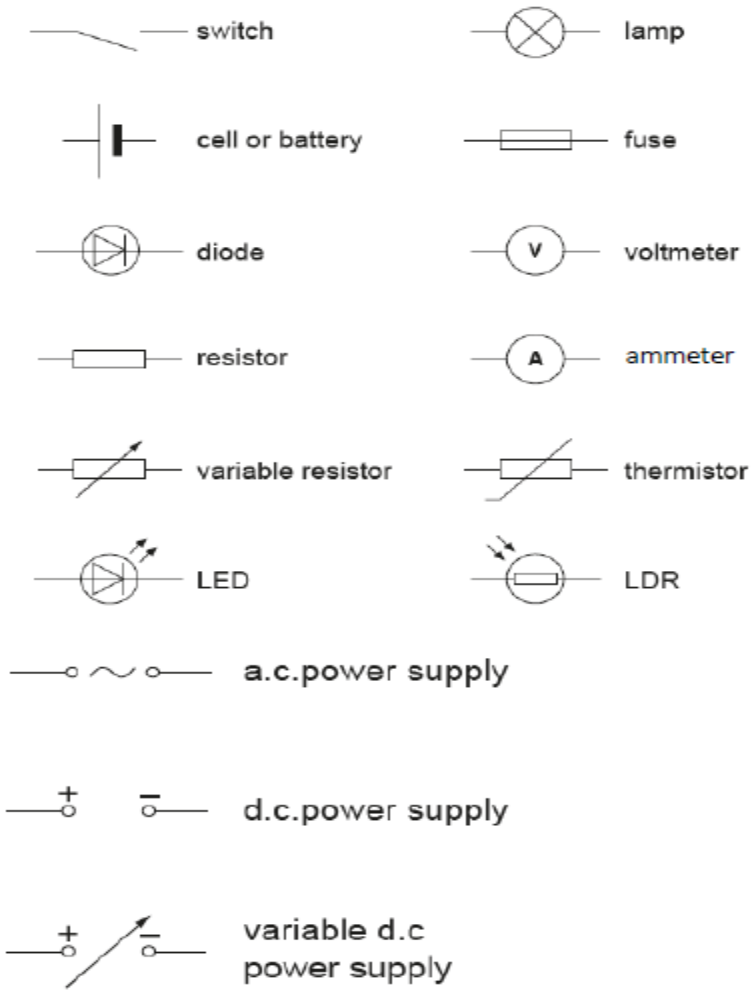
GCSE PHYSICS

UNIT 1 – ELECTRICITY, ENERGY AND WAVES

Section	Item	Definition
1.1(a)	Circuit symbols	
1.2(c)	Generating electricity	**In a fossil fuel power station -** Fuel is burned to heat water to make steam. The kinetic energy of the steam turns a turbine. The turbine then drives a generator which produces electricity.
1.2(d)	Efficiency	If something is 100% efficient then the input energy supplied is not lost or wasted. % efficiency is the % of the input energy transferred to useful output energy.
1.2(f)(g)	National Grid	The National Grid consists of a network of power stations, transformers / sub-stations and power lines all joined together supplying electricity to consumers. **Advantages** are: - it is a reliable supply - it maintains supply in the case of a breakdown - it can respond to changing demand - it has back-ups in case of demand or breakdown - it can import electricity from abroad if needed - it works 24 hours a day.

1.2(g)	Types of transformers	**Step-up transformers** increase voltage and decrease current so reducing energy losses in transmission lines making distribution more efficient. **Step-down transformers** reduce voltage to safer levels for consumers.
1.3(f)	Payback time	$\text{payback time} = \frac{\text{installation cost}}{\text{annual savings}}$
1.4(d)	a.c. and d.c.	An **alternating current** (a.c.) is one that continuously changes direction. A **direct current** (d.c.) has a constant direction.
1.4(e)	Fuse, mcb and rccb	**Fuse** – breaks the circuit when the current exceeds a set value. **Miniature circuit breakers (mcb)** can be easily reset and use an electromagnet to open a switch if the current goes above a certain value. **Residual current circuit breakers (rccb)** switch off the circuit when there is a difference between the currents in the live and neutral wires of the appliance. They are more sensitive than mcb breakers. mcbs protect the circuit whilst rccbs protect the user.
1.4(f)	Ring main, function of live, neutral and earth wires	**Live wire** carries current to the house/appliance at a high voltage. **Neutral wire** completes the circuit and carries current away at low / zero voltage. **Earth wire** is a safety wire that can carry current safely into the ground if a fault develops in a metal framed appliance. The **ring main** is a looped parallel circuit. There are several **advantages** of using a ring main circuit: - the cables can be made thinner because there are two paths for the current - each part of the cable carries less current because the current flows two ways - a ring main circuit is more convenient since sockets can be placed anywhere on the ring - each socket has 230 V applied and they can be operated separately.
1.5(a)	Transverse and longitudinal waves	In a **transverse** wave the vibrations are at right angles to the direction of wave travel. In a **longitudina**l wave the vibrations are parallel to the direction of wave travel.
1.5(b)	Amplitude and frequency	**Amplitude** is the maximum displacement from rest. **Frequency** is the number of cycles of a wave that occur in one second.
1.5(h)(i)	Electromagnetic spectrum	The 7 regions of the spectrum are; Radio waves / microwaves / infra-red / visible / ultraviolet / X-rays / gamma rays. All regions of the spectrum are transverse waves, they travel at the same speed in a vacuum and transfer energy. Radio waves have the longest wavelength and lowest frequency. The different regions have different uses. UV, X-rays and gamma rays are ionising. Gamma is the most ionising and UV the least.
1.5(l)	Satellites	A **geosynchronous** satellite has an orbit time of 24 h however the object in this orbit only returns to exactly the same position in the sky after a period of one day. A **geostationary** orbit is a particular type of geosynchronous orbit. The distinction being that an object in a geosynchronous orbit returns to the same point in the sky at the same time each day, an object in geostationary orbit never leaves that position. A base station can be in constant communication with a geostationary satellite but only once every 24 h with a geosynchronous satellite.
1.6(a)	Conditions for TIR	Angle of incidence greater than the critical angle and movement from a more dense to a less dense material.

1.6(d)	Use of optical fibres for remote imaging	Endoscopy uses optical fibres and CT scans use X-rays. Endoscopy is used to investigate specific areas of the body and it is less harmful than CT scans. CT scans are used to generate more overall images of the body and are a higher risk than endoscopes. CT scans are 3D.
1.7(a)	Properties of P, S and surface waves	**P waves** are the fastest, longitudinal and they travel through both solids and liquids. **S waves** are transverse and they can only travel through solids. **Surface waves** are the slowest, longitudinal, travel along the surface and cause the most damage.
1.8(f)	Specific heat capacity and specific latent heat of fusion	**Specific heat capacity** is the amount of heat energy required to increase the temperature of 1 kg of a substance by 1 ^{o}C. **Specific latent heat of fusion** is the amount of heat energy needed to change a mass of 1 kg of the substance from a solid at its melting point into a liquid at the same temperature. **Specific latent heat of vaporisation** is the amount of heat energy required to change 1 kg of a liquid at its boiling point into a vapour without a change in temperature. The term latent means that the energy supplied does not raise the temperature of the substance but it is used to enable the change of state to take place [per kg]. The term “fusion” refers to the change from a solid to liquid at its melting point and the energy supplied goes into breaking bonds between molecules. In the case of fusion, only a small number of bonds are broken. The latent heat of vaporisation refers to a liquid changing to a gas and is always a much larger value because the change requires a much larger number of bonds to be broken.
1.9(b)	Fleming’s left hand rule	First finger = direction of magnetic field (N $\rightarrow$ S) Second finger = direction of current (+ $\rightarrow$ -) Thumb = direction of motion
1.9(h)	Transformer	A changing current in the primary coil sets up a changing magnetic field in the primary coil which induces a voltage in the secondary coil.

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UNIT 2 – FORCES, SPACE AND RADIOACTIVITY

2.2(b)	Newton's 1st law	**HT only state** - that an object will remain at rest or in uniform motion in a straight line unless acted upon by an external resultant force.
2.2(d)	Newton's 2nd law	**HT only state** - resultant force = mass × acceleration; $F = ma$
2.2(g)	Newton's 3rd law	**HT only state** - if a body A exerts a force on body B then body B exerts an equal and opposite force on body A.
2.3(h)	Energy efficiency of vehicles	**Aerodynamic losses** reduced by more streamlined designs. **Rolling resistance** is reduced by having correctly inflated tyres and using materials which don't heat up as much as they are squashed. **Stop – start systems** reduce idling losses. **Inertial losses** are reduced by having lighter cars.
2.3(i)	Safety features	In terms of **work done:** i.e. an air bag and a crumple zone increase the distance over which the energy is transferred, so reducing the force. In terms of **momentum**: i.e. the same change in momentum happens over a longer time so there is decreased deceleration so the force decreases.
2.4(c)	Conservation of momentum	The momentum before (an interaction) = momentum after (interaction) provided no external forces act.
2.4(e)	Principle of moments	For a body in equilibrium the sum of the clockwise moments = the sum of the anticlockwise moments about the same point.
2.5(a)	Features of the solar system	Order of the planets: Mercury / Venus / Earth / Mars / Jupiter / Saturn / Uranus / Neptune. Asteroid belt located between Mars and Jupiter. Mercury / Venus / Earth / Mars are the rocky planets (the inner planets). The remaining planets (the outer planets) are made from gas.
2.5(b)	AU and light years	1 A.U. is the mean distance from the Sun to the Earth. 1 light year is the distance that light will travel in 1 year.
2.5(c)	Life cycle of a star	**Stars of a similar mass to the Sun –** Protostar → main sequence star → red giant → white dwarf **High mass star –** Protostar → main sequence star → supergiant → supernova → neutron star or black hole
2.5(d)	Stability of stars	In the main sequence the forces acting on a star are balanced. Gravitational inward forces match the outwards combination of gas and radiation pressure forces. When the hydrogen reduces the star will begin to fuse helium and then other increasingly heavier elements to maintain fusion. The star will begin to swell as the combination of gas and radiation pressure exceeds the gravitational force and the forces become unbalanced. Eventually the gravitational force exceeds the combination of gas and radiation pressure and the star shrinks.
2.5(e)	Return of heavy material	Heavy elements which are created in fusion in large stars are ejected during supernovae.
2.5(f)	Origin of the solar system	Gravitational forces cause the matter to get closer together creating the Sun and the planets. During formation rocks tended to gather close to the Sun and formed the rocky planets whilst gaseous substances gathered together at distances further away and formed the gas planets.
2.6(a)	Absorption spectra	Absorption lines arise from gas atoms in a star's atmosphere absorbing specific wavelengths of visible light. The wavelengths absorbed are specific to the elements present in the star.

2.6(b)/(c)	Cosmological red shift	Wavelengths of the absorption lines are increased and this effect increases with distance. The light from further galaxies shows the most red shift due to it having travelled for a greater amount of time through an expanding universe. Therefore increasing the wavelength.
2.6(e)	CMBR and the Big Bang	The wavelength of the early radiation in the form of short wavelength radiation (gamma rays) has become longer wavelength (microwave) radiation. This change (increase) in wavelength is believed to be due to the expansion of space since the Big Bang.
2.7(a)	Isotope	Isotopes of the same element have equal numbers of protons but differing numbers of neutrons in their nuclei.
2.7(b)	Unstable nuclei	Radioactive emissions occur from unstable atomic nuclei due to an imbalance between the numbers of protons and neutrons in the nucleus.
2.7(e)	Radioactive decay	This is a random process.
2.7(g)/(h)	Types of radiation	alpha radiation = helium nucleus: $^{4}_{2}\mathrm{He}^{2+}$ or $^{4}_{2}\alpha$ beta radiation = high energy electron: $^{0}_{-1}\beta$ or $^{0}_{-1}\mathrm{e}$ gamma radiation = electromagnetic wave: γ
2.8(b)	Half-life	It is the time taken to halve the number of radioactive atoms / nuclei.
2.9(b)	Moderator and control rods	**Control rods** are arranged to absorb neutrons so that for every two or three neutrons that are released from a fission reaction, only one (on average) goes on to produce further fission. The **moderator** slows down fast moving neutrons to enable absorption by U-235 nuclei to occur.
2.9(d)	Nuclear fusion	Requires very high temperatures and pressures.