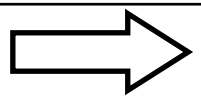
GCSE DT: Mechanical devices – Motion and Linkages

Type of movement	Direction of movement	Examples of movement
Linear = Moves in one direction		Pen (pushing), train, tram, car
Oscillating = Swings in alternative directions		Clock pendulum Turning Key in a lock Door handle
Reciprocal = Moves backwards and forwards		Sewing machine needle. Inside a printer,
Rotating = Turns in a circle		Clock hands, Wheels, Record/CD player, hand drill handle, bike pedals

Linear speed = distance ÷ time

A car travelled 20kmiles in 23 minutes. Calculate the linear speed.

Rotational speed = number of revolutions ÷ time

A bike wheel rotates 12 times in 5 seconds. Calculate the rotational speed.

Have you looked at BBC bitesize revision? It is a really useful website and can be downloaded as an app for free.

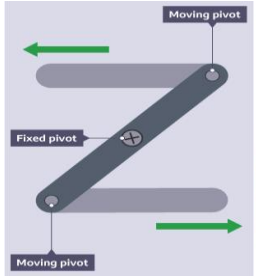
Select the Eduqas section within Design and Technology to find relevant revision content.

Linkages.

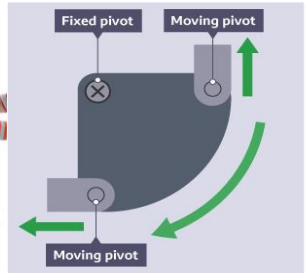
Linkages are mechanisms which allow force or motion to be directed where it is needed. They can be used to **change direction of motion,** type of motion and the size of a force.

Example of a linkage changing direction of motion

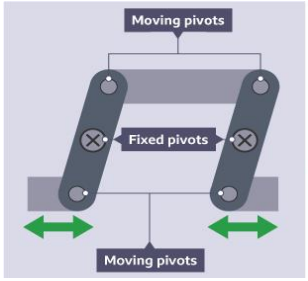
Input		Process		Output
Rotating	→		→	Linear



Reserve motion linkage



Bell crank

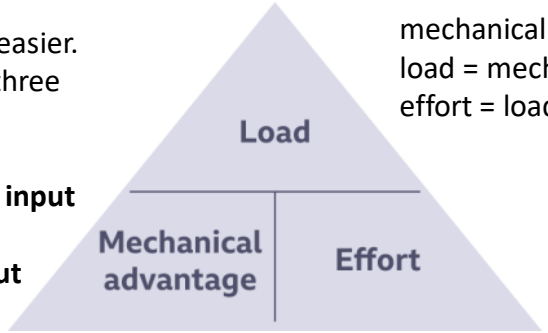


Parallel / push and pull

GCSE DT: Mechanical devices – Levers

Levers use **mechanical advantage** to make lifting or applying pressure easier. All levers are made of a bar and a **pivot**, called a **fulcrum**. Levers have three main parts:

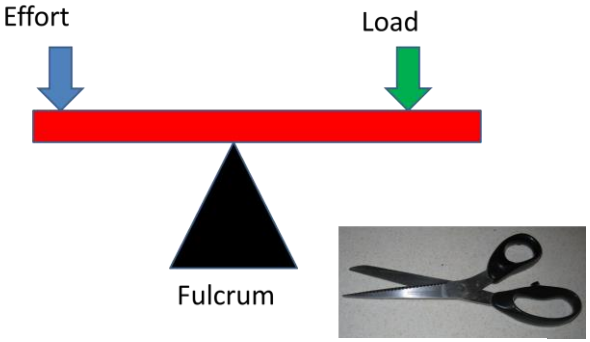
effort - the amount of force applied by the user, also referred to as the **input**
fulcrum - where the lever pivots
load - the weight that needs to be moved, also referred to as the **output**



mechanical advantage = load ÷ effort
load = mechanical advantage × effort
effort = load ÷ mechanical advantage

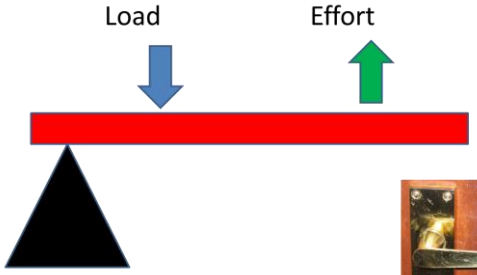
This diagram is useful to help you figure out calculations on levers in the exam.

Class 1 lever



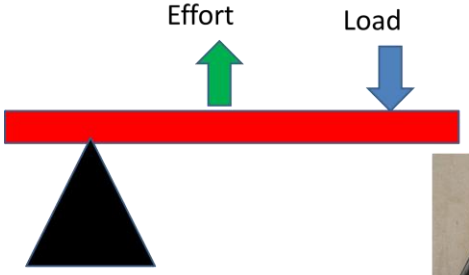
Basic lever

Class 2 lever



Force multiplier

Class 3 lever



Movement multiplier

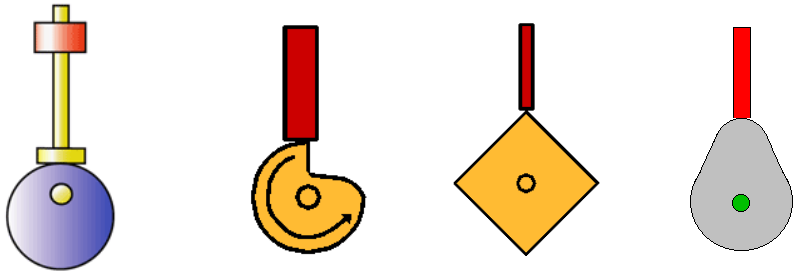
GCSE DT: Mechanical devices – CAMs and Gears

Cams

A CAM **changes** the input motion, which is usually **rotary motion**, to a **reciprocating motion** of the follower.

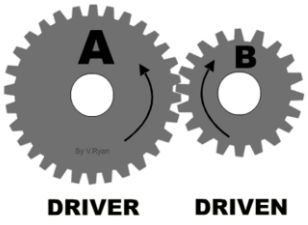
A **cam mechanism** has two parts: **cam** and **follower**

Circular (Eccentric) Snail (drop) Square Pear



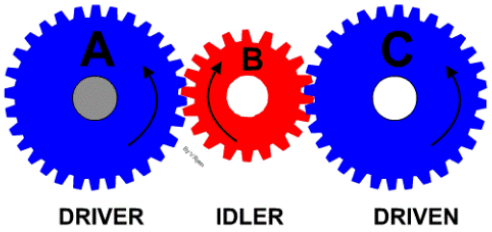
Gears

Gear systems transfer rotary motion. They are linked together in **gear trains** with the simplest form being a 2 gear wheel.

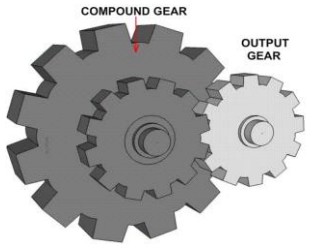


Spur gears
The input and output are different directions

If **one gear was larger** than the other, the **rotational speed would change.**

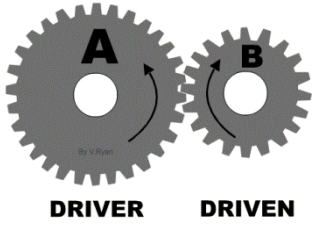


Idler Gear
If both gears were required to turn in the same direction, **an idler** would be placed between the input and output.



Compound gears
Can significantly increase or decrease the number of possible rotational speeds

Gear ratio = number of teeth on driven gear ÷ number of teeth on the driver gear

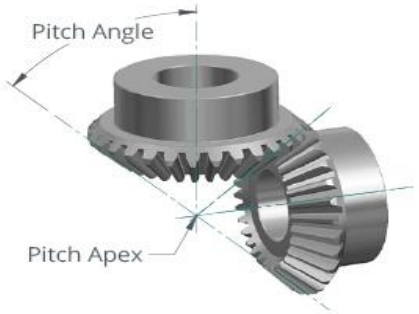


If a cyclist is pedalling with a drive gear of 50 teeth and a driven gear of 25 teeth, what is the gear ratio?

50 ÷ 25 = 1:2

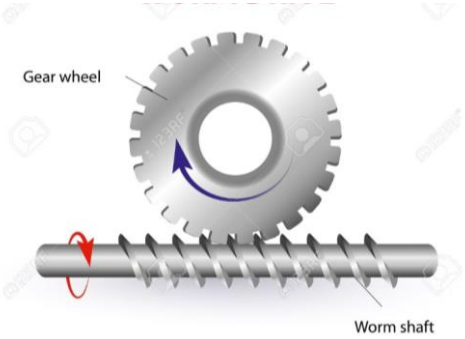
GCSE DT: Mechanical devices – CAMs and Gears

Other types of gear



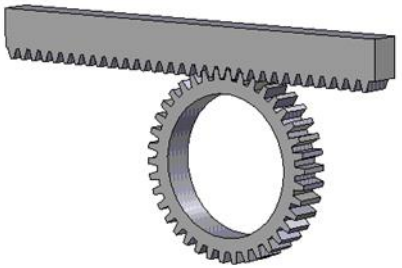
Bevel and mitre

- Can have shafts at 90 degrees
- Different sizes of gears can change the speeds



Worm Gear

- Transmits force and motion through 90 degrees
- Reduction on rotational speed possible
- Used in food mixers



Rack and pinion

- Used to change rotary motion into linear
- Used in pillar drills
- Used in steering mechanisms in cars

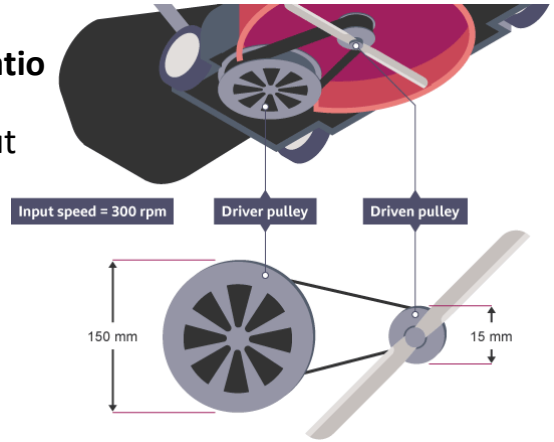
Velocity ratio = diameter of the driven pulley ÷ diameter of the driver pulley

Output speed = input speed ÷ velocity ratio

Calculate the velocity ratio and the output speed of the driven pulley on this lawnmower belt and pulley:

15 ÷ 150 = 0. 1

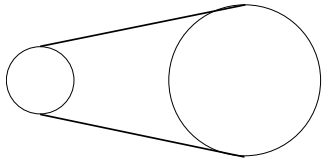
300 ÷ 0.1= 3,000 rpm



Belt drives

A pully and belt drive transfers rotary motion, like a gear system.

They can be used to change the speed, direction of rotation, or turning force or torque.



GCSE DT: Electronic devices

Input

A subsystem that receives a signal from a component such as a sensor. They are 2 types; analogue and digital

Process

A subsystem that can be made from a semi conductor device such as a microcontroller, microprocessor or computer

Output

A subsystem that converts an electrical signal into a function such as light or sound

LDR

An **analogue** component to sense amount of light.
Used in street lamps, night lights, digital clocks etc

Thermistor

An **analogue** component to sense level of temperature.
Used in ovens, car engines, thermostats, heaters etc

Switches

A **digital** component that sensors on/off OR yes/no.
There are several different types of switch

Microcontroller

A microcontroller is a single **Integrated Circuit (IC)** that is typically used for a specific application and designed to implement certain tasks.

Essentially, a microcontroller gathers input, processes this information, and outputs a certain action based on the information gathered.

What can it do?

- Counting – keeping track of scores on a electronic board in a sports match
- Timing - turning on/off a security light

LED

Produces light but must be used with a resistor to limit current. Available in range o colours, sizes and shapes.

Buzzer

Produces sound output.
Used in burglar alarms, microwaves and timers

Are microcontrollers and microprocessors the same?

No – I am highlighting this as pupils use the word microprocessor to describe a microcontroller.

Microcontrollers are versatile because they have the ability to control numerous inputs and outputs simultaneously

Microcontrollers can run multiple programs simultaneously and include interrupts / override features

Microcontrollers are small in size and can reduce the number of components required therefore products can be miniaturised

Many **microcontroller**s run off low voltage supplies making them energy efficient and are also reusable

GCSE DT: Electronic devices

Flow chart programs

To program a microcontroller, you need a set of instructions which tells the microcontroller what to do.

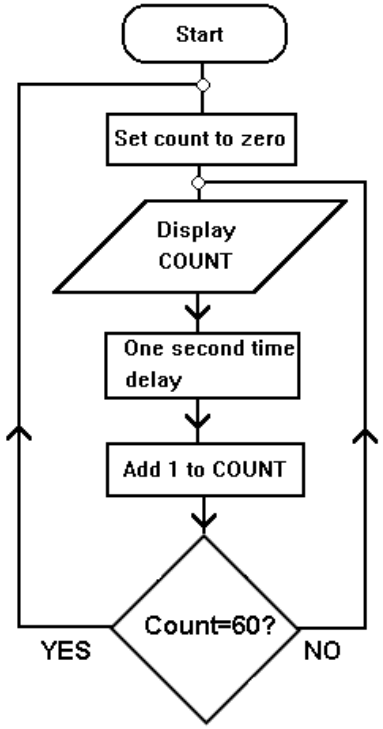
A flow chart is a graphical way of showing program. It uses standard symbols that are shown in the table

How to programme a microcontroller

Stage 1: Compose a program
Stage 2: Run / test the program to see if it works as required
Stage 3: Download onto a microcontroller
Stage 4: Run / test the system to see if it works editing program if needed
Stage 5: Place microcontroller IC into control system and run

Feedback in control systems

Sometimes systems require 'feedback' which means the microcontroller receives information from a sensor and feeds it back into the input to gain 'precise control'.
For example, central heating. If a room is too cold, a sensor monitors the temperate and switches on the heating.



1 MINUTE TIMER

Symbol	Name	Function
	Start / End	An oval shape represents the start or end of a process
	Input / Output	A parallelogram represents input or output
	Decision	A diamond represents a decision
	Process	A rectangle represents a process
	Arrow	An arrow is a connector that shows relationships between the different shapes and what they represent

Subroutines

Subroutines (macros) can be used to simplify the structure of a complex programme.

It is basically a small sub program within a larger programme.

By adding a 'RETURN' command at the ned of a subrouhntine , enables the task to be repeated.

https://www.bbc.co.uk/bitesize/guides/zh8ck2p/revision/1