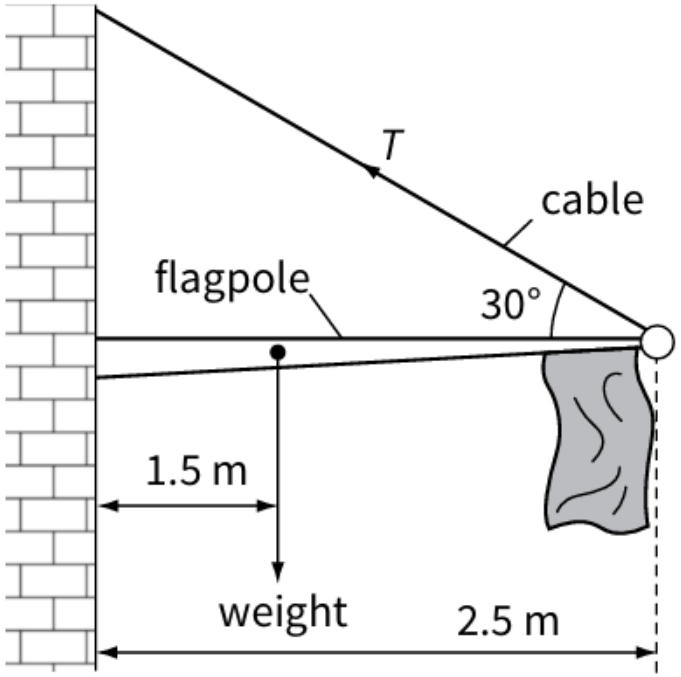
5) A wheelbarrow is loaded as shown in the following figure.

a) Calculate the force that the gardener needs to exert to hold the wheelbarrow's legs off the ground.

b) Calculate the force exerted by the ground on the legs of the wheelbarrow (taken both together) when the gardener is not holding the handles.

6)The asymmetric bar shown in the following figure has a weight of 7.6 N and a centre of gravity that is 0.040 m from the wider end, on which there is a load of 3.3 N. It is pivoted a distance of 0.060 m from its centre of gravity. Calculate the force P that is needed at the far end of the bar in order to maintain equilibrium.





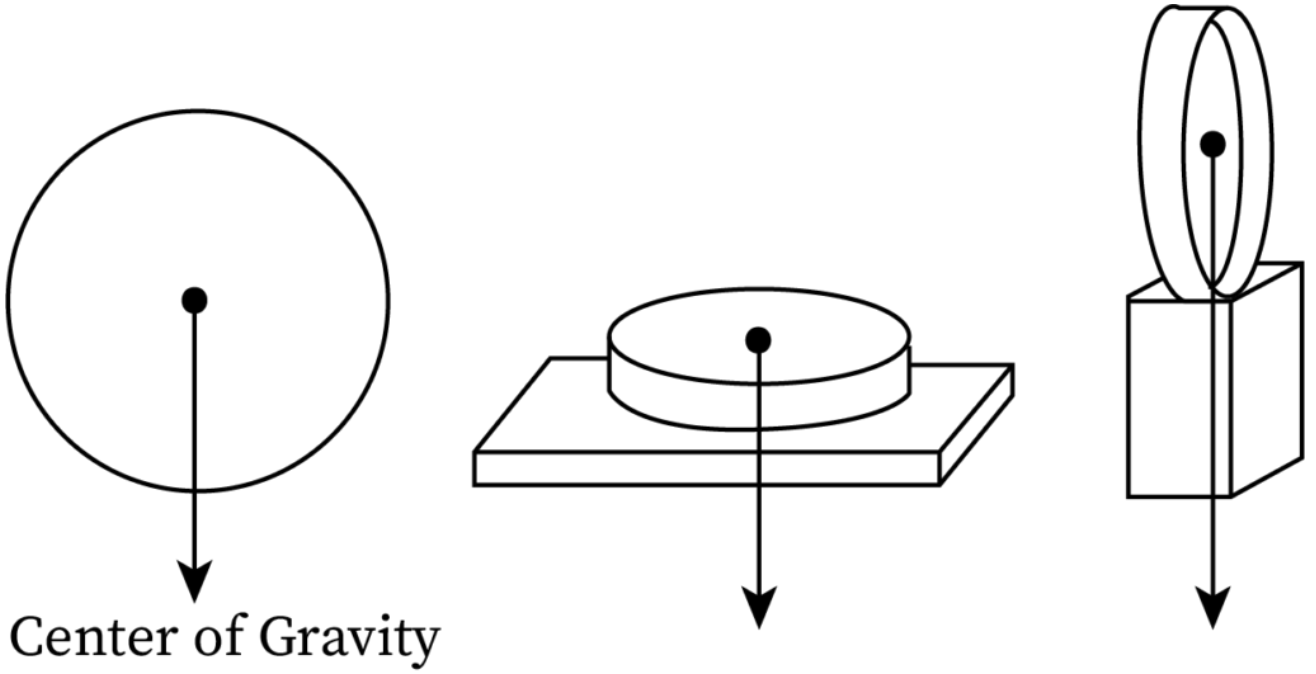
7) A flagpole of mass 25 kg is held in a horizontal position by a cable as shown in the figure. The centre of gravity of the flagpole is at a distance of 1.5 m from the fixed end.

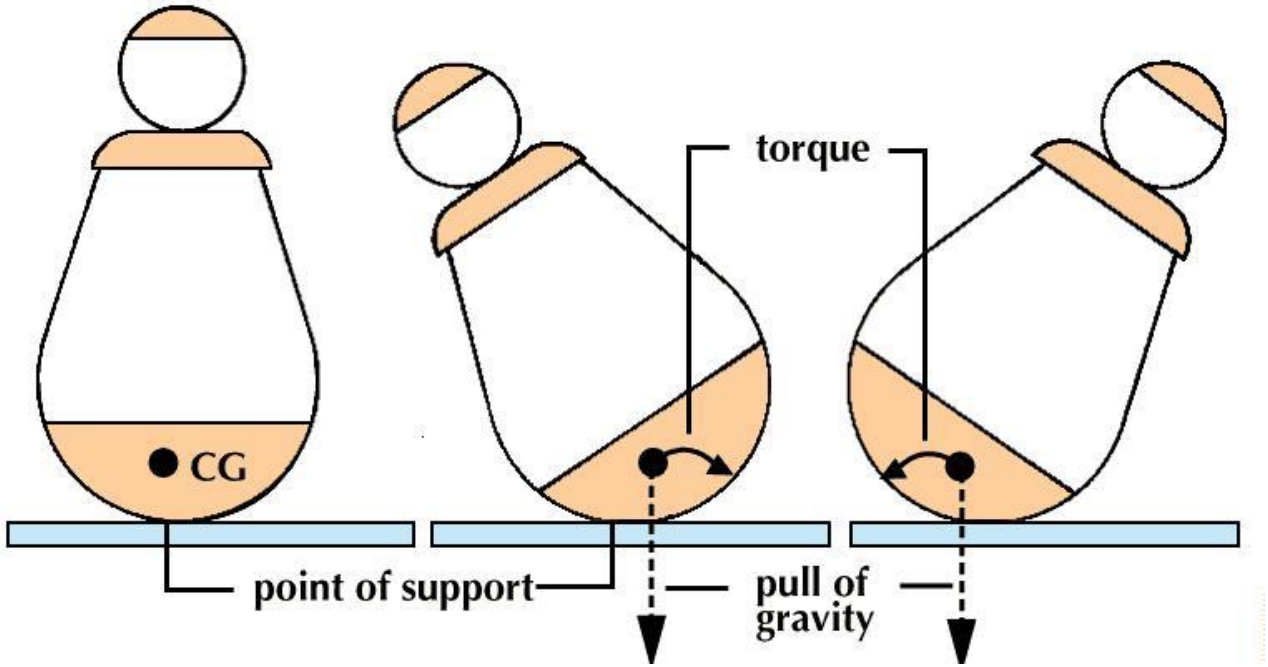
i) Write an equation to represent taking moments about the left -hand end of the flagpole. Use your equation to find the tension T in the cable.

ii) Determine the vertical component of the force at the left -hand end of the flagpole.

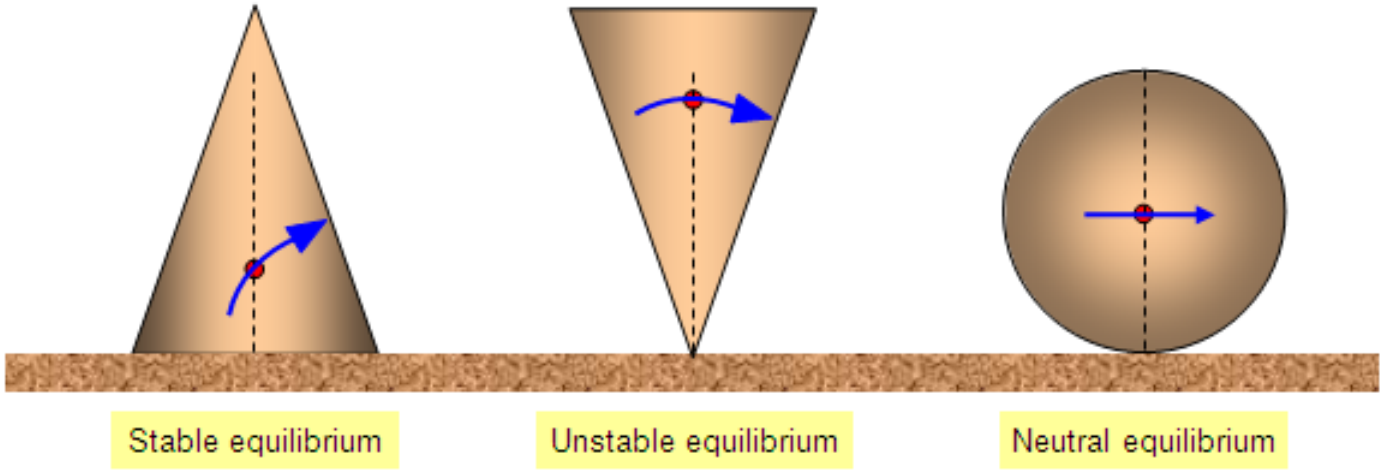
Centre of gravity

The centre of gravity of an object is the point at which the whole weight of the object may be considered to act.

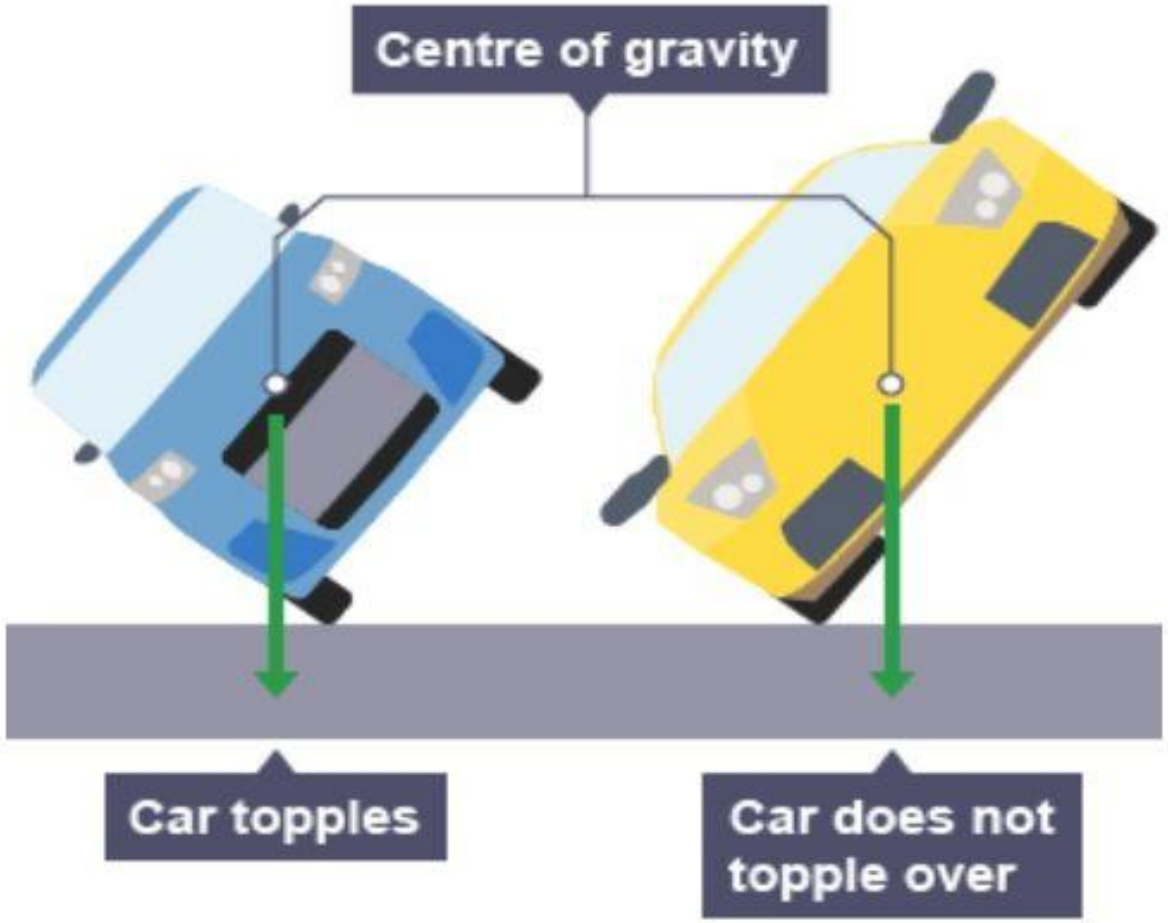




Stability and Centre of Gravity



Stability and Centre of Gravity



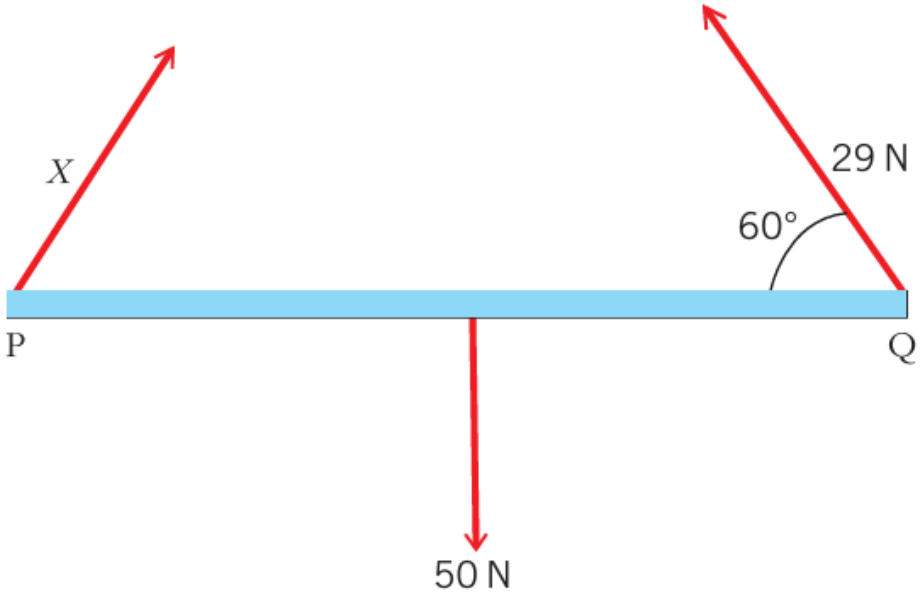
The wider car will not topple over because it has a lower centre of gravity, but the narrow car will

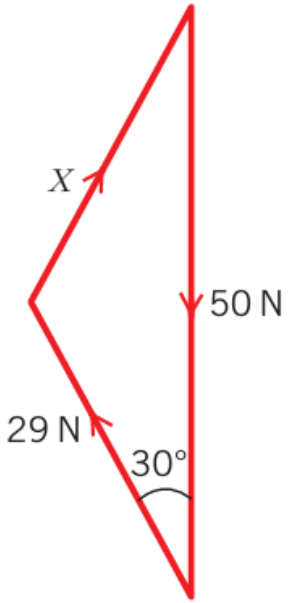
- The dots indicate the athlete's centre of gravity, which follows a smooth trajectory through the air. With his body curved like this, the athlete's centre of gravity is actually outside his body, just below the small of his back. At no time is the whole of his body above the bar.

Equilibrium

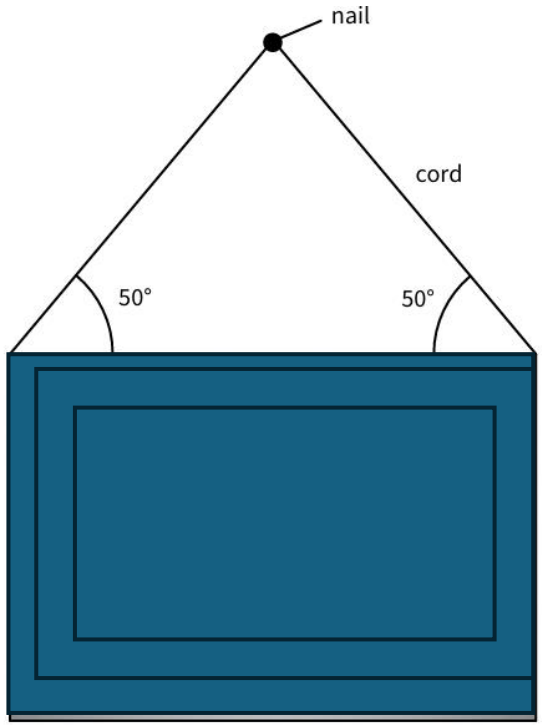
For a body to be in equilibrium:
1 The sum of the forces in any direction must be zero.
2 The sum of the moments of the forces about any point must be zero.

Example: The uniform rod PQ shown in the following figure is horizontal and in equilibrium. Find x.





Concept Learning Questions



Draw a vector diagram to represent the three forces acting on the picture in the vertical plane.
Label each force clearly with its name and show the direction of each force with an arrow.
The tension in the cord is 45 N and the angle that each end of the cord makes with the horizontal is 50°. Calculate:

i) the vertical component of the tension in the cord

ii) the weight of the picture.