Levers

What is a lever?

A lever is a rigid bar that pivots about a fulcrum. It transmits an input motion and force, (the effort) through the lever pivoting on a fulcrum to a resistance force called a load.

Load

The load is anything that is being moved by a lever.

Effort force

The effort force is the energy applied to a lever to move a load.

Fulcrum

The fulcrum is the point at which the lever pivots. A lever may rest on a fulcrum or it may swivel on an axle, e.g. a see-saw (class 1 lever) and a wheel barrow (class 2 lever).

Mechanical advantage (MA)

Machines and mechanical devices are used to create a mechanical advantage. Mechanical advantage helps us do work such as move heavy loads for a relatively small amount of effort. Mechanical advantage can be worked out by dividing the load force by the effort force,

\[ \text{Mechanical advantage} = \frac{\text{Load}}{\text{Effort}} \]

Levers create a mechanical advantage. The long lever pivoted near one end enables a small effort force to lift a heavy load.

Creating a mechanical advantage using a lever

The mechanical advantage of a lever is worked out by dividing the distance of the effort force to the fulcrum by the distance of the load force to the fulcrum.

\[ \text{MA} = \frac{\text{Distance of effort force to fulcrum}}{\text{Distance of load force to fulcrum}} \]
Classes of levers

There are three classes of levers. Each class of lever has the load and effort force in specific positions relative to the fulcrum.

**Class 1 lever**

A Class 1 lever has the fulcrum between the load and the effort force.

**Class 2 lever**

A Class 2 lever has the load between the fulcrum and the effort force.

**Class 3 lever**

A Class 3 has the effort force between the load and the fulcrum.

**Bell Crank Lever**

A bell crank lever is an angled Class 1 lever. It is a Class 1 lever because the fulcrum is between the load and the effort force.

The bell crank lever is used when the effort force must be at an angle, usually a right angle, to the load.

**Cantilever**

A cantilever is a beam that is fixed at one end only. Load is applied to the unsupported end.

A cantilever may be classified as a type of Class 1 lever as fulcrum is between the effort force and the load.
Three examples of tools that utilise levers are shown.

The pair of pliers has its fulcrum between the effort force and the load, so it is a Class 1 lever.

The nut cracker has the load between the effort force and the fulcrum, so it is a Class 2 lever.

The lower arm of the digger has its effort force between the fulcrum and the load, so it is an example of a Class 3 lever.