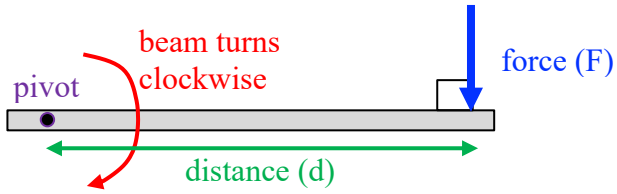
5.4.1 Moments

videos

A moment (M) is the turning effect of a force (F) about a point (or pivot).



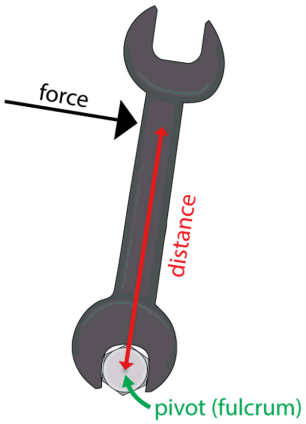
It is defined as:

$$M = F \times d$$

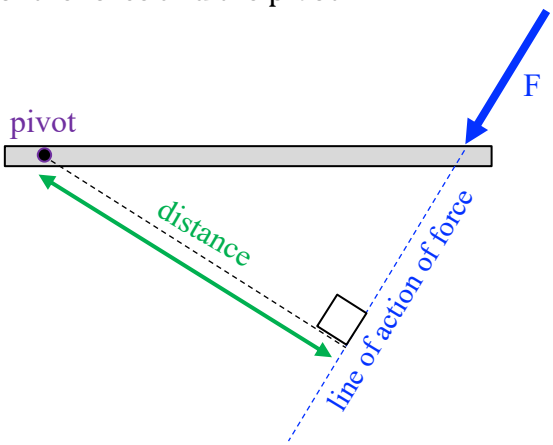
where d=perpendicular distance of the line of action of the force from the turning point (or pivot)

When the force is at right angles (see diagram above), we just multiply the force by the distance of the force from the pivot.

(1) In the diagram (below), a spanner is used to turn a nut. A force of 50N is applied (at right angles) at a distance of 0.20m form the pivot. Calculate the moment?

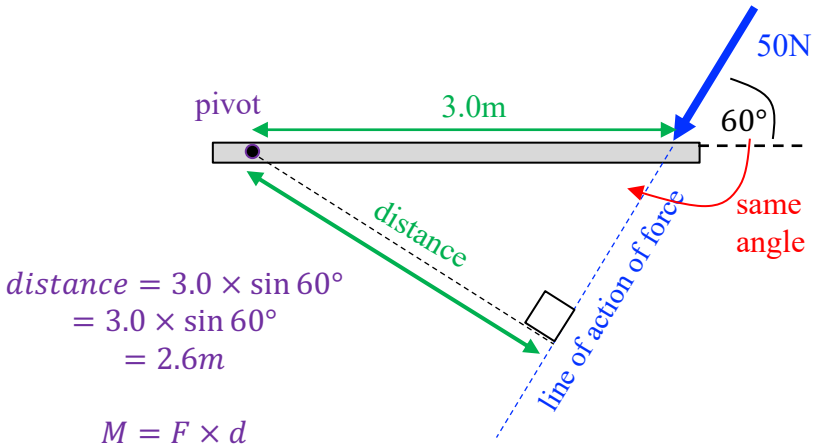


When the force is at an angle, we must take the perpendicular distance between the line of action of the force and the pivot:



Worked example:

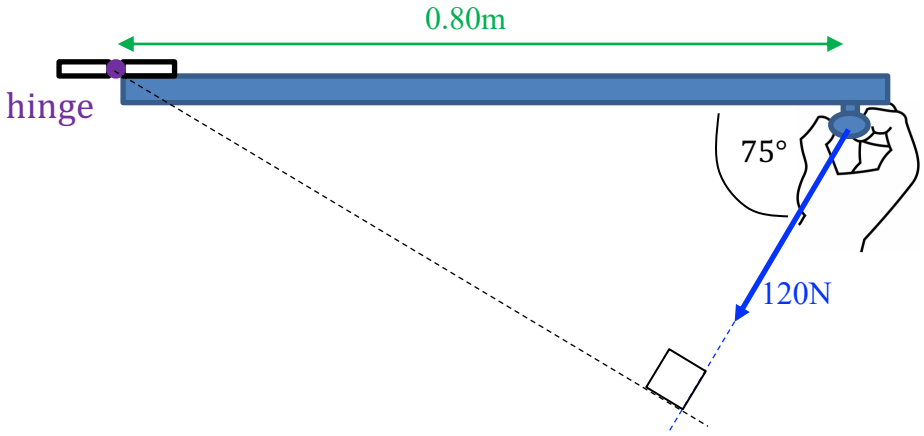
In the diagram (below), A force of 50N is applied at angle of 60° to the beam. Calculate the moment?



$$distance = 3.0 \times \sin 60°$$
$$= 3.0 \times \sin 60°$$
$$= 2.6m$$

$$M = F \times d$$
$$= 50 \times 2.6$$
$$= 130Nm$$

(2) In the diagram (below), a door is opened by pulling on the handle, at an angle to the door. Calculate the moment produced by the force. (Hint: you will need to use some trigonometry (as in the worked example) to calculate the perpendicular distance.)

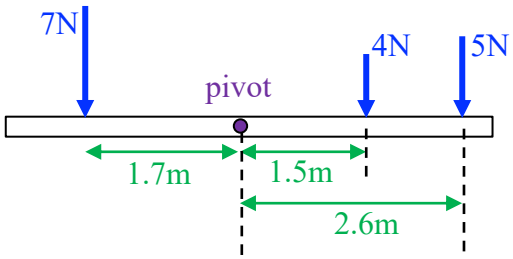


More than one moment/resultant moment

When there is more than one moment acting on an object, the resultant moment is the sum of individual moments. In two dimensions, there will be moments that turn the object clockwise and moments that turn the object anticlockwise. When we add moments we can just take clockwise moments to be positive and anticlockwise moments to be negative. The resultant is just the moments added together.

Worked example:

What is the resultant moment for the following:



The two forces acting on the right-hand side will turn the beam clockwise.

$$total\ clockwise\ moment = (4 \times 1.5) + (5 \times 2.6)$$
$$= 19Nm$$

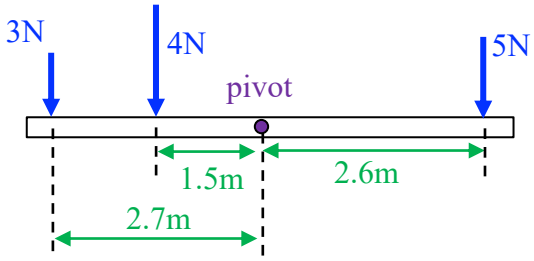
The force on the left-hand side will turn the beam anticlockwise. (We take anticlockwise moments to be negative.)

$$total\ anticlockwise\ moment = -(7 \times 1.7)$$
$$= -11.9Nm$$

$$resultant\ moment = 19 - 11.9 = 7.1Nm$$

Because the answer is positive, the resultant is a clockwise moment.

(3) What is the resultant moment for the following:



(4) What is the resultant moment for the following: (Hint: Note that the 3N force is now a clockwise moment.)