

KS4

Definitions and Concepts for AQA Physics GCSE

Definitions in **bold** are for higher tier only and with a * are for the separate Physics course.

Topic 1 - Energy

Topic 2 - Electricity

Topic 3 – Particle Model of Matter

Topic 4 – Atomic Structure

Topic 5 - Forces

Topic 6 - Waves

Topic 7 – Magnetism and Electromagnetism

Topic 8 - Space

Topic 1: Energy

Closed System: A system that experiences no net change in its total energy when energy transfers occur within it.

Conservation of Energy: The law that energy can be transferred, stored or dissipated but never created or destroyed.

Efficiency: The ratio of useful output energy transfer to total energy input.

Elastic Potential Energy: The store of energy that stretched or compressed objects experience. It is directly proportional to the stiffness constant and to the square of the extension or compression.

Fossil Fuels: Coal, oil and gas.

Gravitational Potential Energy: The store of energy that all raised matter has. It is directly proportional to the mass of the object, the distance that it is risen and the gravitational field strength at that point.

Joule: The unit used for energy. Equal to the work done when a force of one Newton acts over a distance of one metre.

Kinetic Energy: The store of energy that all moving matter has. It is directly proportional to the object's mass and to the square of its velocity.

Power: The rate at which energy is transferred, or at which work is done.

Renewable Energy Resource: An energy resource that can be replenished whilst it is being used.

Specific Heat Capacity: The amount of energy required to raise the temperature of 1kg of a substance by 1°C.

Spring Constant: A measure of a spring's stiffness. The greater the value, the greater the force required to stretch or compress the spring by a given distance.

System: A single, or group, of objects.

Thermal Conductivity: The higher this value is for a given material, the higher the material's rate of energy transfer via conduction will be.

Waste Energy: Energy that isn't usefully used for the purpose of the system.

Watt: A unit of power. One Watt is equivalent to one joule of work being done in one second.

Work Done: The energy transferred when a force acts over a distance.

Topic 2: Electricity

Alternating Potential Difference: A continually oscillating current flow, which results in the potential difference across two points continually oscillating between a positive and negative value.

Amperes (Amps): The unit of current.

Attraction: A force pulling two opposite charges together, when they are brought near each other.

Coulomb: The unit of charge.

Diode: A component that only allows current to flow through in the forward direction. They have very large resistances in the reverse direction.

Direct Potential Difference: A one-directional current flow.

Earth Wire: The green and yellow striped safety wire that prevents an appliance from becoming live.

***Electric Field Lines:** Lines representing an electric field, that point in the direction in which a positive charge would experience an electric force.

***Electric Field:** A region in which a charge will experience a non-contact, electric force. All charged objects have an electric field around them, and this field is stronger the closer you are to the charge.

Electrical Current: The rate of flow of electrical charge. Its value is the same at any position in a single closed loop.

Electrical Work: When charge flows in a circuit, electrical work is said to be done.

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

Insulation: The coating around power cables that prevents electrocution and is colour coded to allow for easy identification.

Light Dependent Resistor (LDR): A light sensitive component whose resistance increases as its temperature decreases.

Live Wire: The brown coloured wire that carries the alternating current from the supply in a mains power supply.

Mains Electricity: An a.c supply, which in the UK has a frequency of 50Hz a value of 230V.

Neutral Wire: The blue coloured wire that completes the circuit in a mains power supply.

Non-Contact Force: A force experienced between two separated objects. Examples include gravity, and magnetic and electric forces.

Ohmic Conductor: A conductor whose current flow is directly proportional to the potential difference across it, when held at a constant temperature.

Ohms: The unit of resistance.

Parallel: Components connected in parallel have the same potential difference across each component. The total current is equal to the sum of the currents flowing through each component.

Potential Difference: The product of a component's resistance and the magnitude of current flow through it.

Repulsion: Caused when two like-charges are brought near each other.

Resistance: A measure of the opposition to current flow.

Resistors in Parallel: The total resistance is equal to the inverse of the sum of the inverses of the resistance of the parallel components. The total resistance of two parallel resistors is always less than the lowest individual resistor value.

Resistors in Series: The total resistance is equal to the sum of the resistances of the individual components.

Series: Components connected in series have the same current passing through each component but share the total potential difference of the power supply.

***Static Charge:** The charge caused by an imbalance of positive and negative charges in, or on, an object's surface. It is often caused by electrons being rubbed from one surface onto another.

Step-Down Transformers: Devices found between the transmission cables and the consumer that lower the potential difference of the power so it is at safe, usable levels.

Step-Up Transformers: Devices that increase the potential difference generated by a power station, so that the electrical power transmitted along the transmission cables is at a higher potential.

The National Grid: The network of power stations, transformers and cables that connect consumers to power stations.

Thermistor: A temperature dependent component, whose resistance increases as its temperature decreases.

Volt: The unit of potential difference.

Topic 3: Particle Model of Matter

Change in Thermal Energy: The product of the mass, specific heat capacity and temperature change of a substance.

Chemical Changes: Changes to the chemical structure of a substance. The substance does not usually restore its original properties when the changes are reversed.

Condensation: The changing from vapour state to a liquid state, when a substance is cooled.

Density: The mass per unit volume of an object.

Evaporation: The changing from liquid state to a vapour state, when a substance is heated.

Freezing: The changing from a liquid state to a solid state, when a substance is cooled.

Gas Temperature: The temperature of a gas is directly proportional to the average kinetic energy of its molecules.

Internal Energy: The energy stored by the atoms and molecules that make up a system. It is equal to the sum of the total kinetic and potential energies of the particles in the system.

Latent Heat: The energy required for a substance to change state.

Melting: The changing from solid state to liquid state, when a substance is heated.

Pascals: The unit of pressure, equal to a force of one Newton acting perpendicular to an area of one metre squared.

Physical Changes: Changes to the physical properties of a substance which can be reversed. Changes of state are physical changes since substances can restore their original properties when the changes are reversed.

Pressure: The force acting perpendicular to a surface, per unit area.

Specific Heat Capacity: The amount of energy needed to increase the temperature of one kilogram of a given substance by one degree Celsius.

Specific Latent Heat of Fusion: The amount of energy needed to change the state of one kilogram of a substance from solid state to liquid state, whilst held at constant temperature.

Specific Latent Heat of Vaporisation: The amount of energy needed to change the state of one kilogram of a substance from liquid state to vapour state, whilst held at constant temperature.

Specific Latent Heat: The amount of energy needed to change the state of one kilogram of a substance, whilst held at constant temperature.

Sublimation: The direct changing of a substance from a solid state to a vapour state, without passing through the liquid phase.

Topic 4: Atomic Structure

Activity: The rate at which an unstable nucleus decays.

Alpha Particle: A positively charged particle consisting of two protons and two neutrons.

Atomic Number: The number of protons found in an atom of a specific element. Each element has a different atomic number.

***Background Radiation:** Radiation that is found in small quantities all around us and originates from natural sources such as rocks and cosmic rays, as well as from man-made sources such as nuclear weapons testing and accidents.

Becquerel: The unit of radioactive activity.

Beta Particle: A high speed electron that a nucleus emits when a neutron converts into a proton.

Bohr Model: A model of the atom that suggested that electrons orbit the nucleus at set distances.

***Chain Reaction:** The process of neutrons released by a fission reaction, being absorbed by another unstable, large nuclei, and inducing further fission.

Count-Rate: The number of decays that a detector measures per second.

Electrons: A negatively charged constituent of the atom, that are found in different energy levels, around the nucleus.

Energy Levels: The stable states in which electrons are found in around a nucleus. Electrons can transition to a higher energy level through the absorption of electromagnetic radiation and can transition to a lower energy level through the emission of electromagnetic radiation.

***Fission Products:** Fission produces two smaller nuclei, two or three neutrons and gamma rays. All these products are released with kinetic energy.

Gamma Ray: Electromagnetic radiation emitted from a nucleus.

Geiger-Muller Tube: A detector that measures the count-rate of a radioactive sample.

Half-Life: The time it takes for the number of unstable nuclei of an isotope in a sample to halve, or the time it takes for the initial count rate of a sample of the isotope to halve.

Ions: Atoms with a resultant charge due to the loss or gain of electrons.

Irradiation: The process of an object being exposed to nuclear radiation. The object doesn't become radioactive.

Isotopes: Atoms with the same number of protons but different numbers of neutrons. The atomic number is the same, but the mass number is different.

Mass Number: The number of protons and neutrons in an atom.

Negative Ions: Atoms that gained electrons and so have a resultant negative charge.

Neutrons: A neutrally charged constituent of the nucleus.

***Nuclear Explosions:** Nuclear explosions in nuclear weapons are caused by an uncontrolled chain reaction which results in vast quantities of energy being produced in a very small period of time.

***Nuclear Fission:** The splitting of a large and unstable nucleus into two smaller and more stable nuclei to produce energy.

***Nuclear Fusion:** The joining of two small, light nuclei to form a larger, heavier one and release energy.

Nucleus: The positively charged centre of an atom, containing protons and neutrons.

Plum Pudding Model: An old model of the atom that represented the atom as a ball of positive charge, with negative charges distributed throughout it.

Positive Ions: Atoms that have lost electrons and so have a resultant positive charge.

Protons: A positively charged constituent of the nucleus.

Radioactive Contamination: The unwanted presence of radioactive atoms on other materials. It is hazardous due to the decay of the contaminating atoms.

Radioactive Decay: The random process involving unstable nuclei emitting radiation to become more stable.

***Sieverts:** The unit used for radiation dosage.

***Spontaneous Fission:** Fission that occurs without the absorption of a neutron.

Spontaneous fission is rare and in most cases, fission is induced with a neutron.

Topic 5: Forces

Acceleration: The rate of change of velocity. It can be calculated from the gradient of a velocity-time graph.

***Atmosphere:** The thin layer of air surrounding the Earth, which gets less dense with increasing altitude.

Braking Distance: The distance a vehicle travels under the braking force. This can be affected by adverse road and weather conditions as well as the condition of the vehicle.

Centre of Mass: The single point through which the weight of the object can be said to act.

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

Conservation of Momentum: **The total momentum of a system before an event is always equal to the total momentum of the system after the event.**

Contact Forces: A force that occurs when objects are physically touching.

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.

Distance: A measure of how far an object moves, that does not depend on direction and is therefore a scalar quantity.

Elastic Deformation: Non-permanent deformation which allows the object to return to its original shape when the deforming forces are removed.

Elastic Limit: The force beyond which an object will no longer deform elastically, and will instead deform plastically.

Elastic Potential Energy: The energy stored in a spring when it is stretched or compressed, due to the work done on the spring by the deforming force. It is equal to the work done as long as the object does not plastically deform.

Equilibrium: An object is in equilibrium if the resultant force and resultant moment are both equal to zero.

***Floating:** An object will float if the volume of liquid it displaces has a greater weight than that of the object itself. The upthrust acting on the object is greater than its weight.

***Fluid:** A liquid or gas.

Forces: A push or pull that an object experiences due to the interaction with another object. Force is a vector quantity.

Inertia: The tendency of an object to remain in its same state of uniform motion or rest.

Inertial Mass: A measure of how hard it is to change an object's velocity. It is defined as the ratio of force over acceleration.

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

***Moment:** The turning effect of a force, equal to the product of the magnitude of the force and the perpendicular distance from the pivot to the line of action of the force.

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

Newtonmeter: A calibrated spring-balance used to measure weight.

Newton's First Law: If a stationary object's resultant force is zero, the object will remain stationary. If a moving object's resultant force is zero, the object will continue to move at the same speed, and in the same direction.

Newton's Second Law: An object's acceleration is directly proportional to the force applied to it, and inversely proportional to its mass.

Newton's Third Law: The forces that two objects exert on each other when they interact are equal and opposite.

Non-Contact Forces: A force that occurs when objects are physically separated.

Plastic Deformation: Permanent deformation which means the object will no longer return to its original shape when the deforming forces are removed.

***Pressure in a Column:** The pressure in a column of liquid is equal to the product of the liquid's density, the height of the column and the gravitational field strength.

Resolution of Forces: All forces can be resolved into two perpendicular components that have the same effect as the single force.

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

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

Scalar Quantities: Quantities that only have a magnitude, not a direction.

***Sinking:** An object will sink if the volume of liquid it displaces has a lower weight than that of the object itself. The upthrust acting on the object is lower than its weight and so there is a resultant downwards force.

Speed: A scalar quantity that is a measure of the rate of increase of distance.

Spring Constant: A measure of a spring's stiffness, which is the constant of proportionality for a spring's extension. The higher the spring constant, the smaller the extension is for a given force.

Stopping Distance: The sum of the thinking and braking distances.

Thinking Distance: The distance a vehicle travels during the driver's reaction time. Typical human reaction times are in the range of 0.2-0.9 seconds. This reaction time may be affected by tiredness, drugs or alcohol.

Upthrust: The upward force acting on an object in a fluid, due to it experiencing a greater pressure below it than above it.

Vector Quantities: Quantities that have both a magnitude and direction. They are represented by an arrow, with the length representing the magnitude and the arrowhead representing the direction.

Velocity: A vector quantity that is a measure of the rate of change of displacement. It is the speed in a given direction.

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

Topic 6: Waves

Amplitude: The maximum displacement of a wave from its undisturbed (equilibrium) position.

Angle of Incidence: The angle between the incident ray and normal.

Angle of Reflection: The angle between the reflected ray and normal.

Black: An object will appear black if it absorbs all wavelengths of radiation incident on it.

Colour Filters: Filters that absorb certain wavelengths (colours) and transmit others. A blue filter for example will absorb all wavelengths other than those in the blue region of the colour spectrum.

Colour: Colour is determined by frequency and wavelength.

***Constant Temperature: A body remains at a constant temperature if it is absorbing radiation at the same rate that it is emitting it.**

Convex Lens: A lens that brings parallel rays to focus at the principal focus. The image formed can be either real or virtual.

Diffuse Reflection: Reflection from a rough surface that results in scattering.

***Echo Sounding: A technique that uses high frequency sound waves to detect objects in deep water and to measure the depth of water.**

Electromagnetic Waves: Transverse waves that transfer energy from the source of the waves, to an absorber. They form a continuous spectrum of different frequencies and all travel at the same speed in a vacuum.

Focal Length: The distance between the centre of a lens and its principal focus

Frequency: The number of waves passing a given point in a second. It is the inverse of the wave's period.

Hertz: The unit of frequency.

***Human Hearing: Humans can hear sounds in the frequency range of 20Hz to 20kHz.**

Infrared Radiation: A type of radiation that all objects emit and absorb. The hotter an object is, the greater the infrared radiation it emits in a given time.

Infrared: Used for cooking food, electrical heaters and infrared imaging.

Ionising Radiation: Radiation that can cause the mutation of genes and cause cancer. X-rays and gamma rays are both forms of ionising radiation.

Lens: An object that forms an image through the refraction of light.

Longitudinal Waves: Waves with oscillations that are parallel to the direction of travel/energy transfer.

Magnification: The ratio of the image height over the object height for a lens. Since it is a ratio, it has no units.

Microwaves: Used for satellite communications and for cooking food.

Normal: The normal is an imaginary reference line that is constructed perpendicular to a boundary at the point that the wave intercepts it.

***P-Waves: Longitudinal, seismic waves that travel at different speeds through solids and liquids.**

***Perfect Black Body:** An object that absorbs all radiation incident on it and does not reflect or transmit any type of radiation.

Period: The time it takes for one complete wave to pass a given point. It is the inverse of frequency.

Radiation Dose: A measure of the risk of harm to the body as a result of radiation exposure.

Radio Waves: Used for television and radio signals. They can be produced by oscillations in electrical circuits.

***Reflection:** Reflection is when a wave bounces off a boundary. The angle of incidence always equals the angle of reflection

***S-Waves: Transverse, seismic waves that cannot travel through liquids.**

***Seismic Waves: Waves that are produced by earthquakes.**

***Sound Waves: The longitudinal waves responsible for sound. In solids, sound waves are transmitted by the vibrations of the solid's particles.**

Specular Reflection: Reflection from a smooth surface, in a single direction.

Transverse Waves: Waves with oscillations that are perpendicular to the direction of travel/energy transfer.

***Ultrasound Scanning: A technique that involves ultrasound waves being transmitted and then partially reflected at a boundary before being detected by a detector. The time between transmission and detection can be used to calculate distances, and build up an image.**

***Ultrasound Waves: Waves that have a frequency higher than the upper limit of human hearing (20kHz).**

Ultraviolet: Used in energy efficient lamps and for sun tanning.

Visible Light: The only type of electromagnetic radiation that our eyes can detect. It is used for fibre optic communications.

Wave Speed: The speed at which energy is transferred through the medium. It is equal to the product of the wave's wavelength and frequency.

Wavelength: The distance from a point on one wave to the same point on the adjacent wave (ie. peak to peak or trough to trough).

White: An object will appear white if it emits all wavelengths equally.

Topic 7: Magnetism and Electromagnetism

Alternator: A device that makes use of the generator effect to generate alternating current.

Attraction: Opposite poles will experience a force of attraction, meaning they will experience a force towards each other. The force between a magnet and magnetic material is always one of attraction.

Current-Carrying Wires: When current flows through a wire, a magnetic field is generated around it. The strength of the field is dependent on the magnitude of the current and the distance from the wire.

Dynamo: A device that makes use of the generator effect to generate direct current.

Electric Motor: A current-carrying coil of wire in a magnetic field. The two sides of the coil that are perpendicular to the magnetic field experience forces in opposite directions, causing rotation.

Electromagnet: A solenoid with an iron core.

Fleming's Left-Hand Rule: A rule used to determine the orientation of the force (thumb), current (second finger) and magnetic field (first finger) when a current-carrying wire is placed in a magnetic field (motor effect).

Generator Effect: When there is relative motion between an electrical conductor and a magnetic field, a potential difference will be induced across the ends of the conductor. A current will flow if this conductor is part of a complete circuit.

Induced Magnet: A material that becomes a magnet when it is placed in an existing magnetic field, but loses its magnetism quickly once it is removed. Induced magnetism always produces attractive forces

Magnetic Compass: A device containing a small bar magnet that points in the direction of the Earth's magnetic field.

Magnetic Field Lines: Lines representing the strength and direction of a magnetic field. The field line direction at any point is in the direction that a force would act on another north pole if placed at that point.

Magnetic Field: The region around a magnet in which another magnet or magnetic material will experience a force.

Magnetic Materials: Iron, steel, cobalt and nickel.

Magnetic Poles: The regions of a magnet where the magnetic forces are at their strongest.

Microphone: A device that uses the generator effect to convert the pressure variations of sound waves into variations in the electrical current of a circuit.

Motor Effect: When a current-carrying wire is placed in a magnetic field, a force will be experienced between the wire and the magnet responsible for the field.

Permanent Magnet: A magnet that produces its own magnetic field. **Repulsion:** Like-poles will experience a force of repulsion, meaning they will experience forces in opposite directions.

Solenoid: A wire wrapped into the shape of a coil, that has a strong and uniform magnetic field inside of it. The solenoid's magnetic field strength can be increased by adding an iron core.

Step-Down Transformer: A transformer that has a smaller potential difference in the secondary coil than in the primary core.

Step-Up Transformer: A transformer that has a larger potential difference in the secondary coil than in the primary core.

Tesla: The unit of magnetic flux density.

Transformer: An iron core with a primary and secondary coil of wire wound around opposite ends.

Topic 8: Space Physics

***Artificial Satellites:** Man-made satellites that have been sent into space for purposes such as satellite imaging and communications.

***Big Bang Theory:** The currently accepted model for the origin of the universe. It suggests that the universe has expanded from an initially very small, hot and dense point.

***Circular Orbits:** Planets and satellites travel in circular orbits. Gravity provides the required force for these orbits.

***Dark Energy:** A hypothesised form of energy, believed to be responsible for the universe's ever increasing rate of expansion.

***Dark Mass:** A hypothesised type of mass that cannot be observed by current methods. It is used to explain why some galaxies rotate faster than they should for their observed mass.

***Main Sequence Star:** The stable state of all stars. The gravitational forces pulling the star together, and the pressure pushing outwards, are balanced.

***Milky Way Galaxy:** The galaxy in which our solar system is located.

***Natural Satellites:** The moons that orbit planets.

***Nebula:** A cloud of dust and gas.

***Protostar:** The first stage all stars go through after forming from a nebula. In this stage the star becomes hot enough for hydrogen nuclei to fuse.

***Red Giant Star:** When their hydrogen is used up and larger nuclei are produced by fusion, stars of a similar magnitude to the Sun will expand to form a red giant.

***Red-Shift:** The observed increase in the wavelength of the light emitted by distant galaxies. The more distant the galaxy, the faster it is moving and so the bigger the observed increase in wavelength.

***Star Life Cycle:** The stages that a star passes through in its lifetime, dependent on the size of the star relative to the sun.

***Sun:** A star formed from a cloud of dust and gas being pulled together by gravitational attraction. Fusion reactions occur in the sun.

***Supernova:** The explosion of a massive star, that distributes the elements created by the fusion reactions in the star, throughout the universe.

***White Dwarf:** When the fusion reactions in stars of a similar magnitude to the sun come to an end, the star will contract under gravity and cool down to form a white dwarf