Moments at work and more about levers and gears

Los:

* What a moment measures
* Calculating a moment
* How to increase a moment
* Why levers are force multipliers and how can you tell
* How gears work

What is a moment

When a force applied to an object makes it turn about a pivot, it is called a moment

Examples of pivots: door hinge, middle of see-saw

The size of the moment depends on two factors…

The bigger the force, the larger the turning effect

The larger the perpendicular distance from the pivot to the point where the force is applied, the larger the turning effect

**Moment, M (nm) = force, F(N) x perpendicular distance from the line of action of the force of the pivot, d (m)**

You can increase either the force or the distance to make the moment bigger

Lever

A leave is an edge which is lowered on one end in order to raise an object on the other end, e.g. a crowbar.

The **load** is the weight to be lifted

The **effort** is force pushing down

The **pivot** is the fixed point

The effort is always a lot smaller than the load, sometimes called a force multiplier

The line of action is the line along which the forces act

Question

A force of 50N is exerted on a claw hammer of length 0.3m. calculate the moment of the force

50 x 3 = 15nm

Force multipliers

Starter

1. The effort is much less than the force on the object
2. The longer distance of the effort from the pivot increases the force on the object

Bottle openers work by increasing the force on the cap using moments.

As the handle creates a long distance from a pivot, less effort is needed to provide necessary force to open the bottle.

A longer handle will need less effort to open the bottle

The hand is the effort and the cap is the load

The handle on scissors is far away from the pivot. This distance creates a greater moment. The hand is the effort and whatever is being cut is the load

Gears

* Gears multiply the effect of a turning force (they are force multipliers)
* In low gear, the small wheel turns a larger wheel
* One whole rotation of a small wheel, is less than one on the larger wheel
* The small wheel exerts an equal and opposite force on the larger wheel where they are in contact
* The force acts at a tangent to the point of contact (at right angles to the wheel radius)
* Because the radius is bigger in the larger wheel, the turning force on the bigger wheel is smaller than in the smaller wheel (due to a greater moment)

Changing gears

Low gear: A small wheel from the engine shaft is used to turn a large wheel in the output shaft. So, the large wheel turns slower

**Low gear means slow speed and high turning effect**

High gear: a large wheel from the engine shaft drives a smaller wheel in the output shaft. So the small wheel turns faster

**High gear means fast speed and low turning effect**

Worked example

A gear wheel of radius 20cm is used to turn another gear wheel of radius 10cm with a force of 80N

Calculate the moment of the force on:

a) The 10cm wheel

80 x 0.1 = 8nm

b) the 20cm wheel

80 x 0.2 = 16nm

Moments and equilibrium

See book for diagram

**Moments must be equal for equilibrium**