

## Definitions and Concepts for Edexcel Physics A Level

### Topic 1: Working as a Physicist

**Accuracy:** How close a measurement is to its true value, influenced by the systematic and random errors of that measurement.

**Base Units:** The set of seven basic measures from which all other SI units can be derived.

**Estimation:** Making a reasonable approximation of a value in order to check a calculation or make a quick comparison to another value.

**Precision:** How close a set of repeated measurements are to one another but not the true value, influenced by the random errors of those measurements.

**Random Error:** The unpredictable variation in a measurement. These can be reduced by taking many repeated measurements and calculating their mean.

**Repeatability:** An experiment is said to be repeatable if the same person with the same equipment obtains the same result when doing the same experiment a number of times, over a short time period.

**Reproducibility:** An experiment is said to be reproducible if different people with different equipment, measuring the same quantity, get a similar result.

**Resolution:** The smallest interval that a given measuring device can measure.

**Systematic Error:** A consistent shift in readings causing a deviation from the true value. This shift is due to the equipment or method being used and cannot be reduced by repeated measurements.

**Uncertainty:** The range of values that could reasonably contain the true value of a measurement, based on the confidence an experimenter has about their result.



## Definitions and Concepts for Edexcel Physics A Level

### Topic 2: Mechanics

**Centre of Mass:** The average point of all parts of an object weighted according to their mass. It is the point through which the total mass of the object is said to act.

**Conservation of Energy:** In a closed system with no external forces the energy of the system before an event is equal to the energy of the system after the event. The energy does not need to be in the same form after the event as it was before the event.

**Conservation of Momentum:** In a closed system with no external forces the momentum of the system before an event is equal to the momentum of the system after the event.

**Drag:** The resistance against the motion of an object through a fluid. It is usually proportional to the speed of the object.

**Efficiency:** The useful output (e.g. power, energy) of a system divided by the total output.

**Elastic Collision:** When the kinetic energy of a system before an event is equal to the kinetic energy of the system after the event.

**Equilibrium:** An object is at equilibrium when the moments on it about a point are balanced and the resultant force on the object is zero.

**Force:** The rate of change of momentum of an object. The product of the object's mass with its acceleration.

**Friction:** The resistance against the motion of an object. This could be caused by the air passing over the object or by the contact of the object with the surface it is moving on.

**Gravitational Potential Energy:** The energy gained by an object when it is raised by a height in a gravitational field.

**Impulse:** The change of momentum of an object when a force acts on it. Equal to the area underneath a force-time graph.

**Inelastic Collision:** When the kinetic energy of a system before an event is not equal to the kinetic energy of the system after the event. The kinetic energy has been transferred to other forms.

**Kinetic Energy:** The energy an object has due to its motion. It is the amount of energy that would be transferred from the object when it decelerates to rest.



**Lift:** A force acting perpendicular to the flow of air or liquid around an object, typically upwards and against the force of gravity.

**Moment:** The product of a force and the perpendicular distance from the line of action to the pivot about which the force is acting.

**Momentum:** The product of an object's mass and its velocity.

**Newton's First Law:** An object at a constant velocity will remain at a constant velocity unless acted on by a resultant force. (If this constant velocity is zero the object is at rest).

**Newton's Second Law:** If an object is acted upon by a resultant force it will accelerate. The acceleration is inversely proportional to the mass of the object and directly proportional to the force acting upon it.

**Newton's Third Law:** Every action has an equal and opposite reaction. If an object A exerts a force on object B, object B will exert a force of equal magnitude but of opposite direction on object A.

**Power:** The work done by a system divided by the time taken for that work to be done.

**Resultant Force:** The sum of all forces on an object.

**Scalar:** A quantity with only magnitude and no direction (e.g. mass, energy, length).

**Terminal Velocity:** The maximum velocity an object can achieve. It is the point at which frictional forces and driving forces are balanced and so no acceleration occurs and the resultant force on the object is 0 N.

**Vector:** A quantity with magnitude and direction (e.g. velocity, acceleration, force).

**Weight:** The force of gravity on an object, the product of the object's mass and the acceleration due to gravity.

**Work Done:** A force applied over a distance, it is the energy transferred in that distance.



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### Topic 3: Electric Circuits

**Conventional Current Flow:** Flow from positive to negative, used to describe the direction of current in a circuit.

**Current:** The rate of flow of charge in a circuit, measured in Amperes and has symbol  $I$ .

**Detecting Circuit:** A circuit with a potential divider with one of the resistors being a semiconductor which when an external condition changes will change its resistance and change the voltage across the other resistor in the potential divider.

**Diode:** Components that allow current through in one direction. In the correct direction, diodes have a threshold voltage (typically 0.6 V) after which current flows normally.

**Electromotive Force (EMF):** The energy supplied by a source per unit charge passing through the source, measured in volts.

**Electron Flow:** The flow of electrons in a circuit, from negative to positive.

**Internal Resistance:** The unavoidable resistance any power source will have that makes it harder for current to flow through the source. It causes energy to be dissipated in the source.

**Kirchoff's First Law:** The total current entering a junction is equal to the total current leaving it.

**Kirchoff's Second Law:** The sum of EMF in any loop of the circuit is equal to the sum of the potential differences of each component.

**Light Dependent Resistors (LDR):** When these components are illuminated with light their resistance goes down. As light intensity increases resistance decreases.

**Ohmic Conductor:** A conductor following Ohm's law where current flowing through it is directly proportional to the potential difference between each end of the conductor. This only holds if the conductor is kept at a constant temperature.

**Ohm's Law:** Electric current is proportional to potential difference and inversely proportional to resistance.

**Parallel Connection:** When two electrical components are on separate loops to one another in a circuit. Potential difference over each loop is the same, current is split between branches.



**Potential Difference:** The difference in electrical potential between two points in a circuit and the work done that is required per coulomb to move a charge from the lower potential point to the higher potential point. It is measured in Volts.

**Potential Divider:** A combination of two or more resistors in series. These result in the potential difference of the circuit being split into a specific ratio depending on the resistance of the resistors. They can be used to get a specific output voltage from the circuit.

**Power:** Rate of energy transfer in a circuit. It can be calculated as the product of the current and the potential difference between two points. Measured in Watts.

**Resistance:** A measure of how difficult it is for current to flow in a circuit or component, measured in Ohms and has symbol  $R$ .

**Resistivity:** A measure of how difficult it is for charge to travel through a material, depending on the material's cross sectional area, length and resistance. It is measured in Ohm metres and has symbol  $\rho$ .

**Semiconductors:** Materials that change their resistance depending on external conditions.

**Series Connection:** When two electrical components are on the same loop to one another in a circuit. Potential difference is split between components depending on their resistance, current is the same across all components. **Superconductor:** A material that has zero resistivity below a critical temperature. They are used for very efficient electricity transmission or to create very strong magnetic fields but require extreme cooling to reach their critical temperatures.

**Terminal Potential Difference:** The actual potential difference across the terminals of a power source. It is the source's EMF minus the voltage drop due to the source's internal resistance.

**Thermistor:** When these components are heated up their resistance goes down. As temperature increases resistance decreases.

**Variable Resistors:** A resistor that can have its resistance changed. Typically, these are used with power supplies to change the voltage of a circuit without using a transformer.

**Voltmeter:** A device used to measure the potential difference between two points on a circuit, ideally it has infinite resistance so no current passes through it.



## Definitions and Concepts for Edexcel Physics A Level

### Topic 4: Materials

**Archimedes' Principle:** When a body is fully or partially submerged in a fluid, it experiences an upthrust equal to the weight of the fluid it has displaced.

**Breaking Stress:** The maximum stress a material can withstand without fracturing.

**Brittle:** A material that fractures without plastic deformation first.

**Density:** Mass per unit volume, with units  $\text{kgm}^{-3}$ .

**Ductile:** A material that can withstand large plastic deformation without breaking, this allows these materials to be stretched into long wires.

**Elastic Deformation:** When a material can return to its original shape, after an applied stress, without a permanent change to its shape. Any work done in elastically deforming an object is stored as elastic strain energy.

**Elastic Limit:** The maximum stress that can be applied to an object without plastic deformation.

**Hooke's Law:** The extension of an object is directly proportional to the force being applied to the object.

**Laminar Flow:** A state of flow where layers of fluid move together in parallel with little or no mixing between layers.

**Limit of Proportionality:** The point at which the stress on an object is so great that Hooke's law no longer applies to an object.

**Plastic Deformation:** When a material is permanently deformed after an applied stress due to the atoms moving relative to one another in the material. Work is done in plastically deforming the material and is dissipated as heat.

**Stoke's Law:** The magnitude of the force of viscosity acting on a spherical body as it moves through a fluid is proportional to its radius, its velocity and the fluid's viscosity. This only applies to spherical bodies travelling in laminar, non-turbulent, flow.

**Tensile Strain:** The extension of an object divided by its original length.

**Tensile Stress:** The internal resistance of an object against a force that acts to deform it. It is the force applied per unit cross-sectional area.



**Turbulent Flow:** A state of flow where layers of fluid mix together unpredictably causing a chaotic state.

**Viscosity:** A quantity measuring the internal friction of a fluid, it acts to reduce the flow of a fluid. It is temperature dependent.

**Upthrust:** The force felt against the weight of an object when fully or partially submerged in a fluid. It is equal to the weight of the fluid displaced by the object.

**Yield Point:** The point on a force-extension graph at which a material begins to rapidly extend without any additional stress.

**Young's Modulus:** The ratio of stress to strain of an object. It is a measure of how stiff a material is.



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### Topic 5: Waves and Particle Nature of Light

**Absorption Spectrum:** The frequencies at which a certain element absorbs photons at a higher rate as these frequencies correspond to the spacings between energy levels in the element's atoms.

**Amplitude:** The maximum displacement of a vibrating particle or wave from its equilibrium position.

**Angle of Incidence:** The angle at which a light ray hits a medium. Measured from a line perpendicular to the surface of the medium.

**Angle of Reflection:** The angle at which a light ray reflects off a surface. Measured from a line perpendicular to the surface of the medium.

**Angle of Refraction:** The angle at which light rays travel after transferring into a different refractive index material. Measured from a line perpendicular to the surface of the medium.

**Antinode:** The point on a stationary wave where the incoming and reflected wave are in phase forming a maximum point.

**Coherence:** Waves with the same frequency and constant phase difference.

**Constructive Interference:** Interference when the two waves are in phase. If the two waves are both at their peak the addition of the two peaks becomes large.

**Converging Lens:** A lens that takes a parallel set of light rays and causes them to meet at a point.

**Critical Angle:** The angle of incidence when the angle of refraction is exactly  $90^\circ$ . It is when the refracted ray travels along the boundary line.

**De Broglie Hypothesis:** All particles have a wave-like nature and a particle-like nature. The wavelength of a particle is inversely proportional to the particle's momentum.

**De-excitation:** The movement of an electron from a high energy level to a lower energy level. This occurs in excited atoms over time and causes photons to be released.

**Destructive Interference:** Interference when the two waves are in antiphase. When one wave is at a peak and one is at a trough their addition results in a minimum point.

**Diffraction:** The spread of a wave as it passes through a gap or over an edge.





**Displacement:** The distance and direction that a vibrating particle or wave has travelled from its equilibrium position.

**Diverging Lens:** A lens that takes a parallel set of light rays and causes them to travel away from each other and not meet.

**Electronvolt:** The kinetic energy gained by one electron that is accelerated through a potential difference of 1 volt. Equal to  $1.6 \times 10^{-16}$  J.

**Emission Spectrum:** When a certain element's atoms de-excite they move from one energy level to another with a specific energy gap between these levels. This creates a photon of that specific energy and it is the frequencies of these photons that make up the emission spectrum.

**Excitation:** The movement of an electron from a low energy level to a higher energy level. This occurs when another electron or photon transfers energy to an orbital electron causing it to move to a higher energy level.

**Focal Length:** The distance from the centre of the lens to the focal point.

**Focal Point:** The point at which rays of light passing through a lens converge (or appear to converge).

**Frequency:** The number of complete oscillations of a wave (wave cycles) per second.

**Fundamental Frequency:** The oscillation of an entire object forming the lowest possible frequency for that object. For a string fixed at both ends this is where there is only a single antinode in the middle of the string.

**Huygen's Principle:** Every point on a wavefront can be treated as a point source of a secondary wavelet.

**Ionisation:** When an electron is removed from an atom giving the atom a positive charge.

**In-Antiphase:** When the phase difference between two waves is 180 degrees or  $\pi$  radians.

**In-Phase:** When the phase difference between two waves is 0 degrees or 0 radians.

**Intensity:** The power transferred by a wave per unit area.

**Lens Power:** The inverse of the focal length.

**Longitudinal Wave:** A wave whose oscillations are parallel to the direction of propagation of the wave (e.g. sound waves).

**Magnification:** The height of an object divided by the height of its image.



**Node:** The point on a stationary wave where the incoming and reflected wave are in antiphase forming a minimum point.

**One-to-one Interaction:** When one photon transfers all of its energy to a single electron in a photoelectric process.

**Path Difference:** For two waves starting from different points and arriving at the same point the path difference is the difference in the length travelled by each wave, measured in metres.

**Period:** The time taken for a wave to complete one full cycle.

**Phase:** If the full cycle of a wave (peak to peak) is represented on a circle with the first peak at  $0^\circ$  (0 radians), the trough at  $180^\circ$  ( $\pi$  radians) and the next peak at  $360^\circ$  ( $2\pi$  radians), the phase is where on that circle the wave is at a given point in space and time. Measured in radians or degrees.

**Phase Difference:** The difference in phase if the phase of two waves is determined at a single point in time, measured in radians or degrees. It can be seen as the amount by which one wave lags behind another.

**Photoelectric Effect:** When light of a high enough energy shone on a metal surface causes electrons to be emitted. The electrons are given enough kinetic energy by the photons to overcome the attractive force of the ions in the metal.

**Polarised Wave:** A wave whose oscillations have been restricted to the same plane.

**Principal Axis:** A passing through the centre of the lens. Passing through the axis of the lens where it is thinnest.

**Progressive Wave:** A wave that transfers energy from one point to another.

**Pulse-Echo Technique:** An ultrasound technique used for imaging of objects notably in medical imaging. Short pulses of ultrasound are sent through a medium and their reflections recorded.

**Real Image:** Where rays of light have actually converged to produce an image and can be projected onto a screen.

**Refraction:** When a wave changes speed when it crosses the boundary into a new medium.

**Refractive Index:** A measure of how much the speed of light changes between two different media. If one media is a vacuum then the **Absolute Refractive Index** is found. For two different non-vacuum materials the **Relative Refractive Index** is found.



**Snell's Law:** The relative refractive index can be found from the ratio of the sines of the angles of incidence and refraction.

**Stationary Wave:** A wave that stores energy instead of transferring it. A common example is a string fixed at both ends. They are formed by a wave propagating and being reflected so that it comes into superposition with itself.

**Superposition:** When two waves meet at the same point in space their displacements combine and the total displacement at that point becomes the sum of the individual displacements at that point. Also referred to as **Interference**.

**Threshold Frequency:** The minimum frequency of light needed to cause electrons to be emitted in the photoelectric effect regardless of the intensity.

**Total Internal Reflection:** When the angle of incidence is greater than the critical angle and the ray reflects at the surface and remains within the medium.

**Transverse Wave:** A wave whose oscillations are perpendicular to the propagation of the wave e.g. electromagnetic waves.

**Ultrasound:** Sound waves with a frequency greater than 20 kHz.

**Virtual Image:** When rays of light only appear to have converged and cannot be projected onto a screen.

**Wavefront:** The surface made up of all the points of the wave that are in phase with each other.

**Wavelength:** The distance between two identical points on a wave. Typically measured peak to peak or trough to trough.

**Wave Speed:** The distance travelled by a wave per second. The product of the frequency and the wavelength. For an electromagnetic wave in a vacuum this is always equal to  $c$  ( $3 \times 10^8$  m/s).

**Work Function:** The minimum energy required to just liberate an electron from the surface of a metal.



## Definitions and Concepts for Edexcel Physics A Level

### Topic 6: Further Mechanics

**Angular Displacement:** In circular motion, the angle turned through. Measured in radians or degrees.

**Angular Velocity:** The angular displacement per unit time, measured in radians or degrees per second. It is different from angular speed as it is defined in either a clockwise or anticlockwise direction.

**Centripetal Acceleration:** As a body follows an orbit its direction constantly changes, this produces a constantly changing velocity and the centripetal acceleration is needed to cause this change in velocity.

**Centripetal Force:** A force felt towards the centre of an object's orbit due to the centripetal acceleration.

**Conservation of Momentum:** In a closed system with no external forces the momentum of the system before an event is equal to the momentum of the system after the event.

**Elastic Collision:** When the kinetic energy of a system before an event is equal to the kinetic energy of the system after the event.

**Impulse:** The change of momentum of an object when a force acts on it. Equal to the area underneath a force-time graph.

**Inelastic Collision:** When the kinetic energy of a system before an event is not equal to the kinetic energy of the system after the event. The kinetic energy has been transferred to other forms.



## Definitions and Concepts for Edexcel Physics A Level

### Topic 7: Electric and Magnetic Fields

**Capacitance:** The ratio of the charge stored in a capacitor to the potential difference between the two sides of the capacitor.

**Coulomb's Law:** The size of the force that acts between two point charges is proportional to the product of their charges and inversely proportional to the square of their separation. It is attractive for opposite charges and repulsive for like charges.

**Dielectric:** An insulating material placed between capacitor plates that prevents charge from crossing between the plates. The dielectric becomes polarised when the capacitor is charged and changes the capacitance of the capacitor.

**Eddy Current:** Small closed loops of current within a conductor or magnet. In a transformer these currents act against the magnetic flux that generates a current in the secondary coil making the transformer less efficient and heating the core.

**Electric Field:** A region of space in which charged particles experience either an attractive or repulsive force depending on the charge of the particle and direction of the field.

**Electric Field Lines:** A way of representing an electric field in a diagram, they point in the direction that a positive charge would experience a force, point positive to negative.

**Electric Field Strength:** Defined at a point. The electrostatic force experienced by a unit positive charge at a that point in the field.

**Electric Potential:** Defined at a point. The work done moving a unit positive charge from an infinite distance away to that point.

**Electric Potential Difference:** The work done moving a unit positive charge between two points.

**Electromagnetic Induction:** When a current carrying conductor moves relative to a magnetic field an EMF is induced in the conductor.

**Electrostatic Force:** The force generated between charges due to Coulomb's Law.

**Equipotential:** Planes of points where the electric potential is the same, no work is done moving charge along these lines.

**Faraday's Law:** The magnitude of the induced EMF is directly proportional to the rate of change of magnetic flux linkage.



**Fleming's Left hand Rule:** The relative direction of motion, field direction and current direction in the motor effect can be represented by the thumb, first finger and second finger of the left hand respectively. For the motion of a charged particle in a magnetic field, its direction replaces the current direction.

**Frequency:** The number of complete oscillations of the current (or voltage) in an A.C circuit per second.

**Lamination:** When a transformers core is made up of sets of layers to prevent eddy currents.

**Lenz's Law:** The direction of an induced current is such that it opposes the current that created it.

**Magnetic Field:** A region of space in which magnetic materials and moving electric charges feel a force.

**Magnetic Flux:** The magnetic field passing through a given area. Given by the product of the magnetic flux density and the area.

**Magnetic Flux Density:** The strength of a magnetic field measured in Tesla.

**Magnetic Flux Linkage:** The magnetic flux of a coil found by the product of the magnetic flux and number of turns of a coil.

**Motor Effect:** The force felt by a current carrying wire in a magnetic field.

**Oscilloscope:** A device used to monitor periodically time changing quantities such as voltage or current in an A.C circuit.

**Peak Value:** The maximum voltage or current that an A.C circuit achieves.

**Period:** The time taken for the current (or voltage) in an A.C circuit to complete one full cycle.

**Radial Field:** A field with field lines originating from a point like spokes on a wheel.

**Root-Mean-Square (RMS) Value:** For an A.C circuit RMS is the value of the voltage or current that would produce the same power dissipation in a D.C circuit as the A.C circuit. It is defined as the peak voltage divided by square root 2.

**Time Constant:** Describes the rate of charge or discharge of a capacitor. It is the time taken for the capacitor to charge from zero to 63% of its full value or to discharge from full to 37% of its full value.



**Transformer:** A device used to increase or decrease the voltage with two sets of coils with different numbers of turns wrapped around a magnetic core. The transformer is step-up if the number of coils on the secondary coil is greater than the number on the primary coil. The transformer is step-down if the number of coils on the secondary coil is fewer than the number on the primary coil.

**Uniform Field:** A field with parallel field lines.



## Definitions and Concepts for Edexcel Physics A Level

### Topic 8: Nuclear and Particle Physics

**Antimatter:** A particle with the same mass / rest energy as its matter particle but with opposite charge and opposite quantum numbers. A particle and an antiparticle will annihilate to create a photon.

**Baryon:** A particle consisting of three quarks, protons and neutrons are both baryons. The most stable baryon is the proton and so all baryons eventually decay to the proton.

**Baryon Number:** A measure of if a particle is a baryon, it is +1 for a baryon, -1 for an antibaryon and 0 for any other particle.

**Cyclotron:** A particle accelerator that has two semicircular electrodes with a gap between. When a charged particle is in the electrodes it is curved due to the magnetic field perpendicular to the plane of the electrodes and when it is in the gap it accelerates in an alternating voltage electric field resulting in a spiral path and accelerated charged particle.

**Fundamental Particles:** Particles that cannot be broken down into smaller constituents.

**Gauge Boson:** Fundamental particles that are the carriers of the fundamental forces.

**Gluon:** Gauge boson of the strong interaction.

**Hadron:** Particles that undergo strong interactions, they are made up of quarks so include mesons and baryons.

**Lepton:** Fundamental particles that do not interact via the strong force. They can transform between flavours via the weak interaction and some have charge so undergo electromagnetic interactions. They include the electron, electron neutrino, muon, muon neutrino, tau and tau neutrino.

**Lepton Number:** A measure of if a particle is a lepton, it is +1 for a lepton, -1 for an antilepton and 0 for any other particle.

**Linac:** Linear accelerator. These accelerate charged particles through sets of oscillating electric fields that create large electric potentials that accelerate the particles.

**Meson:** A particle consisting of one quark and one antiquark. Pions and Kaons are examples of mesons.

**Nucleon Number:** The number of neutrons and protons in the nucleus.

**Photon:** Gauge boson of the electromagnetic force.





**Plum Pudding Model:** A model of the atom that describes it as a ball of positive charge with evenly distributed negative electrons throughout it.

**Proton Number:** The number of protons in the nucleus.

**Quark:** Fundamental particle that interacts with other quarks via the strong interaction, it will change flavour via the weak interaction and annihilate with antiquarks to form photons via the electromagnetic interaction. They come in 6 flavours: up, down, charm, strange, top, bottom.

**Quark Confinement:** The principle that states that quarks cannot exist alone and must be either in quark, antiquark pairs or in threes.

**Relativistic Motion:** Particles that are travelling at close to the speed of light. They will experience time at a slower rate than a non-relativistic particle.

**Strangeness:** A measure of how many anti-strange quarks a particle has, a  $K^+$  is formed of an up and antistrange so has Strangeness +1, a  $K^-$  is formed of a strange and an antiup so has strangeness -1.

**Thermionic Emission:** When a metal is heated free electrons gain sufficient kinetic energy and are released from the metal's surface.

**Weak Interaction:** The force that causes flavour change in quarks and leptons, it is responsible for beta decay.

**$W^+/W^-/Z^0$ :** Gauge bosons of the weak interaction.



## Definitions and Concepts for Edexcel Physics A Level

### Topic 9: Thermodynamics

**Absolute Zero:** When the particles of a substance have zero kinetic energy, 0 K.

**Avogadro's Constant:** The constant number of particles per mole of a substance.

**Black Body Radiator:** A perfect emitter and absorber of all possible wavelengths of radiation.

**Boltzmann Constant:** A constant relating the average kinetic energy of the particle in a gas to the gas' temperature.

**Boyle's Law:** As volume decreases the pressure on a gas at a constant temperature increases.

**Charles' Law:** As temperature increases the volume of a gas at constant pressure increases.

**Ideal Gas:** A hypothetical gas that has molecules with no interactions and occupy negligible space so it obeys the ideal gas law.

**Ideal Gas Law:** A combination of Boyle's, Charles' and the Pressure Law that describes the relationship between pressure, volume and temperature of an ideal gas.

**Internal Energy:** The sum of all the randomly distributed potential and kinetic energies of the particles that make up a substance.

**Luminosity:** The total power radiated by a light emitting source.

**Pressure Law:** As temperature increases the pressure of a gas of constant volume increases.

**Specific Heat Capacity:** The energy required to raise the temperature of 1 kg of a substance by 1 Kelvin without changing its state.

**Specific Latent Heat:** The energy required to change the state of 1 kg of a substance without a change in temperature. Specific latent heat of fusion for solid to liquid and specific latent heat of vapourization for liquid to gas.

**State Changes:** During a state change a substance will not change kinetic energy, temperature will be constant, but its potential energy will change, bonds will be broken or formed.



**Stefan-Boltzmann Law:** The luminosity of a black body radiator is directly proportional to its surface area and its absolute temperature to the fourth power.

**Wein's Law:** The peak wavelength of emitted radiation is inversely proportional to the absolute temperature of the black body.



## Definitions and Concepts for Edexcel Physics A Level

### Topic 10: Space

**Astronomical Unit:** Mean distance of the earth to the sun.

**Big Bang Theory:** The theory that the universe originated as a small, dense and hot region that expanded and cooled forming the structures in the universe we see today.

**Cosmic Microwave Background Radiation (CMBR):** After the big bang the hot dense state of the universe was full of photons which interacted with the matter in the universe. At a certain time this interaction stopped due to the lower temperature of the universe and these photons were allowed to propagate freely, at this point these photons were gamma rays. At present the universe has expanded, redshifting these photons so that they are microwaves.

**Doppler Effect:** The apparent change in the wavelength of a wave as the source moves relative to an observer. For a source moving away the wavelength increases, for a source moving towards the observer the wavelength decreases.

**Dark Energy:** An energy that is responsible for the acceleration in expansion of the universe which cannot be explained by any observable energy and so must be dark.

**Dark Matter:** Certain observations of galaxies and their dynamics shows that they are far more massive than they appear to be with just the matter we can observe. This has led to the theory of dark matter to make up the rest of the unobservable mass.

**Giant Star:** A large star with a higher luminosity than a main sequence star and a broad temperature range.

**Hertzsprung-Russell Diagram:** Visual representation of the lifecycle of a star. A plot of luminosity against temperature.

**Hubble's Law:** The speed of a galaxy moving away from ours is proportional to its distance away from us. The constant of proportionality is Hubble's constant.

**Light Year:** Distance travelled through space by a photon in a year.

**Luminosity:** The total power radiated by a star.

**Main Sequence Star:** A star that sits on the central band of stars on a Hertzsprung-Russell diagram where temperature increases with luminosity.

**Standard Candle:** Objects of known luminosity used as references to measure other stars and to measure the distance to stars.



**Parallax:** The change in position of an object depending on the viewing angle, this can be used to estimate the distance to a star based on how much it moves relative to the background of stars when the earth has moved half an orbit.

**Parsec:** Unit of distance. It is the distance to a star whose parallax angle is 1 arcsecond.

**Redshift:** The shift in light of distant galaxies. This redshift is due to all galaxies moving away from each other and the larger redshift of distant galaxies is due to these galaxies moving away at a faster rate.

**Supergiant Star:** Very large luminous stars with a large temperature range of 3,500-20,000K.

**White Dwarf:** A dense star, similar mass to the sun, similar size to the earth. A final stage of a low mass star's life with low luminosity.



## Definitions and Concepts for Edexcel Physics A Level

### Topic 11: Nuclear Radiation

**Activity:** The activity of a radioactive source is the number of nuclei that decay per second, measured in Becquerels (Bq).

**Alpha Radiation:** The radiation of a particle containing two protons and two neutrons. It is strongly ionising, slow moving and positively charged so therefore deflected by a magnetic field.

**Atomic Mass Unit:**  $1/12$  the mass of a Carbon-12 nuclei.

**Background Radiation:** Constant radiation everywhere that is due to radioactive substances in the environment.

**Beta-minus Radiation:** Radiation consisting of a high energy electron that is mildly ionising, fast moving and negatively charged so therefore deflected by a magnetic field.

**Beta-plus Radiation:** Radiation consisting of a high energy positron that is mildly ionising, fast moving and positively charged so therefore deflected by a magnetic field in the opposite direction to beta-minus radiation.

**Binding Energy:** The energy required to split a nucleus into its individual nucleons. The greater the binding energy per nucleon the more stable the nucleus is.

**Chain Reaction:** When the fission of one nuclei produces neutrons that cause fission in another nuclei.

**Control Rod:** A rod that is inserted into a reaction vessel that stops neutrons preventing them from continuing on to cause more fission reactions. These are made from substances that absorb neutrons without fissioning themselves.

**Coolant:** A fluid that passes around the reaction vessel and carries away any thermal energy produced by the fission reactions. This thermal energy is used to generate steam and drive generators to produce electricity.

**Cooling Pond:** A large pool of water that nuclear waste is placed in to allow it to cool to safe temperatures.

**Critical Mass:** The minimum amount of a fissile substance needed to maintain a chain reaction and a steady flow of fission.

**Decay Constant:** The probability of a decay occurring per unit time.



**Fuel Rod:** Contains the fissile material, each rod has many pellets of nuclear fuel which prevents the critical mass of fuel being reached meaning the reactions are controlled.

**Gamma Radiation:** High energy photons, it is weakly ionising, travels at the speed of light and has no charge so is not deflected by magnetic or electric fields.

**Half-Life ( $T_{1/2}$ ):** The time taken for half of the radioactive nuclei to decay.

**Moderator:** A substance inserted between the nuclear fuel that reduces the speed of the neutrons coming from a fission reaction allowing them to become thermal neutrons that can induce further fission.

**Nuclear Fission:** The splitting of a large nucleus to produce smaller nuclei, fast moving neutrons and energy.

**Nuclear Fusion:** The fusing of two smaller nuclei to form a single nucleus producing a large quantity of energy. Very high temperatures and pressures are needed as well as high magnetic fields to contain the fusing plasma.

**Nuclear Waste:** The by-product of a nuclear reaction. This waste is no longer undergoing fission that can be used due to the reduced activity but the waste is still radioactive and will be for thousands of years so it is stored underground in reinforced containers.

**Mass Defect:** The difference between the mass of the nucleus and its individual components. If this mass defect is large and positive then when a nucleus undergoes fission this mass defect is released as energy. If this mass defect is negative then when two nuclei are fused together the mass defect is released as energy.

**Spontaneous Fission:** The process by which a nucleus splits without absorbing a thermal neutron.

**Thermal Neutron:** A slow moving neutron that when absorbed by an unstable nucleus causes it to undergo fission.



## Definitions and Concepts for Edexcel Physics A Level

### Topic 12: Gravitational Fields

**Equipotential:** A plane of points with equal gravitational potential. The work done travelling on an equipotential is zero.

**Geostationary Orbit:** An orbit with a time period of one day and stay over one point on the earth's surface. They are directly above the equator and travel in the same direction as the earth's rotation.

**Gravitational Field:** A region of space where objects with mass experience an attractive force due to gravity.

**Gravitational Field Strength:** The gravitational force on an object divided by its mass, it is the acceleration due to the gravitational field.

**Gravitational Potential:** Defined at a point. The amount of work done in moving a unit mass from an infinite distance to that point.

**Low Orbit:** An orbit with a height between 160 km and 2000 km.

**Newton's Law of Gravitation:** Force of gravity is proportional to the product of the masses involved and inversely proportional to the square of the separation of the masses.

**Synchronous Orbits:** A orbit with a time period of one day so will return to the same point in the sky each day.





## Definitions and Concepts for Edexcel Physics A Level

### Topic 13: Oscillations

**Critical Damping:** Where the oscillations stop and return to equilibrium in the quickest possible time.

**Damping:** When the energy in a SHM system is not kept as KE or PE and the total energy is no longer constant. All real systems experience some damping from friction or air resistance.

**Free Vibrations:** When a system oscillates without any driving force.

**Force Vibration:** When a system's oscillations are forced to vibrate by an external driving force.

**Light Damping:** (under damping), Where the oscillation's amplitudes reduce slowly. Friction and air resistance cause light damping.

**Natural Frequency:** The frequency at which a system naturally vibrates, a free vibration will be at the natural frequency.

**Overdamping:** When the damping is greater than critical damping, it stops the oscillations but the system takes longer to return to equilibrium position than a critically damped system.

**Pendulum Oscillator:** A mass on a string that oscillates with simple harmonic motion from side to side. The time period is independent of the object's mass and the initial displacement.

**Resonance:** When the driving force is at the natural frequency of a system causing maximal energy transfer with the amplitude of oscillation at its maximum. The driving force is  $\pi/2$  radians ahead of phase of the oscillations.

**Simple Harmonic Motion:** A mechanical process where the force on an object is proportional to the negative of the displacement from equilibrium. This means there is always a restoring force pointing towards equilibrium which is proportional to the extension. The resulting motion is oscillatory about this equilibrium position.

**Spring Oscillator:** A mass on a spring that oscillates with simple harmonic motion up and down. The time period is independent of gravitational field strength and the initial displacement.

