

# Definitions and Concepts for WJEC (Eduqas) Physics A-level

## Component 1: Newtonian Physics

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**Absolute Zero:** The lowest possible temperature of a system. At absolute zero the particles in the system have no kinetic energy, and theoretically the volume is zero.

**Acceleration:** The rate of change of velocity.

**Air Resistance:** A resistive force that opposes an object's motion through air.

**Amplitude:** The maximum displacement of an oscillator from its equilibrium position.

**Angular Velocity:** A measure of the speed of an object's angular rotation. It is equal to the frequency of rotation multiplied by  $2\pi$

**Annihilation:** The process of a particle and its antiparticle colliding and being converted into energy. The energy is released in two photons to conserve momentum.

**Antiparticles:** All particles have a corresponding antiparticle with the same mass but opposite charge and conservation numbers.

**Baryon Number:** A quantum number that is conserved in all particle interactions. Baryons have a baryon number of +1 and non-baryons have a baryon number of 0.

**Baryons:** A class of hadron, that is made up of three quarks. The proton is the only stable baryon.

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

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

**Brittle:** A brittle object will show very little strain before reaching its breaking stress.

**Centre of Gravity:** The single point through which the object's weight can be said to act.

**Centripetal Acceleration:** The acceleration of an object moving in circular motion. Any object in circular motion must have an acceleration since the direction of the object, and therefore the velocity of the object, is constantly changing.

**Centripetal Force:** The resultant force responsible for an object moving in circular motion. Centripetal forces always act towards the centre of the object's rotation.

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**Circular Motion:** The motion of an object travelling in a circle. An object travelling in circular motion is always accelerating due its continual direction change. This means that a centripetal force is always required.

**Conservation of Charge:** The total charge in a system cannot change.

**Conservation of Energy:** Energy cannot be created or destroyed - it can only be transferred into different forms.

**Conservation of Momentum:** The total momentum of a system before an event, must be equal to the total momentum of the system after the event, assuming no external forces act.

**Critical Damping:** The form of damping that reduces the displacement of an oscillating object to its equilibrium position in the quickest time possible and without further oscillation.

**Damping:** The dissipation of energy from an oscillating system. The consequence is that the amplitude of oscillation will decrease. Damping occurs when a force opposes the system's motion.

**Density:** The mass per unit volume of a material.

**Displacement-Time Graph:** A plot of how an object's displacement changes over time. The gradient of the graph at any point, equals the object's velocity at that point.

**Displacement:** A measure of how far an object moves in a given direction. It is the straight line between the starting and finishing points and is a vector quantity.

**Dissipative Forces:** Forces which reduce the efficiency/useful types of energy in a system.

**Distance:** A measure of how far an object moves. It doesn't depend on direction and is therefore a scalar quantity.

**Drag:** A resistive force that acts to oppose the motion of an object through a fluid.

**Driving Frequency:** The frequency at which a driving force causes a system to oscillate at.

**Efficiency:** A ratio of the useful output of a system over the total input.

**Elastic Collisions:** A collision in which the total kinetic energy of the system before the collision is equal to the total kinetic energy of the system after the collision.

**Elastic Potential Energy:** The energy stored in an object when it is stretched. It is equal to the work done to stretch the object and can be determined from the area under a force-extension graph.

**Equation of State:** An equation linking pressure, volume, number of moles, temperature and the ideal gas constant.



**Equilibrium:** An object in equilibrium has a zero resultant force and a zero net moment.

**First Law of Thermodynamics:** A form of the conservation of energy. It states that the total energy supplied or removed from a system is equal to the sum of the change in internal energy and the work done on it.

**Fluid:** A liquid or gas.

**Force-Extension Graph:** The gradient of a force-extension graph for a spring obeying Hooke's law is equal to the spring constant. The area under the graph is the work done in stretching the spring.

**Free Body Diagrams:** A visual representation of the forces that act on an object.

**Free-Fall:** Motion under the force of gravity alone.

**Free Oscillations:** Oscillations that are not caused by a driver. An object will naturally oscillate at its natural frequency.

**Frequency:** The number of complete oscillations completed by an oscillator per unit period of time.

**Friction:** A resistive contact force that acts to oppose the relative motion between two surfaces.

**Forced Oscillations:** Repeated up and down oscillations, at the frequency of a driver. The amplitude of oscillation is small at high frequencies and large at low frequencies.

**Gravitational Field:** A region surrounding a mass in which any other object with mass will experience an attractive, non-contact force.

**Gravitational Interaction:** The interaction between two bodies with mass at a given distance. It follows the inverse square law.

**Gravitational Potential Energy:** The component of an object's energy due to its position in a gravitational field.

**Heat:** The movement of thermal energy from a hotter region to a cooler region. Heat is the movement of energy and so is not stored by a system.

**Homogeneity of Units:** The units on each side of an equation must always be equivalent to each other.

**Hooke's Law:** The extension of an elastic object will be directly proportional to the force applied to it up to the object's limit of proportionality.

**Ideal Gas:** A gas that meets the ideal gas assumptions. All the gas laws are based on ideal



gases.

**Inelastic Collisions:** A collision in which the total kinetic energy of the system before the collision is not equal to the kinetic energy of the system after the collision.

**Internal Energy:** The sum of the randomly distributed kinetic and potential energies of the particles in a given system.

**Inverse Square Law:** The decrease of intensity is inversely proportional to the square of the distance you are from the source. This means that if the distance doubles, the intensity quarters.

**Kinetic Energy:** A form of energy that all moving objects possess. It is directly proportional to the mass of the object, and to the square of its velocity.

**Kinetic Theory of Gases:** A model of ideal gases that assumes their molecules move randomly, collide elastically, have negligible volume and have no intermolecular forces acting between them. There is a random energy distribution between the molecules

**Limit of Proportionality:** The point beyond which the extension of an elastic object is no longer directly proportional to the force applied to it.

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

**Mass-Spring Oscillator:** An oscillator whose time period depends only on the magnitude of the mass and the constant of the spring.

**Molar Gas Constant:** A fundamental constant, used in the ideal gas law.

**Molar Mass:** The mass of one mole of the substance in question.

**Mole:** The SI unit for the amount of a substance.

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

**Net Moment:** The single moment that has the same effect as the sum of all the other clockwise and anticlockwise moments acting on an object.

**Neutron:** A neutrally charged nucleon, found in the nucleus of an atom. Neutrons are a form of hadron. Composed of udd quarks.

**Newton's First Law:** An object will remain in its current state of motion, unless acted on by a resultant force. An object requires a resultant force to be able to accelerate.

**Newton's Second Law:** An object's acceleration is directly proportional to the resultant force acting on it, and inversely proportional to the object's mass.



**Newton's Third Law:** Every action has an equal and opposite reaction. If an object exerts a force on another object, then the other object must exert a force back, that is opposite in direction and equal in magnitude.

**Overdamping:** A type of damping where the system is damped more than required to stop the oscillations. It takes longer for the system to return to equilibrium than for critical damping.

**Period:** The time taken for an oscillator to complete one full oscillation.

**Perpendicular:** At right-angles ( $90^\circ$ ) to each other.

**Phase:** A measure of how far through a complete cycle an oscillator is.

**Power:** The rate of transfer of energy. Its unit is the Watt.

**Pressure:** The force that a surface experiences per unit area. It is measured in Pascals (Pa).

**Pressure-Volume Graph:** A graph showing how the volume of a gas changes with pressure. The area under the graph gives you the work done by the gas during the process.

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

**Radian:** A unit of angle. One radian is equal to the angle subtended by an arc whose length is equal to the radius of the circle.

**Rate of Change of Momentum:** When a force acts on a moving object, or on an object that has the ability to move, a change of momentum will occur. The force is equal to the rate of change of this momentum.

**Relative Molecular Mass:** The ratio of the mass of a given molecule over the mass of one twelfth of a carbon-12 atom.

**Resolution of Forces:** Resolving a force into its components along each axis.

**Resonance:** Resonance occurs when the frequency of oscillations is equal to the natural frequency of the oscillating system. The rate of energy transfer is at a maximum during resonance.

**Resultant Force:** The single force that can replace all the individual forces acting on an object, and have the same effect.

**Scalar Quantities:** A quantity that only has a magnitude. Examples include length, mass and temperature.



**Simple Harmonic Motion:** Motion where the acceleration of an object is directly proportional, and in the opposite direction, to its displacement.

**Simple Pendulum:** An oscillator whose time period depends only on the length of the pendulum and the gravitational field strength at its location.

**SI Units:** The standard units used for measurement.

**Specific Heat Capacity:** The amount of energy required to increase the temperature of 1kg of a substance by 1 Kelvin.

**Speed:** A scalar quantity that is a measure of the rate of change of distance. The average speed is calculated by dividing the distance travelled by the speed taken.

**Spring Constant:** The constant of proportionality for the extension of a spring under a force. The higher the spring constant, the greater the force needed to achieve a given extension.

**Stability:** A measure of the likelihood of an object toppling. Object's are stable if the line of action of their weight lies within the object's base.

**Temperature:** A measure of the average kinetic energy of the particles in a system. Absolute temperature is proportional to the mean kinetic energy.

**Terminal Velocity:** The maximum velocity of an object that occurs when the resistive and driving forces acting on the object are equal to each other.

**Thermal Equilibrium:** A stable state in which there is no thermal heat transfer between two regions with the same temperature.

**Undamped System:** A system from which no energy is dissipated, due to no opposing forces acting. An undamped system will oscillate infinitely.

**Underdamping:** A type of damping where energy is gradually removed from the system and the amplitude of oscillations slowly decreases.

**Vector Quantities:** A quantity that has both a magnitude and a direction. Examples include velocity, displacement and acceleration.

**Velocity-Time Graph:** A plot of how an object's velocity changes over time. The gradient at any point, equals the object's acceleration at that point. The area under the graph equals the object's displacement.

**Velocity:** The rate of change of an object's displacement.

**Weight:** The force acting on an object due to gravity. It is equal to the product of the object's mass and the gravitational field strength at its location.



**Work Done by a Gas:** For a system at constant pressure, the work done by a gas in changing volume is equal to the volume change multiplied by the pressure.

**Work-Energy Relationship:** The work done on a body is equal to the change in kinetic energy of that body.

**Work:** Work is done on an object when a force causes it to move through a distance. It is equal to the product of the distance travelled and the magnitude of the force in the direction of motion.



