Mechanisms

Mechanisms change an input force /movement into an output force/movement. They can alter the direction of movement and change the amount of force.

Movement /Motion

Input	Control	Output
Force/movement is put into a mechanism	Mechanism converts/transmits the input force and movement	Force/movement to satisfy the need

There are 4 basic types of motion:

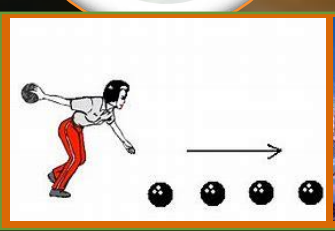
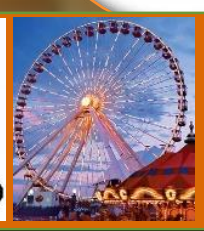
Linear — Moves in a straight line

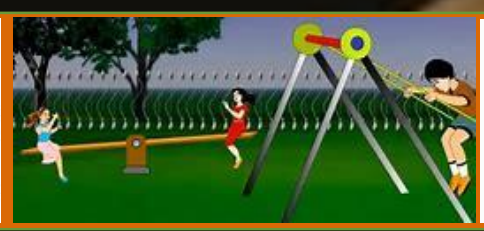
Reciprocating — Moves forwards & backwards

Rotary — Moves round & round

Oscillating — Moves on an arc

	Input	Control	Output
	Rotary motion of pedals	Chain & sprocket	Wheels rotate and bicycle moves in a linear motion
	Rotary motion of handle	Bevelled gears	Drill bit rotates at a 90 ° angle
	Rotary motion of motor	Pulley system	Linear movement of cable as load is lifted





Cams & Followers

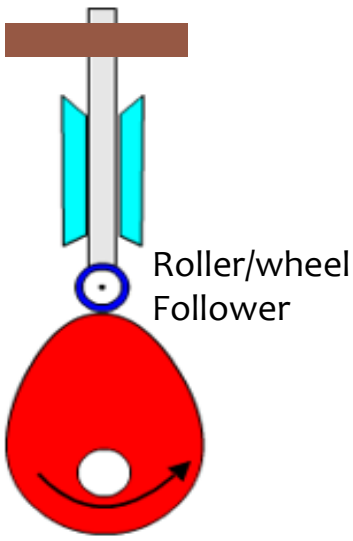
A CAM is a simple mechanism. It changes rotary motion to reciprocating motion. They are found in many machines (sewing machines, cars, toys etc.).

A cam mechanism will often also include:

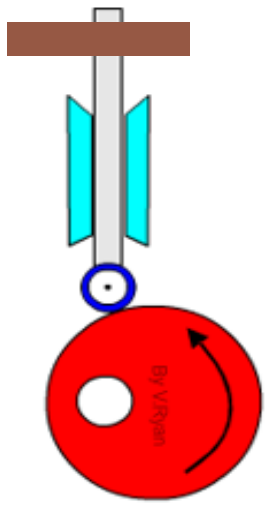
- A **slide** to prevent the follower from slipping
- A **crank** (handle) to manually rotate the camshaft
- A **wheel follower** to reduce friction between the cam and follower

Cam Shapes

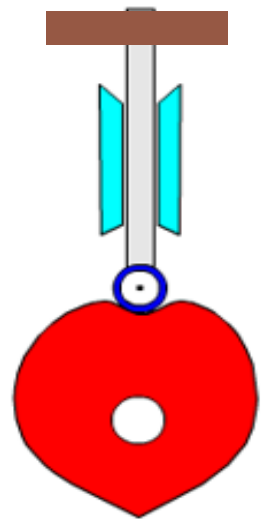
Different shaped cams give different movements. The circular cam is smoother with a steady rise and fall. The snail cam has a slow but higher rise, and a sudden drop.



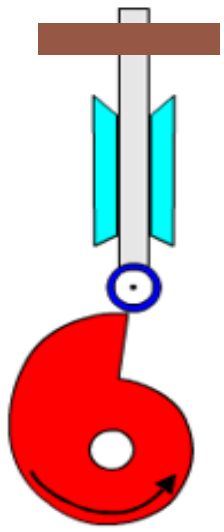
Pear-shaped



Circular/eccentric



Heart -shaped



Drop/snail-shaped

Helpful website:
https://technologystudent.com/cams/cam1.htm

Mechanisms

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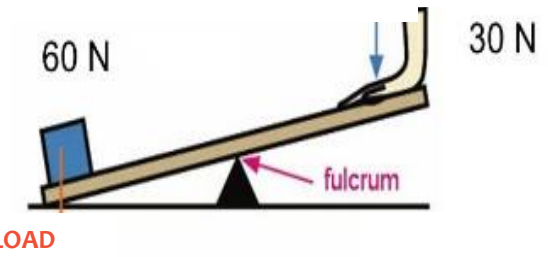
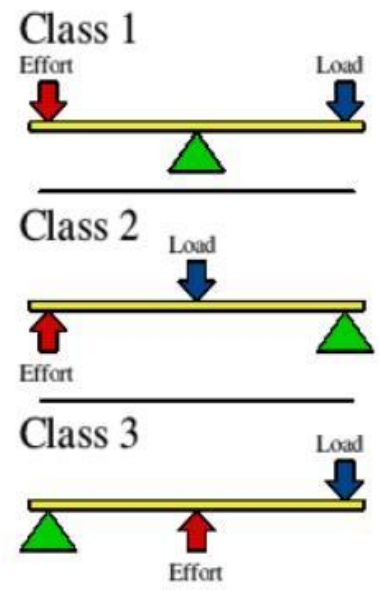
Levers & Linkages

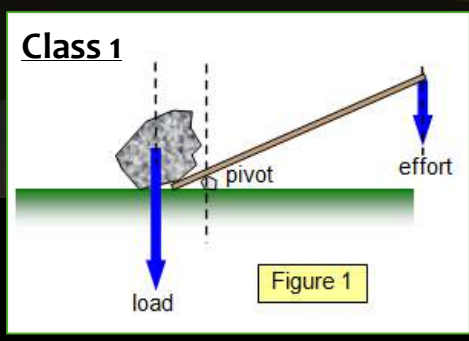
A lever is a rigid beam. Levers are the simplest form of mechanism, dating back to prehistoric times.
By using a stiff branch resting on a log, early man could move heavy loads such as rocks.
This is similar to the way we use scissors to cut, or pincers to take out a nail from wood.
Levers rotate about a fixed pivot point called a fulcrum .
Effort is applied to one end of the lever, lifting a load at the other end. By moving the fulcrum nearer to the load, you can lift a large load with little effort.
This is called MECHANICAL ADVANTAGE.

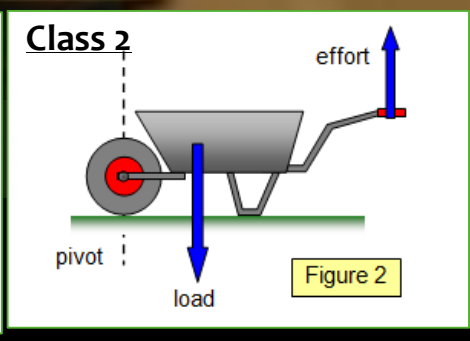
What is the mechanical advantage of the lever below?

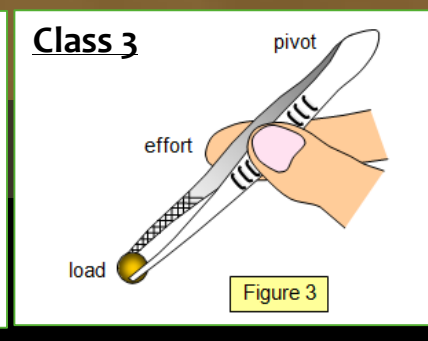
MA= LOAD / EFFORT

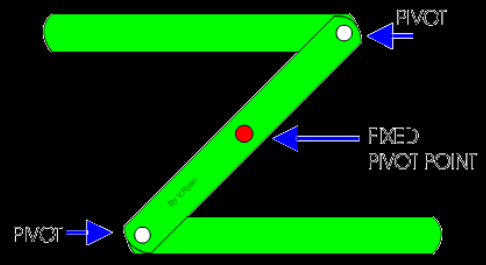




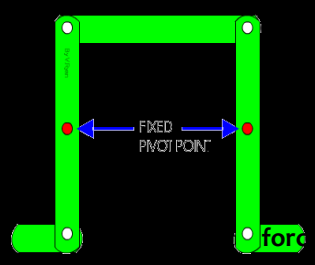




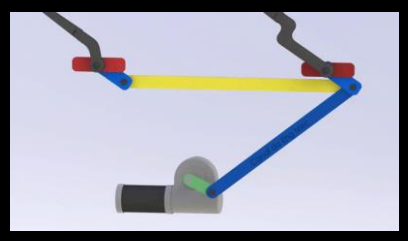


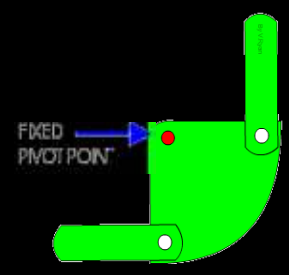


Reverse Motion linkage
Uses: car jack, lazy tongs



Parallel Motion linkage
Uses: windscreen wipers

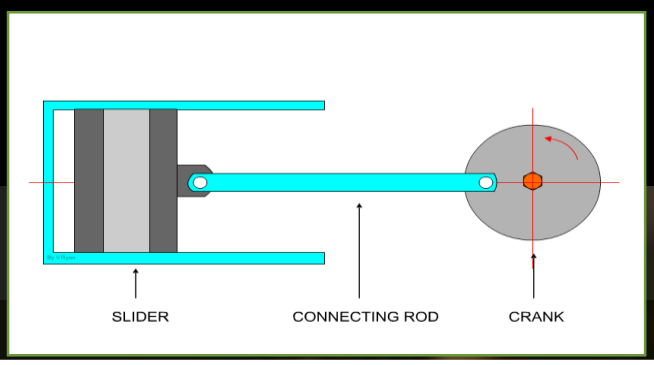


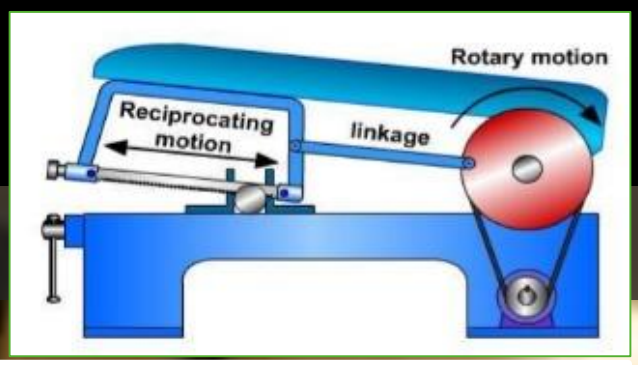


Bell Crank linkage
Uses: bicycle brakes

Crank and slider

The crank is the wheel. As it rotates, the connecting rod pushes the load into the slider.
Input movement: rotary
Output movement: reciprocating
example: mechanical hacksaw





Helpful website:
https://technologystudent.com/forcmom/lever1.htm
https://technologystudent.com/cams/link1.htm
https://technologystudent.com/cams/crkslid1.htm

Mechanisms

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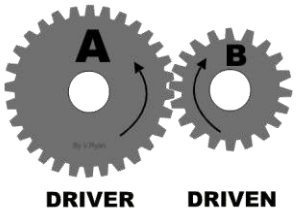
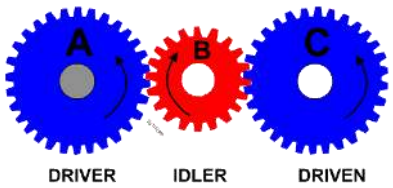
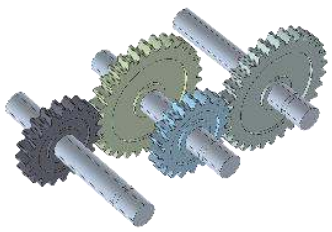
Gears







Simple Gear Train.
When 2+ gears are meshed together but there is only one gear on a shaft

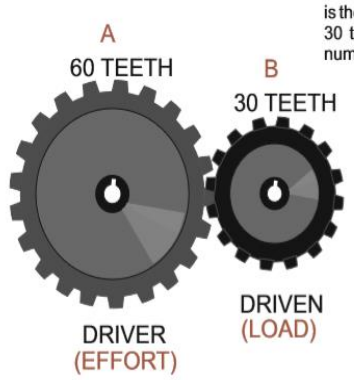
Simple gear train with an idler gear. The idler allow the driven gear to go in the same direction as the driver gear

Compound Gear Train.
There is more than one gear on a shaft. Gears are used to change speed

Calculating velocity ratio in a gear mechanism

VR = number of teeth on the DRIVER gear / number of teeth on the DRIVEN gear

In the example below, the DRIVER has 60 teeth and because it is the largest we say that it revolves once. The DRIVEN gear has 30 teeth. Simply divide 60 teeth by 30 teeth to work out the number of revolutions of the driven gear.



GEAR RATIO / VELOCITY RATIO

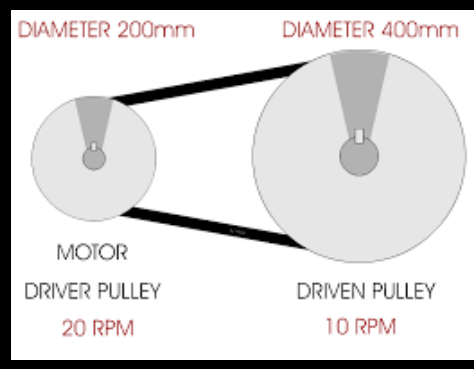
$$\frac{\text{Distance moved by Effort}}{\text{Distance moved by Load}} = \frac{\text{60T (GEAR A)}}{\text{30T (GEAR B)}}$$

$$= \frac{1}{2} = \frac{\text{Input movement}}{\text{Output movement}}$$

$$= \text{Driver : Driven}$$
$$1 : 2$$

Pulleys

What is a pulley?
Pulleys use **mechanical advantage**, similar to levers, to lift up loads. Pulleys are wheel shaped with a V shaped groove that allows a cord to sit inside the groove. They can be used by hand or attached to a motorised **winch** to increase the amount of weight that can be lifted. The pulley wheels are often V shaped to increase grip so they don't slip when the belt is moving.



The driver pulley revolves 20 rpm (revolutions per minute), and the driven pulley 10 rpm. For every single revolution of the driven pulley wheel, the driver wheel rotates twice. This is due to velocity ration. Your answers have to be written as a ratio. *In this case the VR =2:1. The V.R. can be worked out in several ways. Here are the two most common ways to work out V.R.:*

Calculating velocity ratio

METHOD ONE:

$$\frac{\text{DISTANCE MOVED BY DRIVEN PULLEY}}{\text{DISTANCE MOVED BY DRIVER PULLEY}} = \frac{400\text{mm}}{200\text{mm}} = 2 \quad \text{OR} \quad 2 : 1$$
DRIVER : DRIVEN

METHOD TWO:

$$\text{VELOCITY RATIO} = \frac{\text{DRIVER PULLEY MOVES 2 REVOLUTIONS}}{\text{DRIVEN PULLEY MOVES 1 REVOLUTIONS}} = \frac{2}{1} \quad \text{OR} \quad 2 : 1$$
DRIVER : DRIVEN

Helpful website:
https://technologystudent.com/gears1/gears1.htm
https://technologystudent.com/gears1/pulley1.htm