

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

### Component 2: Electricity and the Universe

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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.

**Ammeter:** A device that measures the current in the loop of the circuit that it is connected in series with. An ideal ammeter is modelled to have zero resistance.

**Amorphous:** Materials where the atoms or molecules are arranged in a non-ordered structure.

**Amperes:** The unit of current.

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

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

**Capacitance:** The charge stored per unit pd in a capacitor.

Capacitance 2. Electrostatic and gravitational fields of force 3. Orbits and the wider universe

**Capacitors in Parallel:** When capacitors are connected in parallel, their individual capacitances are summed to give the total capacitance.

**Capacitors in Series:** When capacitors are connected in series, the total capacitance is equal to the inverse of the sum of the inverses of the individual capacitances.

**Cells in Series:** When cells are connected end to end, one after another.

**Charge:** A property of matter that causes it to experience force when placed in an electromagnetic field. It can be positive or negative.

**Charging Capacitor:** When charge builds up on the plates of a capacitor.  
Conduction

**Conductor:** A material that allows the flow of electrical charge. Good conductors have a larger amount of free charge carriers to carry a current.

**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

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into different forms.

**Continuous Emission Spectrum:** An emission spectrum that covers a full range of frequencies without any gaps.

**Coulomb:** The unit of charge.

**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.

**Crack Propagation:** The way a crack propagates in a solid. For example, a crack opening up and causing a brittle fracture.

**Critical Angle:** The angle of incidence beyond which a wave will be totally internally reflected.

**Critical Density:** The density of the universe such that the expansion of the universe will eventually halt.

**Crystalline:** materials which have atoms arranged in an ordered structure making a crystal

**Current-Carrying Wire:** A wire that carries a current.

**Current Law:** The sum of the currents entering a junction must always equal the sum of the currents leaving the junction. It is a consequence of the conservation of charge.

**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.

**Dielectric:** An insulating material placed between the two plates of a capacitor in order to increase the amount of charge it can store.

**Discharging Capacitor:** When a capacitor is discharging charge stored on the plates

**Dislocations:** Small gaps in the ordered structure of crystalline materials.

**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 (red shift), for a source moving towards the observer the wavelength decreases (blue shift).

**Doppler Relationship:** The equation describing the doppler effect.  $\frac{\Delta\lambda}{\lambda} = \frac{v}{c}$

**Ductile Fracture:** Occurs when necking continues until the material separates at a point

**Electrical Field Strength:** The force per unit positive charge exerted on a charged object placed at a chosen point in the field.



**Electric Current:** The rate of flow of charge in a circuit.

**Electric Field:** A region surrounding a charged object which causes a non-contact force to be exerted on any charged object placed within the field.

**Electric Field Lines:** Lines that represent the direction and strength of an electric field. The density of the lines indicates the strength of the field and their direction shows the direction in which a positive charge would experience a force.

**Electric Potential:** The work done per unit charge on a positive test charge in bringing it from infinity to a chosen point in the field.

**Electromotive Force:** The amount of energy transferred by a source, to each unit of charge that passes through it. The energy is transferred into electrical energy.

**Elementary Charge:** The smallest possible charge, equal to the charge of an electron.

**Energy Stored in a Capacitor:** The energy stored by a capacitor.

$$E = \frac{QV}{2} = \frac{CV^2}{2} = \frac{Q^2}{2C}$$

**Equipotential Surfaces:** A surface of constant potential. No work is done by the field when an object moves along an equipotential.

**Exo-Planet:** A planet that orbits a star other than our Sun.

**Filament Lamp:** A light emitting component consisting of an enclosed metal filament. Its resistance increases as the filament's temperature increases.

**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.

**Force Field:** A region where an object will experience a non-contact force.

**Grain Boundaries:** The boundary between two grains in a solid.

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

**Gravitational Field Strength:** The force per unit mass exerted on a small test mass placed within the field.

**Gravitational Potential:** The work done per unit mass required to move a small test mass from infinity to a chosen point in a gravitational field.

**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.



**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.

**Hysteresis:** When the stress-strain graph is different depending on whether you are loading or unloading the material.

**Internal Resistance:** The resistance to the flow of charge within a source. Internal resistance results in energy being dissipated within the source.

**Kepler's First Law:** All planets travel in elliptical orbits, centred around the sun.

**Kepler's Second Law:** All planets sweep out the same area in a given period of time.

**Kepler's Third Law:** The square of an object's orbital period ( $T$ ) is directly proportional to the cube of its orbital radius ( $r$ ) –  $T^2 \propto r^3$ .

**Light-Dependent Resistor (LDR):** A light sensitive semiconductor whose resistance increases when light intensity decreases.

**Line Absorption Spectrum:** When emitted radiation passes through a star's atmosphere a line absorption spectrum is produced where atoms absorb certain wavelengths of the electromagnetic spectrum.

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

**Mean Drift Velocity:** The average velocity of an electron passing through an object. It is proportional to the current, and inversely proportional to the number of charge carriers and the cross-sectional area of the object.

**Multiwavelength Astronomy:** Astronomy involving detecting electromagnetic radiation of a variety of wavelengths.

**Necking:** where the cross-sectional area of the metal reduces as it deforms plastically

**Newton's Law of Gravitation:** The gravitational force acting between two objects is directly proportional to the product of their masses and inversely proportional to the square of the distance between their centres.

**Ohmic Conductor:** A conductor for which the current flow is directly proportional to the potential difference across it, when under constant physical conditions.

**Ohms:** The unit of resistance.

**Ohm's Law:** The current and potential difference through an ohmic conductor held under constant physical conditions are directly proportional, with the constant of proportionality being resistance.

**Orbital Speeds:** The speed of an orbiting object.



**Parallel Plate Capacitor:** A capacitor consisting of two parallel conducting plates with an insulator between them (dielectric). The field lines within the plates are uniform and parallel.

**Plastic Strain:** If a material undergoes plastic strain, it will not return to its original shape when the deforming forces are removed. The object will be permanently deformed.

**Polymeric:** Materials that contain long chain polymer molecules. The bonds in most polymers are strong and can rotate.

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

**Potential Divider:** A method of splitting a potential difference, by connecting resistors in series. The total potential difference is split in the ratio of their resistances.

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

Radiation to investigate stars

**Resistance:** A measure of how difficult it is for current to flow through a material.

**Resistivity:** A measure of how difficult it is for charge to travel through a material. It is proportional to the object's resistance and cross-sectional area, and inversely proportional to the object's length. It is measured in Ohm metres.

**Resistors in Parallel:** When resistors are connected in parallel. The total resistance is given by  $\frac{1}{R_{total}} = \frac{1}{R_1} + \frac{1}{R_2} + \dots$

**Resistors in Series:** When resistors are connected in series. The total resistance is given by  $R_{total} = R_1 + R_2 + \dots$

**Series:** When electrical components in a circuit are connected one after the other.

Solids under stress

**Spiral Galaxies:** A class of galaxies where the stars/mass are concentrated into spiral arms.

**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.

**Star's Radial Velocity:** The velocity of the star along the line connecting the center of the Earth and the star.

**Stefan's Law:** A law stating that the power output (luminosity) of a star is directly proportional to its surface area and its absolute temperature to the 4<sup>th</sup> power.

**Stellar Spectrum:** The spectrum created when light from a star is dispersed. There are



continuous, line and emission spectra.

**Strengthening Metals:** Introducing 'foreign atoms' to reduce the effect of dislocations in a metal or by increasing the number of grain boundaries.

**Stress-Strain Graph:** A graph showing the stress on a material for a given strain. The gradient is the Young's Modulus.

**Superconductor:** A material which has zero resistivity when the temperature is decreased to, or below, the material's transition temperature. Superconductors can be used to produce strong magnetic fields and reduce energy loss when transmitting electric power.

**Surface Imperfections:** Imperfections on the surface of a material which allows the stress to concentrate there and cause a brittle fracture.

**Tensile Strain:** The ratio of an object's extension to its original length. It is a ratio of two lengths and so has no unit.

**Tensile Stress:** The amount of force acting per unit area. Its unit is the Pascal (Pa).

**Terminal Potential Difference:** The potential difference across the terminals of a power source. It is equal to the source's emf minus any voltage drop over the source's internal resistance.

**Thermistor:** A temperature sensitive semiconductor whose resistance increases when temperature decreases.

**Time Constant:** The time taken for a capacitor to discharge to 37% ( $e^{-1}$ ) of its initial charge. The time constant is equal to the product of the capacitance and the resistance of the fixed resistor (that the capacitor is being discharged through).

**Transition Temperature:** The temperature below which a superconductor has zero resistivity.

**Vacuum:** A region in which there is no matter.

**Volt:** The unit of potential difference.

**Voltage Law:** The sum of the emfs around a closed loop must always equal the sum of the potential differences around the same loop. This is a consequence of the conservation of energy.

**Wien's Displacement Law:** A law stating that the peak wavelength of emitted radiation is inversely proportional to its absolute temperature.

**Young Modulus:** The ratio of stress to strain for a given material. Its unit is the Pascal (Pa).



