Scalar quantities- magnitude only (distance, speed, volume)
Vector quantities – magnitude AND direction (e.g. force, velocity)

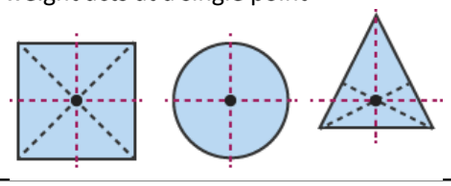
Contact forces – friction, air resistance, tension
Non-contact – gravitational, electrostatic, magnetic

P2

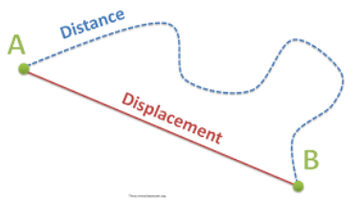
Velocity (Vector) – speed in a given direction
A Ferris wheel may have constant speed but changing velocity
On a **distance – time graph** the **gradient = velocity (y axis/ x axis)**
A **tangent** could be used if the line is not linear (accelerating or decelerating)

Weight = mass x gravity Weight and Mass are **directly proportional**

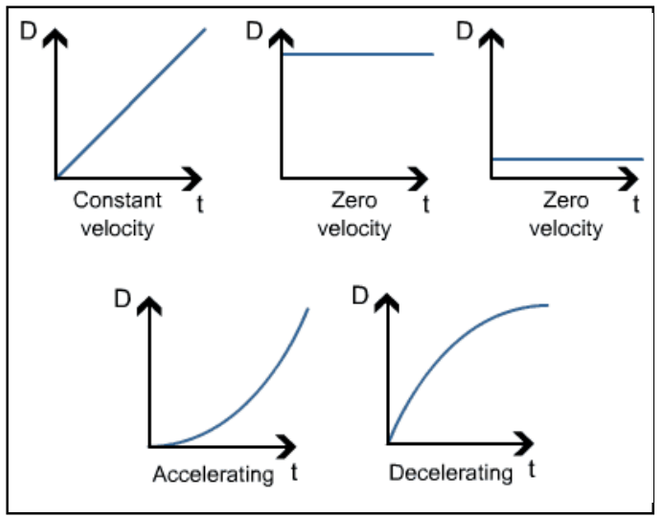
Centre of Mass – weight acts at a single point



Displacement includes both the distance an object moves, measured in a straight line from the start point to the finish point and the direction of that straight line. Displacement is a **vector quantity**



Speed (scalar)
Speed = distance / time
walking ~1.5 m/s
running~3 m/s
cycling~6 m/s
car~ 13-30m/s
train~ 50m/s
plane~ 250m/s
Sound in air~ 330m/s



Acceleration
Acceleration = velocity change/ time

Car~ 4 m/s^2
Lorry~ 2m/s^2

Work done = force x distance **1Joule = 1 newton metre**
1J of work is done if 1N causes an object to be displaced 1m
If a trolley is pushed 3m with a force of 2N = 6J of energy is transferred

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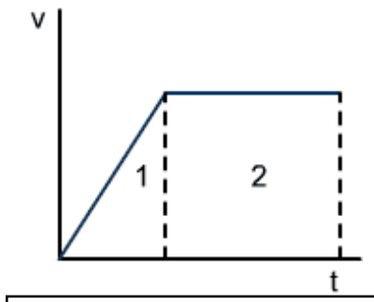
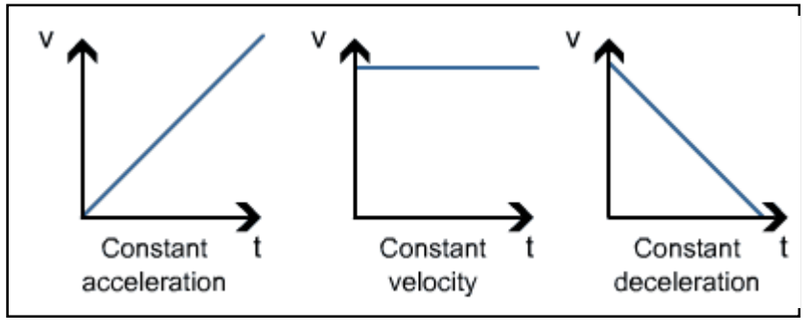


Area 1+ Area 2 = distance travelled

Velocity- Time graph

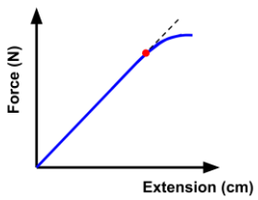
Gradient = acceleration

Distance travelled (displacement) = area under the graph (HT)



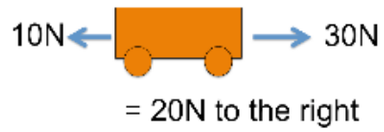
Force = spring constant x extension **Force and extension are directly proportional**
To change a shape of an object (stretch, bend, compress) you apply more than one force
Elastic deformation – an object will return to its original shape
Inelastic deformation – Object stays in new shape
Limit of proportionality - spring is deformed

If the spring is not inelastically deformed, work done = elastic potential energy
elastic potential energy = 0.5 × spring constant × extension^2

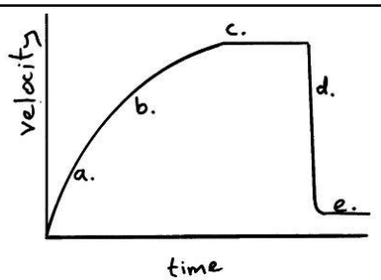


Momentum = mass x velocity

Conservation of momentum: The total momentum before an event is equal to the momentum after an event. e.g. two snooker balls colliding



Terminal velocity – parachute example
a) If an object is falling it will **initially accelerate** due to gravity
- Acceleration as an object falls to Earth is **9.8 m/s^2**
b) As an object moves faster the greater the **air resistance**
c) The **resultant force will become 0** as constant **terminal velocity** reached. Downwards force and upwards force **balance**
d) Parachute opened and velocity decreases
e) As forces balance again another **Terminal velocity** is reached



Newton's First Law: If the **resultant force = 0** a stationary object **stays stationary** and a moving object will have a **constant speed**
Continuing with rest or constant motion = **inertia**

Newton's Second Law: Acceleration is proportional to resultant force and inversely proportional to mass – so more resultant force = more acceleration, but more mass = less acceleration
Force = mass x acceleration

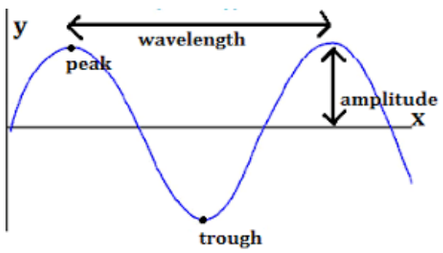
A measure of how difficult it is to make an object change velocity= **inertial mass**
Ratio of **force: acceleration (mass = force/acceleration)**

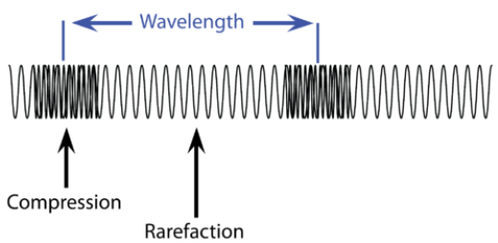
Newton's Third Law: If objects interact the forces are always equal and opposite
If I push on a wall with 20N it will push back with 20N

Waves

Transverse wave (EM waves):
Oscillations (vibrations) are at right angles (perpendicular) to the direction of energy

Longitudinal wave (sound):
Oscillations are in the same direction as the energy





Frequency = number of waves per second (Hz)

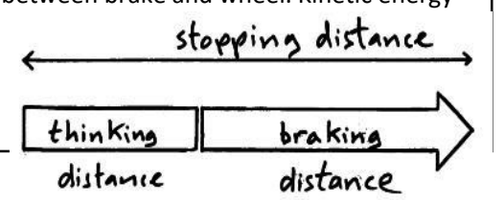
Period = 1/ frequency
Time taken for one wave

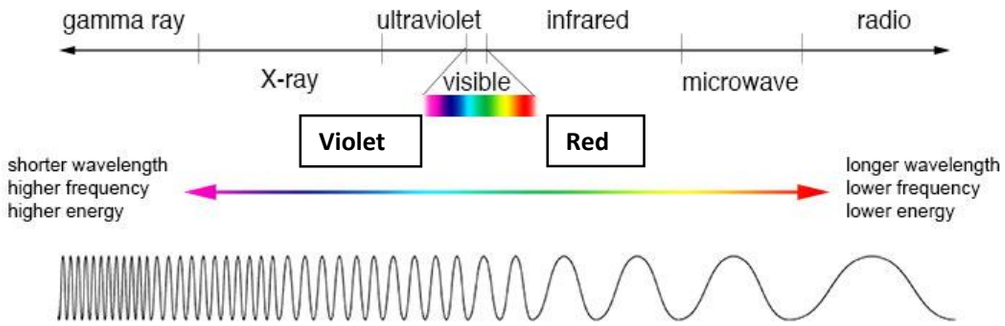
Wave speed = wavelength x frequency

Stopping distance = thinking distance + braking distance
- A driver's reaction time can be affected by **tiredness, distractions, drugs and alcohol**
- Reaction times range form 0.2s- 0.9s
- A vehicle's braking distance can be affected by adverse road and weather **conditions** (wet or icy) and **poor condition brakes and tyres**

When brakes are applied, work is done by friction force between brake and wheel. Kinetic energy decreases as car stops. Temperature will increase.

A high breaking force and quick deceleration = brakes overheat and loss of control



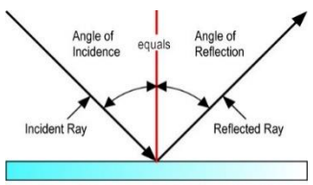


Red, monkeys, in, very, unusual, x-ray, glasses

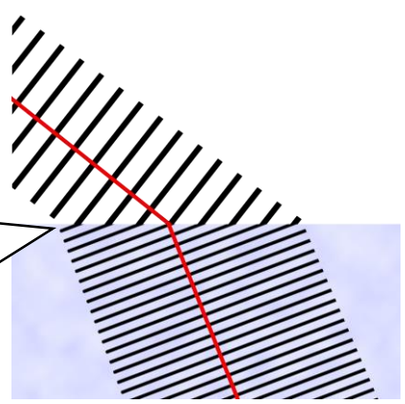
EM Spectrum: **Radiowave, Microwave, Infrared, Visible light, UV, X-rays, Gamma rays (10^{-15}m – 10^{4}m)**
All transverse waves that transfer energy from source to absorber.
All have same velocity and can travel in a vacuum (300 million m/s)

EM wave	Uses and Key points
Radio	TV and Radio telecommunication (HT)When radio waves are absorbed they create an electric **alternating current** with the same frequency. Information can be coded into the transmission
Microwave	Satellite communication and cooking food
Infrared	Electrical heaters, infrared cameras and cooking food Internal energy of the bonds increases when absorbed
Visible light	Fibre optic communication
ultraviolet	Energy efficient lamps and sun tanning Can cause skin aging and skin cancer
X rays	Medical imaging Ionising radiation that can mutate DNA and cause cancer
Gamma	Cancer treatment Originate from changes in an atom nucleus Ionising radiation that can mutate DNA and cause cancer

EM Wave behaviour (HT)
Different substances may **absorb, transmit, refract or reflect** electromagnetic waves in ways that vary with wavelength



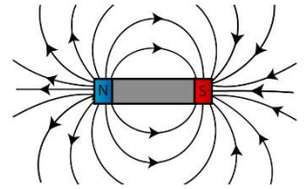
The refraction 'wave front diagram' shows that as a wave changes to a denser medium the wavelength gets shorter and the speed increases. If the wave hits at an angle the direction will also change



Magnetism
The **poles** of a magnet are the places where the magnetic forces are strongest
Two like poles **repel** each other. Two unlike poles **attract** each other

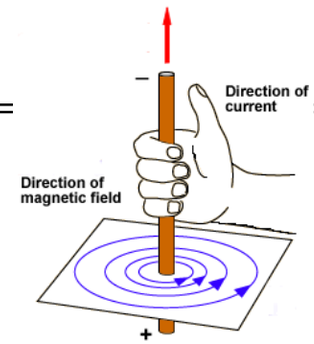
An **induced magnet** is a material that becomes a magnet only when it is placed in a magnetic field.
Magnetic metals – **iron, steel, cobalt and nickel**

A **compass** contains a small magnet. It will point in the direction of the Earths magnetic field.
You can use a small compass to plot magnetic field lines



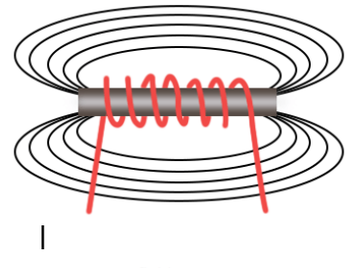
Magnetism from a conducting wire
When a current flows through a wire a magnetic field is produced
The strength of the magnetic field depends on
1. **Current**
2. **Distance from the wire**

The direction of current or magnetic field can be worked out using the **right hand grip rule**

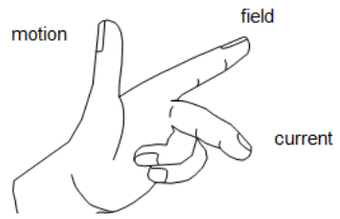


Radiation dose	Sv
Current	A
Force	N
Mass	kg
acceleration	m/s^2
velocity	m/s
weight	N
Gravity	N/kg
Energy	J
Extension	m
Spring cons.	N/m
Work done	J
Momentum	Kgm/s

Electromagnets
If you shape a wire into a coil it is called a **solenoid –** this increases the magnetic field. To increase the magnetic field of a solenoid;
1. **Increase number of coils/turns**
2. **Increase current**
3. **Use an iron core**



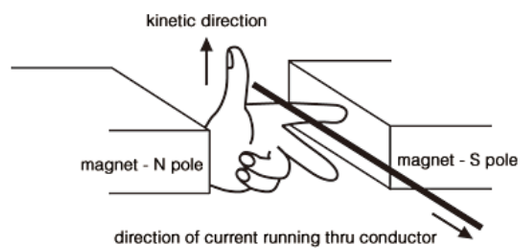
Motor Effect
If you place a wire into a magnetic field a force will be exerted (wire moves)– this is how a motor works
The **Fleming left hand rule** will tell you the direction the wire will move



RP1: Elasticity: Force = spring constant x extension
IV: Weight (N) DV: Extension of the spring CV: Same spring (spring constant)
Once you have plotted force against extension you could then use this to find the weight of an unknown object by seeing how much extension there is on the spring
Safety: ensure clamp stand is secured to table

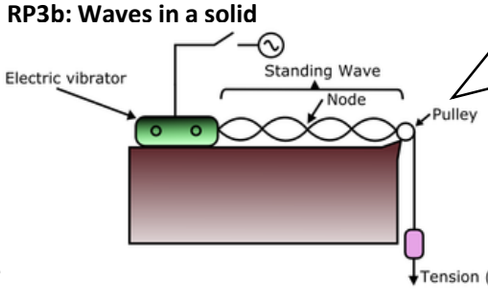
RP2a: Is Resultant Force proportional to acceleration? (Newtons 2nd Law)
IV: Weight (N) DV: Calculate Acceleration using velocity change/time (using 2 light gates)
CV: Mass (Kg). Expected result: **As force increases so does the acceleration**

RP2b: Is acceleration inversely proportional to mass (Newtons 2nd Law)
IV: Mass (Kg) DV: Calculate Acceleration using velocity change/time CV: Weight (N)
Expected result: **As mass increases acceleration decreases**



RP3a: Ripple Tank - Wave speed = wavelength x frequency
1. Measure the wavelength of one wave in meters
2. Calculate the frequency – number of waves per second
3. Wave speed = wavelength x frequency

RP3b: Waves in a solid



1. A standing wavelength is measured
2. Frequency is read off the signal generator
3. Calculate wave speed

RP4: Leslies cube
IV: Different surfaces, DV Infrared radiation emitted CV: Distance between surface and detector

Detector would have a better resolution than a thermometer

Surface	Temperature (C)
Matt Black	78
Shiny Black	60
Matt White	46
Shiny Metal	32