GCSE Physics Definitions

Paper 1 Definitions

Sound waves are longitudinal waves that cannot travel through a vacuum.

Infrasound: longitudinal sound waves that are too low for humans to hear (below 20 Hz).

Ultrasound: longitudinal sound waves that are too high for humans to hear (above 20 kHz).

Seismic waves are waves that travel through the earth. There are two types: P waves & S waves.

The human ear. Sound waves are collected by the **outer ear** and pass to the **ear drum** which is made to vibrate by the alternating compression and rarefaction of the air next to it. Vibrations pass to the **oval window** by three bones called the hammer, anvil and stirrup which magnify the force of the vibrations. **Hair cells (cilia)** of different lengths in the **cochlea** detect different frequencies which send electrical impulses to the brain.
In a **transverse wave** the oscillations are perpendicular to the direction of energy transfer.
Examples: water waves, all electromagnetic waves, seismic S waves.

In a **longitudinal wave** the oscillations are parallel to the direction of energy transfer.
Examples: sound waves, ultrasound, infrasound, seismic P waves.

Refraction is the change in direction of a wave when it changes speed.

Electromagnetic waves are transverse waves that can travel at the speed of light in a vacuum.

Wavelength is the distance from any point on a wave to the next exactly equivalent point.

Frequency is the number of oscillations per second. (The units are Hz)

Period is the time for one complete oscillation. (The units are s). **T = 1/f**

Wave speed is the speed at which energy is transmitted. (The units are m/s)

Critical angle is the angle of incidence that gives an angle of refraction of 90°. Angles above this give reflection and no refraction.

The law of reflection: angle of incidence = angle of reflection

Total internal reflection: When the angle of incidence is greater than the **critical angle** only reflection occurs. This is used in fibre optics.

The **power** of a lens is a measure of how strongly refracting a lens is. **Power = 1 ÷ focal length** (in metres). A thicker lens has a greater power. Converging lenses have positive power. Diverging lenses have negative power. [The units are dioptres (D)]

Focal length is the distance from the middle of the lens to the focal point.

The **focal point** (of a converging lens) is the point where **parallel** rays of light converge after passing through the lens.

A **real image** forms where light rays focus. A real image forms on the opposite side of a lens to the object and can only be seen on a screen.

A **virtual image** is one from which light rays appear to come. It exists on the same side of the lens as the object and does not form an image on a screen.

The **geocentric model** assumes the earth is at the centre of everything.

The **heliocentric model** assumes the Sun is at the centre of the Solar System.

The **life cycle of a star like our Sun:**
Dust cloud/nebula → **protostar** →**main sequence star** → **red giant** → **white dwarf**

The **life cycle of a star much more massive than the Sun:**
Dust cloud/nebula → **protostar** → **main sequence star** → **red supergiant** → **supernova** → **neutron star** OR **black hole** (if really massive)

Planets in the solar system: Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus and Neptune.

Centripetal force is the resultant force on an object, acting towards the centre of a circle and at right angles to its velocity, that causes the object to move in a circle.

Redshift: The wavelength of light shifts to longer wavelengths when the source is moving away from the observer. Wavelength increases and frequency decreases.

Expansion of the universe is shown by galaxies further away having a greater red shift which means they are moving away faster.

The Big Bang theory states that the Universe started as a hot dense point of energy 14 billion years ago. Evidence is cosmic microwave background radiation.

The Steady State theory states that the Universe has always existed and is expanding as matter is continuously created.

Cosmic microwave background radiation (CMBR) is microwaves detected from all directions in the sky. It provides evidence for the Big Bang theory.

Types of energy: light energy (electromagnetic energy), electrical potential energy, kinetic energy, sound energy, chemical potential energy, nuclear potential energy, elastic potential energy (strain energy), gravitational potential energy, thermal energy, internal energy.

The law of conservation of energy: Energy cannot be created or destroyed but can only be converted from one form to another.

Thermal equilibrium: an object remains at constant temperature when it radiates energy out at the same rate that it absorbs energy.

Non-renewable energy resources cannot be replaced when they have been used eg fossil fuels.

Renewable energy resources can be replaced when used eg wind power, solar power, hydroelectricity, wind turbines, geothermal energy, tidal power, wave power.

Displacement is the shortest distance between two points in a state direction.

Velocity is the speed in a stated direction.

In a **velocity-time graph**: displacement = area under the line, acceleration = gradient of the line.

A **scalar** quantity has magnitude (size) only eg mass, speed and distance.

A **vector** quantity has both magnitude and direction eg velocity, force and displacement.

Newton's First Law: If there is no resultant force acting on an object it will remain at rest OR continue to move with constant velocity.

Newton's Second Law: Force = mass x acceleration.

Weight is the force exerted by gravity on an object. Weight = mass x g. (g is the gravitational field strength and is approximately 10 N/kg on the surface of the Earth.) $W = m \times g$

Inertial mass is a measure of how difficult it is to change the velocity of an object (= F/a)

Newton's Third Law: When two bodies interact the forces they exert on each other are equal in size and opposite in direction.

A **free body diagram** shows all the forces acting on a single object.

The **moment** of a force is equal to force $\times$ distance to the pivot normal to the direction of the force.

The Principle of Moments: For an object to be in rotational equilibrium, the sum of the clockwise moments about a point must equal the sum of the anticlockwise moments about that point.

Half-life is the time taken for half the undecayed nuclei to decay. It is also equal to the time for the activity to half from an initial value.

Activity is the number of nuclear decays per second.

1 Becquerel (Bq) = 1 decay per second. It is the unit of activity of a radioactive source.

Background radiation is the natural radiation from: radon gas, rocks, medical procedures, food and drink and cosmic rays.

Contamination means that a person has particles of a radioactive isotope on their skin or inside their body. This is much more dangerous than **irradiation** by a source which will no longer pose a risk once the source is removed.

Irradiation is exposure to the radiation produced by a source without being contaminated by the source itself.

Nuclear fission: a large nucleus + neutron splits into two smaller daughter nuclei and more neutrons giving out a large amount of energy.

Control rods absorb neutrons and slow down the rate of fission. They can be raised and lowered.

Fuel rods contain uranium fuel.

The **moderator** slows down the neutrons so they are more likely to be absorbed by uranium nuclei. It increases the rate of fission.

Nuclear fusion: Small nuclei fuse to make larger ones. eg hydrogen nuclei form helium. This occurs in stars. if developed it could provide a cheap, safe source of energy.

Atomic number is the number of protons in the nucleus. ${}_{a}X$

Mass number is the total number of protons and neutrons in the nucleus. ${}^{m}X$

Isotopes have the same number of protons but different numbers of neutrons in each atom.

Fundamental particles are particles which cannot be broken down into smaller components**.**

A **positron** (β+) is an anti-matter version of an electron. It has the same mass but a positive charge.

The (incorrect) **plum pudding model** describes the atom as a positive 'dough' with electrons spread evenly out through it like plums in a pudding.

The **Bohr model** describes atoms as having a small, positive, dense nucleus at its centre with small low mass electrons orbiting around it.

A **proton** has charge = +1 and relative mass = 1. A **neutron** has charge = 0 and relative mass = 1.

An **alpha particle** (α) consists of 2 protons & 2 neutrons. It is most ionising and least penetrating.

A **beta particle** (β or β–) is a high energy electron.

A **gamma ray** (γ) is a high energy, high frequency, small wavelength electromagnetic wave.

During **alpha decay** atomic number goes down 2 and mass number goes down 4.

During **beta (minus) decay** atomic number goes up 1 but mass number is unchanged.

During **beta plus decay** atomic number goes down 1 but mass number is unchanged.

In a **PET scan** a (β^+) radioactive tracer is injected into the patient which produces a positron that annihilates with an electron to produce two gamma rays which are detected to build up a 3D image.

Momentum = mass x velocity (The units are kgm/s)

The Law of Conservation of Momentum: The total momentum before a collision is equal to the total momentum after the collision (**as long as no external force is applied**).

Stopping distance is the sum of the thinking distance and braking distance.

Thinking distance is the distance travelled from first seeing the hazard until the brakes are applied. It increases with velocity, tiredness and alcohol/drugs in the bloodstream.

Braking distance is the distance travelled by the vehicle from when the brakes are first applied until the vehicle comes to a halt. It increases with velocity, mass of the vehicle, wet/icy roads and worn tyres/brakes.

These Formulae you need to learn and be able to apply

distance travelled = average speed x time	
acceleration = change in velocity ÷ time taken	$\boldsymbol{a = \frac{(v-u)}{t}}$
force = mass x acceleration	$\boldsymbol{F = m \times a}$
weight = mass x gravitational field strength	$\boldsymbol{W = m \times g}$
momentum = mass x velocity	$\boldsymbol{p = m \times v}$
change in gravitational potential energy = mass x gravitational field strength x change in vertical height	$\boldsymbol{\Delta GPE = m \times g \times h}$
kinetic energy = ½ x mass x (speed)^2	$\boldsymbol{KE = \frac{1}{2} \times m \times v^2}$
efficiency = $\frac{\text{useful energy transferred by the device}}{\text{total energy supplied to the device}}$	
wave speed = frequency x wavelength	$\boldsymbol{v = f \times \lambda}$
wave speed = distance ÷ time	$\boldsymbol{v = \frac{x}{t}}$

Paper 2 Definitions

Work done is force done x the distance moved in the direction of the force.

Power is the rate at which work is done or the rate at which energy is transferred from one form to another. (Units are watts W)

1 Watt is one joule per second. (W = J/s)

Efficiency is the fraction of energy supplied to a device that is usefully used. (May be a decimal fraction or a percentage)

Direct current (d.c.) is current that flows in the same direction all the time.

1 amp is flow of 1 coulomb of charge per second.

1 volt is one joule of energy per coulomb of charge.

In **series**: current is constant and voltage is shared between components. In **parallel**: voltage is the same across each branch and current is shared between branches.

An **ammeter** is a device for measuring current flow. Used in **series**.

The **Junction rule:** the total current entering a junction is equal to the total current leaving the junction.

Potential difference (p.d.) (voltage) is the energy transferred per unit charge.

A **voltmeter** is a device for measuring potential difference (voltage) across a component.
Used in **parallel** to one or more components.

A **thermistor** has resistance that **de**creases when temperature **in**creases. (Opposite to ordinary resistor.)

An **LDR (light dependant resistor)** has resistance that **de**creases when the light levels **in**creases.

Alternating current (a.c.) is current that changes direction many times per second.

The 3 pin plug: Live (brown) cable carries an alternating voltage of ±230 V relative to the netural (blue) cable which is approximately zero volts. The Earth (green and yellow) cable is connected to earth nearby so is at 0 V.

Electromagnetic induction: A current induced by the movement of a wire in a magnetic field. The current is increased by having: more turns in a coil, an iron core, a stronger magnetic field & by increasing the speed of movement of the wire(s).

An **alternator** consists of a spinning coil in a magnet and is used to generate an alternating current.

A **microphone** consists of a diaphragm connected to a wire coil inside a magnet. It converts air pressure variations due to sound waves into variations in electrical current.

A **loudspeaker** consists of a thin cone connected to a wire coil inside a magnet. It converts variations in electrical current into variations in air pressure (sound waves).

A **transformer** consists of two coils linked by an iron core. It is used to increase or decrease the voltage according to the number of turns in each coil.

Elastic distortion is when a material will return to its original shape and size when the force is removed. **Inelastic** distortion is when the material is permanently deformed and does not return to its original size and shape when the force is removed.

Hooke's Law: Extension is proportional to the applied force as long as the elastic limit is not exceeded. $F = k x x$
Current is rate of flow of charge.

Magnetic field lines show the direction of the force that would act on the north pole of another magnet. They point from north to south. Closer field lines indicate a stronger magnetic field. Field lines must not touch or cross.

Electric field lines show the direction of the force that would act on a positive charge. They point towards negative and away from positive. Closer field lines indicate a stronger electric field. Field lines must not touch or cross.

Fleming's Left Hand Rule: the force exerted on a current in a magnetic field acts perpendicular to both the current and the magnetic field. The direction is found using your left hand with thumb = force, first finger = field and second finger = current.

DC motors: the size of the force can be increased by having: more turns in the coil, an iron core, a larger current, a stronger magnetic field.

Absolute zero (0 K, –273°C) is the temperature at which particles stop moving and have no kinetic energy and so exert no pressure.

Specific heat capacity is the energy required to raise the temperature of 1 kg of a substance by 1°C.

Specific latent heat of fusion is the energy required to convert 1 kg of a substance from solid to liquid at its melting point.

Specific latent heat of vaporisation is the energy required to convert 1 kg of a substance from liquid to gas at its melting point.

A good thermal **insulator** will have a low thermal conductivity and a high specific heat capacity.

Upthrust is the upwards force acting on an object in a fluid (gas or liquid). It is equal to the weight of fluid displaced.

These Formulae you need to learn and be able to apply

change in gravitational potential energy = mass x gravitational field strength x change in vertical height	$\Delta GPE = m \times g \times h$
kinetic energy = ½ x mass x (speed)^2	$KE = \frac{1}{2} \times m \times v^2$
efficiency = $\frac{\text{useful energy transferred by the device}}{\text{total energy supplied to the device}}$	
work done = force x distance moved in the direction of the force	$E = F \times d$
power = work done ÷ time taken	$P = \frac{E}{t}$
moment of a force = force x distance normal to the direction of the force	$M = F \times d$
energy transferred = charge moved x potential difference	$E = Q \times V$
charge = current x time	$Q = I \times t$
potential difference = current x resistance	$V = I \times R$
power = energy transferred ÷ time taken	$P = \frac{E}{t}$
electrical power = current x potential difference	$P = I \times V$
electrical power = current squared x resistance	$P = I^2 \times R$
density = mass ÷ volume	$\rho = \frac{m}{V}$
force exerted on a spring = spring constant x extension	$F = k \times x$
pressure = force normal to surface ÷area of surface	$P = \frac{F}{A}$