

# 1.1 Turning effects

## Definition of the moment of the force:

The turning effect of a force  $F$  about some axis is called **moment**. It can be increased if the force is made larger or if its line of action is farther from the point considered.

If the force acts in a plane perpendicular to the rotation axis, the moment is defined by

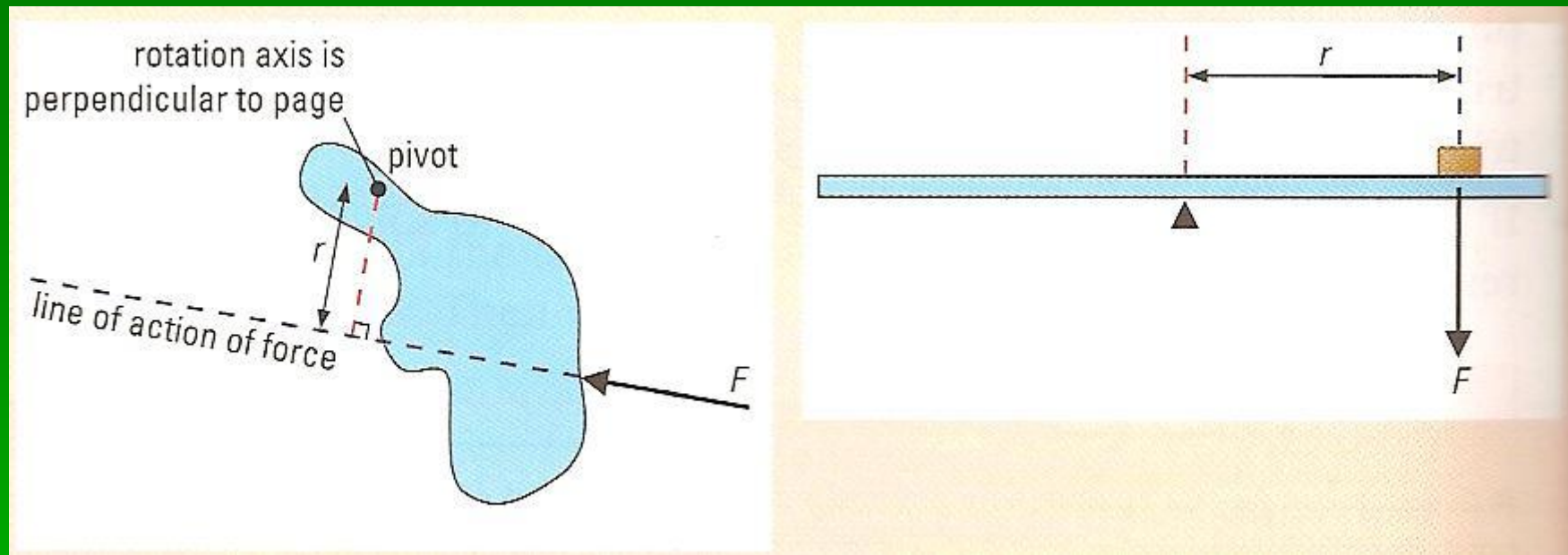
**Moment = magnitude of force x perpendicular distance of the line of action of the force from the axis of rotation**

**Moment of a force –  $M$  – is measured in N.m**

$$M = F \cdot r,$$

where  $r$  – distance of point of rotation (m)

$F$  – force acting in a distance of point of rotation (N)



## Equilibrium of coplanar forces

The object is in equilibrium if the sum of moments of forces acting on it is zero.

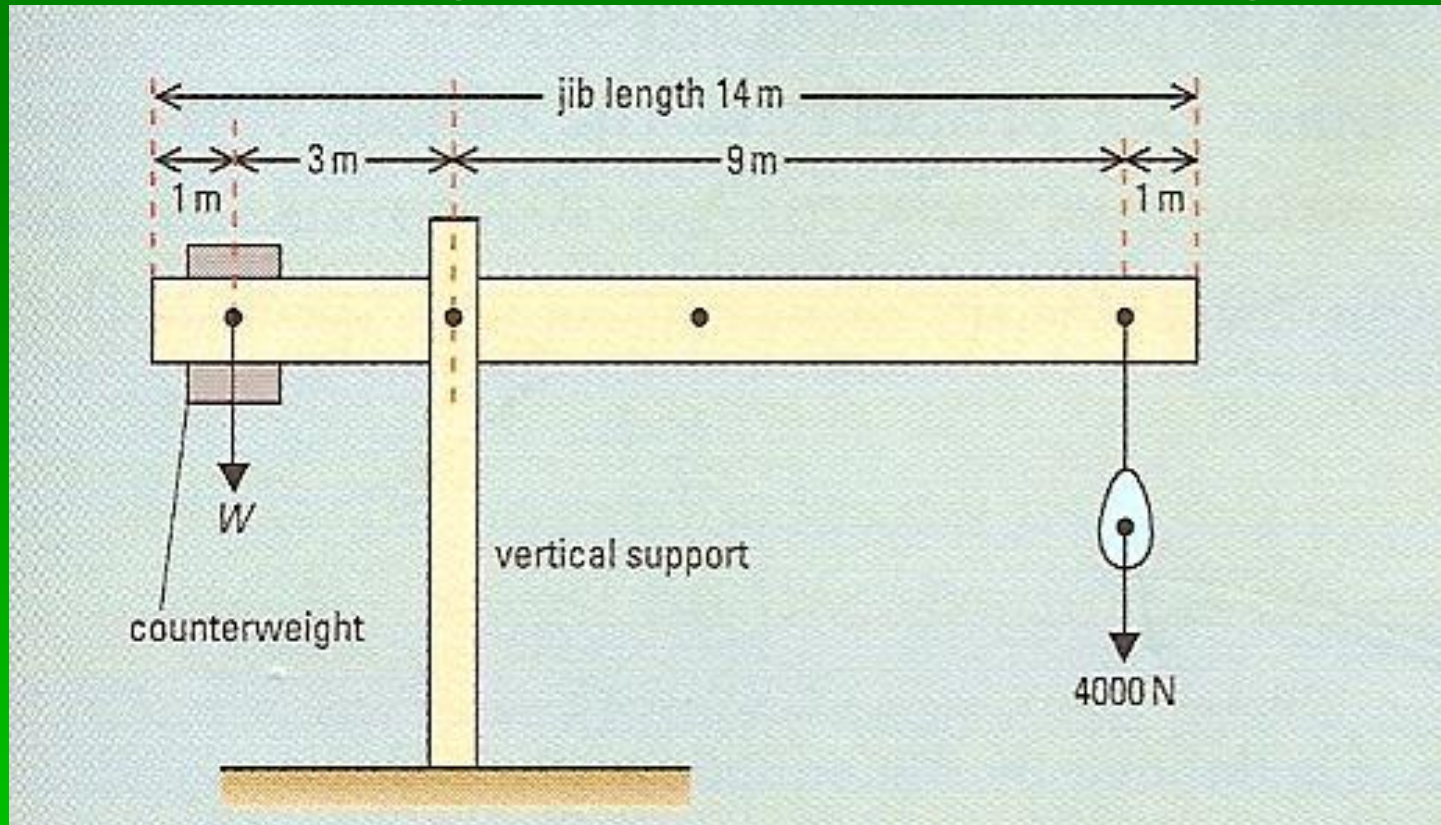
The moment of a force acting clockwise has sign – and anticlockwise +.

$$\Sigma M = 0$$

## Questions

1. A spanner 15 cm long is used to undo a nut against a maximum frictional torque of 10 Nm. What is the minimum force that must be applied to the spanner to undo the nut?

2. A crane is lifting a load as shown in the diagram.



- Ignoring weight of the jib, what is the ideal weight of the counterbalance?
- A bird of mass 2 kg lands on the counterbalance. Does the crane collapse? Explain.

- c) What would the ideal mass of the counterbalance in this example if the jib has a weight of 7000 N and its centre of gravity is halfway along its total length?
- d) If the vertical structure of the crane has weight of 15 000 N, calculate the total vertical support force from the ground (do not ignore the weight of the jib).
3. A wardrobe is 2 m high and 1,6 m wide. When empty it has a mass of 110 kg and its centre of gravity is 0,8 m above the centre of its base. What is the minimum angle through which it must be tipped before it will continue to fall by itself?