AQA FORCES – part 1

Forces and their interactions

Each Kg has a gravitational pull of 9.8N.

Unit	*Newton (N)*	1N
Kilo	*Kilonewton (KN) = 1000*	1X 10^3
Mega	*Meganewton (MN) = 1000,000*	1 X 10^6

Gravitational field strength	*Gravity exerted around an object.*	Earth's gfs = 9.8N/kg

Centre of mass	*The weight of an object acts through a single point*

Weight = mass X gravitational field strength — W = m X g

Gravity

Weight	*Force acting upon an object due to gravity*	Newton (N)
Mass	*How much matter*	Kilograms (Kg)

Scalar and vector quantities

Scalar	*A quantity that only has magnitude (size)*	e.g. mass, time, speed, temperature, energy,
Vector	*A quantity that only has magnitude and direction*	e.g. force, velocity, momentum

An arrow can be used to show vectors	*Length of arrow = magnitude of vector*
	Direction of arrow = direction of vector

Velocity	*Speed + direction*	The speed of a car is 30m/s. A car moves forward with a velocity of 30m/s
Distance	*How far*	The table is 1m long
Displacement	*Distance + direction*	The beach is 1km due east of the town

Area	*Metres squares (m^2)*
Weight	*Newton (N)*
Mass	*Kilograms (kg)*
Gravitational field strength	*Newton per kilogram (N/Kg)*
Force	*Newton (N)*
Work done	*Joules (J)*
Distance	*Metres (m)*
Moment	*Newton-metres (Nm)*

Pressure = height X density X gfs

Contact and Resultant forces

Force	*Push or pull*	Stretch, squash, turn.
Contact force	*Exerted between two objects when they touch*	Friction, air resistance, tension.
Non-contact force	*Exerted between two objects without touching*	Gravity, electrostatic forces, magnetic forces.

Resultant force	*The overall effect of all of the forces acting upon an object*	Two forces acting in the same direction are added.
		Two forces acting in the opposite direction are taken away.

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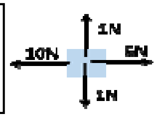
Resolving forces	*An object pulled with a force at an angle*	A single force can be split into two components acting at right angles to each other.

The component forces combined have the same effect.

Free body diagram	*Show magnitude and direction of all forces upon an object*

Object moves left with a force of 5N



Work done against frictional forces, temperature of object rises.

Work done and energy transfer

If force is at right angles to direction of movement, NO work is done.

Work done	*When work is done, energy is transferred*	Work done = force X distance moved W = F X s
	1J of work is done when 1N of force moves an object through a distance of 1m, in the direction of the force.	

Moments, levers and gears

PHYSICS ONLY

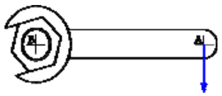
M = F X d

Moment = force X distance

Moment	*Turning effect of a force about a pivot*
Lever	*A small force exerted with a long lever applies a large force*
Gears	*Increase or decrease the rotational effect of a force*

Principle of moments

In a balanced system, the sum of the clockwise moments = the sum of the anti-clockwise moments



Pressure

HIGHER ONLY

Pressure = Force ÷ Area

P = F ÷ A

Fluid	*A liquid or gas*
	Flows and changes shape to fill a container.

Pressure and depth

Pressure on divers depends on weight of water above

Upthrust

Resultant force exerted by a fluid

Hydraulic machine	*Use liquids to transmit pressure*

Atmospheric pressure

Caused by billions of air particles colliding with a surface.

Forces and elasticity

One force	*The object changes speed or direction*
More than one force	*The object changes shape*

Two balanced forces can stretch a object.

Two balanced forces can compress an object.

Three balanced forces can bend an object.

Elastic deformation	*The object has been stretched but returns to its original length*
Inelastic deformation	*The object has been stretched but does not return to its original length*
Extension	*The difference between stretched and unstretched lengths*

Limit of proportionality

Beyond this point the spring is permanently deformed

Stretching a spring	Force = spring constant X extension, F = k X e
	EPE = ½ X spring constant X $(\text{extension})^2$, EPE = ½ ke^2

Elastic Potential energy (EPE)	*Energy stored in a stretched spring*

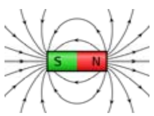
Force	*Newton (N)*
Spring constant	*Newton per metre (N/m)*
Extension	*Metres (m)*
EPE	*Joules (J)*

AQA MAGNETISM AND ELECTROMAGNETISM

Permanent and Induced Magnetism

Magnets

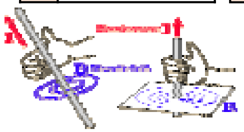
Magnetic	***Materials attracted by magnets***	Uses non-contact force to attract magnetic materials.
North seeking pole	***End of magnet pointing north***	Compass needle is a bar magnet and points north.
South seeking pole	***End of magnet pointing south***	Like poles (N – N) repel, unlike poles (N – S) attract.
Magnetic field	***Region of force around magnet***	Strong field, force big. Weak field, force small. Field is strongest at the poles.
Permanent	***A magnet that produces its own magnetic field***	Will repel or attract other magnets and magnetic materials.
Induced	***A temporary magnet***	Becomes magnet when placed in a magnetic field.



Magnetic field around a wire

Electric current flowing in a wire produces a magnetic field around it.

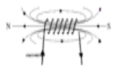
- If current is small, magnetic field is very weak.
- Current large enough, iron filings show circular magnetic field.
- Further away from the wire, magnetic field is weaker.
- Reverse current, magnetic field direction reverses.



Right hand rule

Thumb	Direction of current.
Fingers	Direction of magnetic field.

Solenoid



Solenoid	***A long coil of wire***	Magnetic field from each loop adds to the next.

Electromagnet

Electromagnet	***Lots of turns of wire increase the magnetising effect when current flows***
	Turn current off, magnetism lost.

Increase strength of magnetic field

- ***Use larger current***
- ***Use more turns of wire***
- ***Put turns of wire closer together***
- ***Use iron core in middle***

Relay

Relay	***A device using a small current to control a larger current in another circuit***	Solenoid is wound around an iron core. Small current magnetises the solenoid. This attracts to electrical contacts, making a complete circuit. Current flows from battery to starter motor.

Motor effect

HIGHER only

Magnetic fields from the permanent magnet and current in the foil interact. This is called the motor effect.

- Reverse the current, foil moves upwards.
- Aluminium foil placed between two poles of a strong magnet, will move downwards when current flows through the foil.
- Size of force acting on foil depends on magnetic flux density between poles, size of current, length of foil between poles.

F = B X I X l

Force = magnetic flux density X current X length

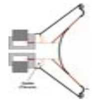
If current and magnetic field are parallel to each other, no force on wire.

Magnetic flux	***Lines drawn to show magnetic field***	Lots of lines = stronger magnets.
Magnetic flux density	***Number of lines of magnetic flux in a given area***	Measures the strength of magnetic force.

Electric motor

Electric motor	***Coil of wire rotates about an axle***	Current flows through the wire causing a downward movement on one side and an upward movement on the other side.

Split-ring commutator	***Split ring touching two carbon brush contacts***



Fleming's left-hand rule

To predict the direction a straight conductor moves in a magnetic field.

Thumb	Direction of movement.
First finger	Direction of magnetic field.
Second finger	Direction of current.

Generators, loud speakers and microphones

Generators	***Coil of wire rotating inside a magnetic field. The end of the coil is connected to slip rings.***	Produces altering current.
Loud speakers	***Converts variations in electrical current into sound waves .***	Varying current flows through a coil that is in a magnetic field. A force on the wire moves backwards and forwards as current varies. Coil connected to a diaphragm. Diaphragm movements produce sound waves.
Microphones	***Converts pressure variations in sound waves into variations in current in electrical circuits.***	

Induced potential, transformers and National Grid

National Grid	***Distributes electricity generated in power stations around UK***

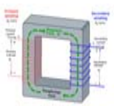
PHYSICS HIGHER only

Induced potential	***When a conducting wire moves through a magnetic field, p.d. is produced***
Generator effect	***Generates electricity by inducing current or p.d.***
Uses of the generator effect	***Dynamo, Microphones***

Transformer	***Two coils of wire onto an iron core***	Alternating current supplied to primary coil, making magnetic field change. Iron core becomes magnetised, carries changing magnetic field to secondary coil. This induces p.d.

Step-up transformers	Step-down transformers
Increase voltage, decrease current	***Decrease voltage, increase current***
Increases efficiency by reducing amount of heat lost from wires.	Makes safer value of voltage for houses and factories.

Power lost = Potential difference X Current



Power supplied to primary coil = power supplied to secondary coil

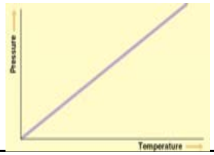
$V_p \times I_p = V_s \times I_s$

Voltage across the coil X number of coils (primary) = Voltage across the coil X number of coils (secondary)

$V_p \div V_s = n_p \div n_s$

Force	***Newton (N)***
Magnetic flux density	***Tesla (T)***
Current	***Amperes (A)***
Length	***Metres (m)***
Power	***Watts (W)***
p.d.	***Voltage (V)***

AQA PARTICLE MODEL OF MATTER



Pressure of a fixed volume of gas increases as temperature increases (temperature increases, speed increases, collisions occur more frequently and with more force so pressure increases).

Kinetic theory of gases

Temperature of gas is linked to the average kinetic energy of the particles.

If kinetic energy increases so does the temperature of gas.

No kinetic energy is lost when gas particles collide with each other or the container.

Gas particles are in a constant state of random motion.

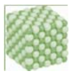
Particle model

State	*Particle arrangement*	Properties
Solid	*Packed in a regular structure. Strong forces hold in place so cannot move.*	Difficult to change shape.
Liquid	*Close together, forces keep contact but can move about.*	Can change shape but difficult to compress.
Gas	*Separated by large distances. Weak forces so constantly randomly moving.*	Can expand to fill a space, easy to compress.

	Units
Density	*Kilograms per metre cubed (kg/m^3)*
Mass	*Kilograms (kg)*
Volume	*Metres cubed (m^3)*
Energy needed	*Joules (J)*
Specific latent heat	*Joule per kilogram (J/kg)*
Change in thermal energy	*Joules (J)*
Specific heat capacity	*Joule per kilogram degrees Celsius (J/kg°C)*
Temperature change	*Degrees Celsius (°C)*
Pressure	*Pascals (Pa)*

$P = m \div V$

Density = mass ÷ volume.



Density	*Mass of a substance in a given volume*

Pressure

PHYSICS ONLY: when you do work the temperature increases e.g. pump air quickly into a ball, the air gets hot because as the piston in the pump moves the particles bounce off increasing kinetic energy, which causes a temperature rise.	Reducing the volume of a fixed mass of gas increases the pressure.
	Halving the volume doubles the pressure.

PV = constant.

$P_1V_1 = P_2V_2$

Internal energy and energy transfers

Specific Heat Capacity	*Energy needed to raise 1kg of substance by 1°C*	Depends on: • Mass of substance • What the substance is • Energy put into the system.

Change in thermal energy = mass **X** specific heat capacity **X** temperature change.

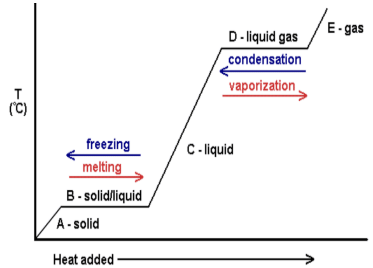
$\Delta E = m$ **X c X** $\Delta\theta$

Internal energy		
	Energy stored inside a system by particles	Internal energy is the total kinetic and potential energy of all the particles (atoms and molecules) in a system.
	Heating changes the energy stored within a system	Heating causes a change in state. As particles separate, potential energy stored increases. Heating increases the temperature of a system. Particles move faster so kinetic energy of particles increases.

Specific Latent Heat	*Energy needed to change 1kg of a substance's state*
Specific Latent Heat of Fusion	*Energy needed to change 1kg of solid into 1 kg of liquid at the same temperature*
Specific Latent Heat of Vaporisation	*Energy needed to change 1kg of liquid into 1 kg of gas at the same temperature*

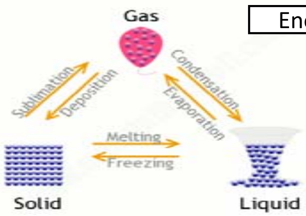
Energy needed = mass **X** specific latent heat.

$\Delta E = m \times L$



Change of state

Freezing	Liquid turns to a solid. Internal energy decreases.
Melting	Solid turns to a liquid. Internal energy increases.
Boiling / Evaporating	Liquid turns to a gas. Internal energy increases.
Condensation	Gas turns to a liquid. Internal energy decreases.
Sublimation	Solid turns directly into a gas. Internal energy increases.
Conservation of mass	When substances change state, mass is conserved.
Physical change	No new substance is made, process can be reversed.



AQA SPACE PHYSICS PHYSICS ONLY

Solar system

Milky Way our galaxy.

Planet	*A large body orbiting the Sun*
Moon	*A natural satellite orbiting a planet*
Dwarf planet	*A body large enough to have its own gravity which caused a spherical shape*
Solar system	*Any object orbiting the Sun due to gravity*
Galaxy	*Collection of billions of stars*
Universe	*Collection of galaxies*

Comets, asteroids, satellites.

Other objects.

Effect of gravity.

- Gravity causes moons to orbit planets, planets to orbit the Sun, stars to orbit galaxy centres.
- Force of gravity changes the moon's direction not its speed.
- Gravity pulls objects towards the ground.

Orbital motions

Speed of Orbit.

- Too fast = disappears into Space.
- Correct speed = steady orbit around Earth.
- Too slow = falls to Earth.

HIGHER: Circular orbits.

- To calculate speed of Orbit: distance object moves in 1 orbit, Distance = 2∏r, then average speed = distance ÷ time.

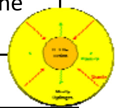
- Planets close to the Sun, gravity pull is strong. Planets move quickly.
- Planets further away from the Sun, gravity pull is weaker. So speed of planet is slower.

HIGHER:

- Velocity = a vector.
- A planet's velocity changes but speed remains constant.
- Due to the Sun's gravity, planets accelerate towards the Sun and so changes direction.

The life cycle of a star.

Nebula	*A cloud of cold hydrogen gas and dust*	Cloud collapses due to gravity, particles move very fast colliding with each other, kinetic energy transfers into internal energy and the temperature increases.
Protostar	*The large ball of gas contracts to form a star*	High temperature causes Hydrogen nuclei to collide and nuclear fusion begins. A star is 'born'.
Main sequence	*Stable period of star*	Gravity tries to collapse the star but enormous pressure of fusion energy expands and balances the inward force.



Stars the same size as our Sun.

Red giant	*A large star that fuses Helium into heavier elements*	Hydrogen runs out, star becomes unstable, pressure inside drops causing star to collapse. Atoms now closer together results in atoms fusing and temperature increases. This increase in temperature causes the core to swell.
White dwarf	*Star collapses*	Nuclear fuel runs out, fusion stops, dense very hot core.
Black dwarf	*Cold dark star*	White dwarf cools down.

Stars larger than our Sun.

Red super giant	*Star swells greatly*	Nuclear fuel begins to run out and star swells (more matter = bigger size).
Supernova	*Gigantic explosion due to run away fusion reactions*	Rapid collapse, heats to very high temperatures causing run away nuclear reactions, star explodes, flinging remnants out into space. Large gravitational forces collapse the core into a tiny space. Remains of supernova form heavier elements (Iron and above)
Neutron star	*Very dense star*	Made out of neutrons.

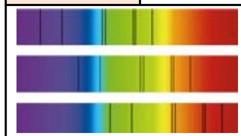
OR if collapse is into a really tiny space.

Black hole	*No light escapes*	Gravitational forces so strong everything is pulled in.

Red shift

- When ambulances go past the sound changes from a high pitch to a low pitch.
- Frequency of sound wave decreases, wavelength increases.

Red-shift	*The observed increase in wavelength of light from most distance galaxies. Light moves towards the red end of the spectrum.*
Hubble (1929)	*He studied light from distant galaxies; found as frequency decreases, wavelength increases.*



- Light from star in our galaxy.
- Light from star in nearby galaxy.
- Light from star in distant galaxy.

The Big Bang	*Universe began 13.8 billion years ago*
All matter and space expanded violently from a single point.	Red—shift provides evidence for expansion.

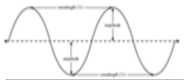
- Galaxies are moving away from us in all directions.
- Light from distant galaxies is red-shifted, so galaxy is moving away from us.
- Galaxies further away have bigger red-shift so are moving faster away.

Understanding models.

Aristotle (ancient Greek)	*Earth at the centre, other heavenly bodies move around the Earth.*
Copernicus (1473 - 1543)	*Sun at the centre, other heavenly bodies move around the Sun.*
Galileo (1610)	*Made a telescope, looked at Jupiter, found four moons rotating around planet.*

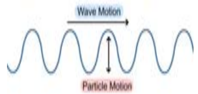
Planets and moons moved at different speeds to stars = reason for different positions.

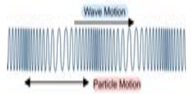
PiXL
Partners in excellence



Wave speed	Wave speed = frequency X wavelength	V = f X λ
Wave period	Wave period = 1 ÷ frequency	T = 1 ÷ f
Speed	Speed = distance ÷ time	v = d ÷ t

Wavelength	*Distance from one point on a wave to the same point of the next wave*
Amplitude	*The maximum disturbance from its rest position*
Frequency	*Number of waves per second*
Period	*Time taken to produce 1 complete wave*





Transverse wave	*Vibration causing the wave is at right angles to the direction of energy transfer*	Energy is carried outwards by the wave.	Water and light waves, S waves.
Longitudinal wave	*Vibration causing the wave is parallel to the direction of energy transfer*	Energy is carried along the wave.	Sound waves, P waves.

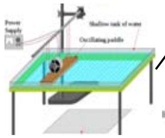
Transverse and Longitudinal waves

AQA Waves

Waves in air, fluids and solids

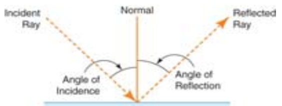
Properties

Measuring speed



In water, use a ripple tank.

In air, use echoes.

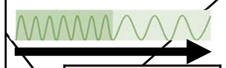


Angle of incidence = angle of reflection
(i) = (r)

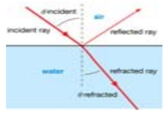
PHYSICS ONLY

Sound waves travelling through different mediums, the frequency stay constant.

Air Water

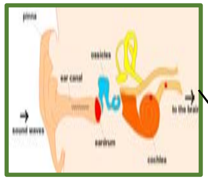


Reflection	Wave bounces off the surface.
Refraction	Waves changes direction at boundary.
Transmitted	Passes through the object.
Absorbed	Passes into but not out of, transfers energy and heats up the object.



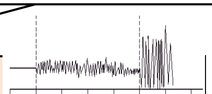
Light refracts as it slows down in a denser substance

PHYSICS HIGHER ONLY

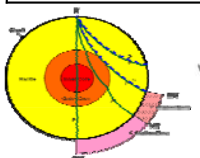


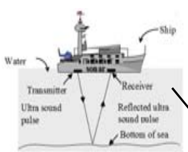
Hearing	*Frequencies between 20 – 20,000 Hz*	Longitudinal waves cause ear drum to vibrate, amplified by three ossicles which creates pressure in the cochlea.

Seismic waves



P wave	S wave	Seismograph
Longitudinal	*Transverse*	*Shows P and S waves arriving at different times.*
Fast	*Slow*	
Travel through solids and liquids	*Travels through solids*	By using the times the wa[CB1][MCD1] arrive at the monitoring centres, the epicentre of earthquake can be found. (v = x ÷ t).
Produced by earthquakes.		





Ultra sound	*Partially reflected off boundary*	Used for medical and foetal scans.
Sonar	*Reflected off objects*	Used to determine depth of objects under the sea.

Black body radiation

PHYSICS ONLY

Earth and Global warming

Ultraviolet, visible light, infra-red radiation penetrate atmosphere and heat up Earth's surface.

Longer wavelengths are radiated back, trapped by atmosphere.

Energy lost is not at the same rate as energy being absorbed so Earth heats up.

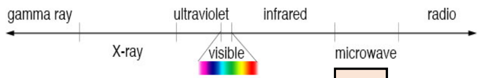
Black body radiation	*All objects absorb or reflect infrared radiation*	Hotter objects emit more infrared radiation.
Constant temperature	*Rate of absorption = rate of radiation*	Intensity and wavelength of energy affects temperature.

Electromagnetic waves

e.g. Gamma

Short wavelengths have high frequency and high energy.

Electromagnetic wave	*Continuous spectrum of transverse waves*



Absorbed light changes into thermal energy store.

Black surfaces	*Good emitters, good absorbers*
White surfaces	*Poor emitters, poor absorbers*
Shiny surfaces	*Good reflectors*

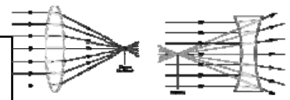
EM waves refract

PHYSICS ONLY

Magnification = image size ÷ object size

	Units
Distance	*Metres (m)*
Wave speed	*Metres per second (m/s)*
Wavelength	*Metres (m)*
Frequency	*Hertz (Hz)*
Period	*Seconds (s)*

HIGHER: Lenses



HIGHER: Properties

Convex	Real or virtual images.
Concave	Only virtual images.

2F	Image same size, upside down, real.
2F - F	Image larger, upside down, real.
< F	Image bigger, right way, virtual.

Specular	Flat surface reflection.
Diffuse	Rough surface reflection.

EM wave	Danger	Use
Radio	Safe.	Communications, TV, radio.
Microwave	Burning if concentrated.	Mobile phones, cooking, satellites.
Infrared		Heating, remote controls, cooking.
Visible	Damage to eyes.	Illumination, photography, fibre optics.
Ultra violet	Sunburn, cancer.	Security marking, disinfecting water.
X-ray	Cell destruction, mutation, cancer.	Broken bones, airport security.
Gamma		Sterilising, detecting and killing cancer.

Low frequency, long wavelength.

White	Wave lengths reflected
Black	Wave lengths absorbed

High frequency, short wavelength

Slide 5

CB1 This sentence does not make sense but I don't want to add anything in as wasn't sure I would take the sentence in the way you intended!
Clare Buffham, 07/10/2017

MCD1 words missed out of sentence
Ms C. Dawes, 02/11/2017