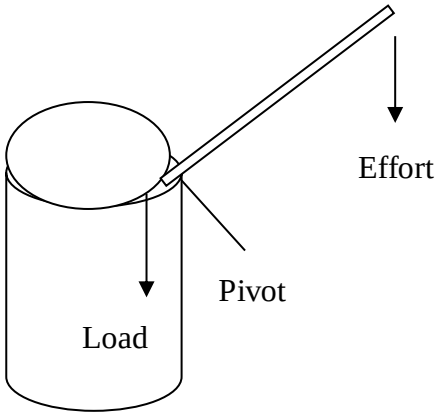
MACHINES

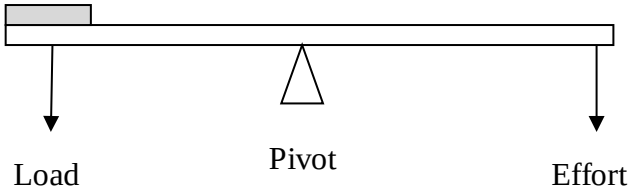
A machine is a device which converts energy from one form to another. A force can be applied at one point and it can be used to overcome a force at another point.

LEVERS

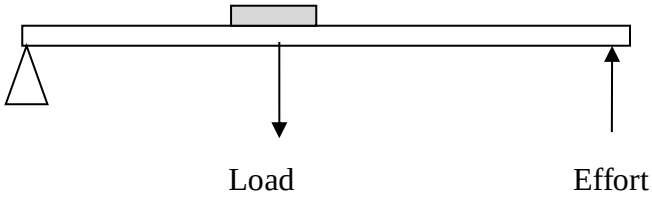
A lever is a simple machine which uses a pivot or a fulcrum to transfer the work done by the effort to a load. There are three types of levers.

1st ORDER LEVERS

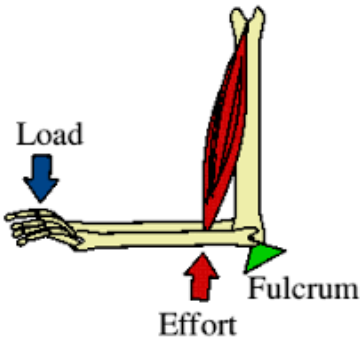


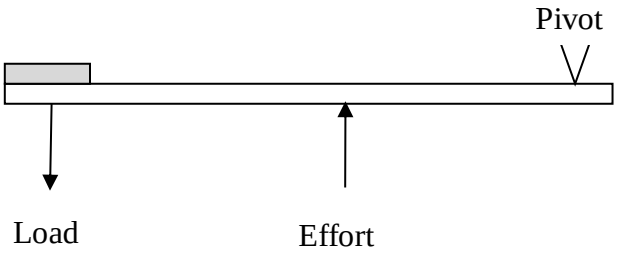


2nd ORDER LEVERS



3rd ORDER LEVERS





The lever works on the principle of moments; that means that the force applied to the lever turns it about the pivot. The turning effect depends on the size of the force used and how far away from the pivot it was applied.

Moment of force = force × perpendicular distance from the pivot
moment = F × d

Units = Nm NOTE units of moments are NOT Joules

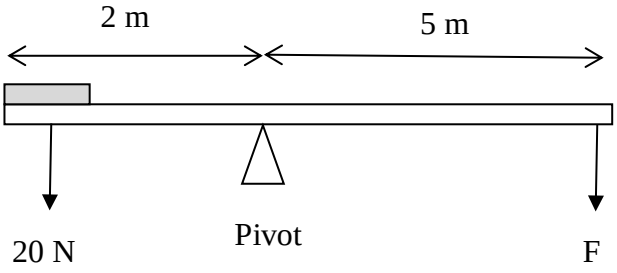
Moments can either be clockwise or anticlockwise depending on the way they turn.

e.g. A spanner produces a turning effect when we try to remove a nut.

We can increase the turning effects of the spanner by a) increasing the force applied or b) increasing the length of the spanner.

<u>Principal of moments</u>
When a body is in equilibrium the sum of the anticlockwise moments are equal to the sum of the clockwise moments about the pivot.

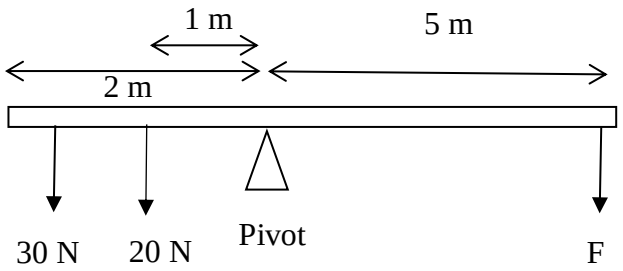
Examples
1. Calculate the moment the force below.



The 20 N force acts in an anticlockwise direction about the pivot.
The force F (the effort) acts in a clockwise direction about the pivot.
Using the principal of moments

Anticlockwise moments	=	clockwise moments
20 X 2	=	F X 5
F	=	40 / 5
F	=	5N

2.

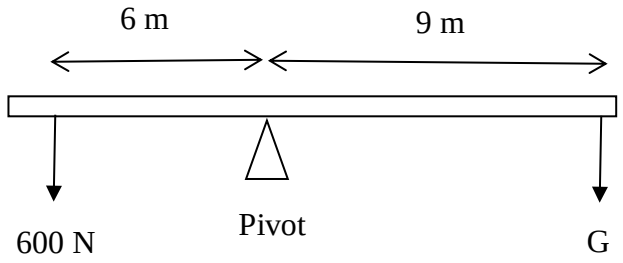


Using the principal of moments

Anticlockwise moments	=	clockwise moments
30 X 2 + 20 X 1	=	F X 5
60 + 20	=	5F
80Nm	=	5F
F	=	80Nm/5m
F	=	16N

3. A boy weighing 600N sits at 6m from the pivot of a see-saw. A girl sits on the opposite side 9m from the pivot and balances the see-saw.
How much does the girl weigh?

Solution:
Draw diagram



Anticlockwise moments = Clockwise moments

$600 \times 6 = G \times 9$

$3600 = 9\ G$

$G = \frac{3600}{9} = 400\ N$

Try

A boy of 80kg sits to the left of a plank 1m away from the pivot. A girl of mass 30kg sits 3m behind him. A man 100kg sits on the right side of the pivot and balances the plank. How far from the pivot is the man sitting?

Answer: Man is 2m from pivot