# GCSE Separate PHYSICS – Extra Key ideas

| 1. ENERGY | |
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| There are no extra facts in this topic for separate sciences. | |

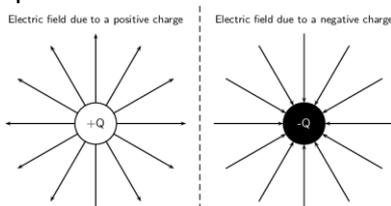| 2. ELECTRICITY (Static Electricity) | |
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| When certain insulating materials are rubbed against each other they become charged due to electron transfer | When electrons are rubbed onto a material, it will become negatively charged. When electrons are rubbed off a material, it will become positively charged. |
| Two charged objects will exert a force on each other. Like charges repel and unlike charges attract. This is an example of a non-contact force. | A charged object creates an electric field around itself. The field is strongest close to the charged object. |
| A second charged object placed in the field of a charged object experiences a force. The force gets stronger as the distance between the objects decreases. | The electric field pattern around an isolated charged sphere looks like this:  |

| 3. PARTICLE MODEL OF MATTER | |
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| A gas can be compressed or expanded by pressure changes. The pressure produces a net force at right angles to the wall of the gas container. | Increasing the volume in which a gas is contained, at constant temperature, causes a decrease in pressure. This is due to the gas molecules hitting the surface of the container less often. |
| Use this equation, which is given on the equation sheet:<br>**Pressure × volume =constant**<br>$pV = constant$<br>pressure, $p$, in pascals, Pa<br>volume, $V$, in metres cubed, $m^3$ | HIGHER TIER ONLY<br>Doing work on a gas increases the internal energy of the gas and can increase the temperature e.g. doing work on an enclosed gas, such as a bicycle pump, increases the temperature of the gas |

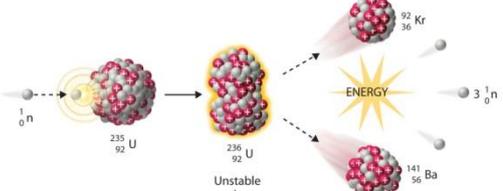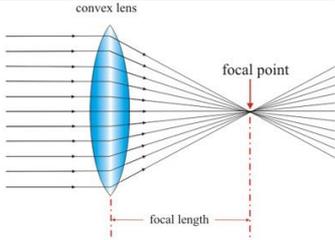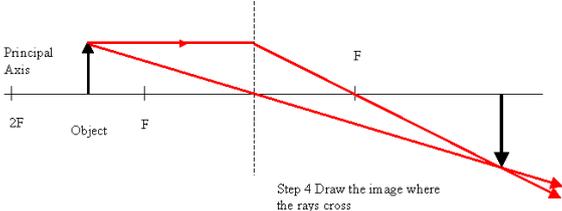| 4. ATOMIC STRUCTURE | |
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| Background radiation is around us all the time. Natural sources of background radiation are rocks and cosmic rays. Man-made sources are fallout from nuclear weapons testing and nuclear accidents. | The level of background radiation and radiation does may be affected by occupation and/or location. Radiation does is measured in Sieverts (Sv)<br>1000mSv = 1Sv |
| Radioactive isotopes have a wide range of half lives. | Nuclear radiations are used in medicine for the: exploration of internal organs control or destruction of unwanted tissue. |
| The half life of a medical tracer must be long enough to be detected but not too long as it is hazardous in the body. | Sources of gamma (or beta) radiation can be used as medical tracers e.g. for monitoring the function of a patient's kidneys. Gamma is not too ionising (hazardous) and can be detected through the body. |
| Nuclear fission is the splitting of a large and unstable nucleus (eg uranium or plutonium). | Spontaneous fission is rare. Usually, for fission to occur the unstable nucleus must first absorb a neutron. |
| The nucleus undergoing fission splits into two smaller nuclei, roughly equal in size, and emits two or three neutrons plus gamma rays. Energy is released by the fission reaction. | All of the fission products have kinetic energy. The neutrons may go on to start a chain reaction. In a nuclear reactor, the chain reaction is controlled to control the energy released. The explosion |

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|  | caused by a nuclear weapon is due to an uncontrolled chain reaction. |
| Nuclear fusion is the joining of two light nuclei to form a heavier nucleus. Some of the mass may be converted into the energy of radiation. | |

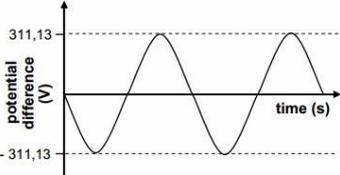| 5. FORCES | |
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| A force or a system of forces may cause an object to rotate. | The turning effect of a force is called the moment of the force.  Recall and use this equation:<br>**M = Fd**<br>M = moment of force (Nm)<br>F = Force (N)<br>d = perpendicular distance from the pivot to the line of action of the force (m) |
| If an object is balanced, total clockwise moments = total anticlockwise moments | A simple lever and a simple gear system can both be used to transmit the rotational effects of forces. Students should be able to explain how levers and gears transmit the rotational effects of forces. |
| A lever increases the distance to the pivot, this multiplies the effect of the effort force. | Gears are like levers because they multiply the effect of a turning force.  When a car is in a low gear, a small gear wheel turns a larger gear wheel. |
| A fluid is a liquid or gas.  Pressure in fluids causes a force that is normal (at right angles to) any surface | Recall and use this equation to calculate pressure at the surface of a liquid:<br>**p = F/A**<br>p = Pressure (pascals)<br>F = Force (newtons)<br>A = area (metres squared) |
| HIGHER TIER ONLY<br>Use this equation (given on equation sheet) to calculate the pressure due to a column of liquid:  **p = h$\rho$g**<br> p= pressure (pascals)<br>h = height of column (metres)<br>$\rho$ = density (kg/m$^3$)<br>g = gravitational field strength (N/kg) | HIGHER TIER ONLY<br>In a liquid, pressure at a point increases with the height of the column of liquid above that point and with the density of the liquid. |
| HIGHER TIER ONLY<br>A partially (or totally) submerged object experiences a greater pressure on the bottom surface than on the top surface. This creates a resultant force upwards called upthrust. | HIGHER TIER ONLY<br>An object floats when its weight is equal to upthrust. It sinks when its weight is greater than upthrust. |
| The atmosphere is a thin layer (relative to the size of the Earth) of air round the Earth. The atmosphere gets less dense with increasing altitude. | Air molecules colliding with a surface create atmospheric pressure. |

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| The number of air molecules (and so the weight of air) above a surface decreases as the height of the surface above ground level increases.  Atmospheric pressure decreases with increase in height because there is less air above a surface at a higher height. | |
| Draw v-t graphs for objects that reach terminal velocity.  Interpret changing motion in terms of forces acting. | F = ma and a = (v-u)/t can be combined to give the equation F = mΔv/Δt.  This equation is given on the equation sheet<br>F = force (N)<br>m = mass (kg)<br>Δv = change in velocity (m/s)<br>Δt = change in time (s) |
| Safety equipment including air bags, seat belts, gymnasium crash mats, cycle helmets and cushioned surfaces for playgrounds increases the time taken for a particular change in momentum to happen. This reduces impact force. | Estimate how the distance for a vehicle to make an emergency stop varies over a range of speeds. Interpret graphs relating speed to stopping distance for a range of vehicles. |
| | A change in momentum occurs when a force acts on an object that is moving, or is able to move. |

| 6. WAVES | |
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| Show how changes in velocity, frequency and wavelength, in transmission of sound waves from one medium to another, are inter-related. | Waves can be reflected at the boundary between two different materials. Waves can be absorbed or transmitted at the boundary between two different materials. |
| Ray diagrams can be used to illustrate reflection of a wave at a surface. | Sound waves cause the ear drum and other parts of the ear to vibrate. This only happens over a certain range of frequencies. |
| The range of normal human hearing is 20Hz to 20kHz | Ultrasound waves have a frequency greater than 20kHz (above the upper limit of human hearing) |
| Ultrasound waves are partially reflected when they meet the boundary between two different media. The time takenfor the reflections to reach a detector can be used to determine how far away the boundary is. Ultrasound is used for medical and industrial imaging. | Seismic waves are produced by earthquakes.  P-waves are longitudinal and travel at different speeds through solids and liquids.  S-waves are transverse and cannot travel through liquids. P-waves and S-waves give evidence for the structure and size of the Earth's core. |
| Echo sounding, using high frequency sound waves is used to detect objects in deep water and measure water depth. | |
| Lenses form images by refraction of light. | A **converging** (convex) lens focuses parallel rays to a point called the principal focus.  The distance from the lens to the principal focus is called the focal length. |

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| A real image can be formed on a screen. A virtual image cannot be formed on a screen.<br>The image formed by a convex lens can be either real or virtual. The image formed by a concave lens is always virtual. |  |
| Use this equation (given on equation sheet):<br>Magnification = image height/ object height<br>Magnification is a ratio and so has no units. | In ray diagrams a convex lens will be represented by:<br><br>A concave lens will be represented<br><br>by: |
| Ray diagrams can be used to find the position and size of an image<br> | Each colour in the visible spectrum has its own narrow band of wavelength and frequency. Colour filters absorb certain wavelengths and transmit others. The colour of an opaque object depends on which wavelengths of light are more strongly reflected. For white objects, all wavelengths are reflected equally. For black objects, all wavelengths are absorbed. |
| **Specular reflection**: Reflection from a smooth surface in a single direction. **Diffuse reflection**: Reflection from a rough surface causes scattering. | Objects that transmit light are either transparent or translucent. |
| All bodies (objects) emit and absorb infra-red radiation. The hotter a body is, the more infra-red radiation it radiates in a given time. The intensity and wavelength distribution of any emission depends on temperature. | A perfect black body absorbs all of the radiation that is incident on it. It does not reflect or transmit any radiation. It would also be the best possible emitter. |
| HT ONLY A body at constant temperature is absorbing radiation at the same rate as it is emitting it. The temperature of a body increases when the body absorbs radiation faster than it emits radiation. | (HT only) The temperature of the Earth depends on many factors including: the rates of absorption and emission of radiation and reflection of radiation into space. |

| 7. MAGNETISM AND ELECTROMAGNETISM |
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| Loudspeakers and headphones use the motor effect to convert variations in current in electrical circuits to the pressure variations in sound waves. | Devices such as electromagnetic relays and electric bells use electromagnets. |
| The generator effect: A potential difference is induced between the ends of a conductor if an electrical conductor moves relative to a magnetic field or if there is a change in magnetic field around a conductor. A current flows if the conductor is part of a complete circuit. The induced potential difference is bigger if the magnetic field is stronger or the movement is faster. | The size of the induced potential difference depends on the magnetic field strength and the speed of movement. The direction of induced potential difference depends on the direction of movement. |
| An induced current generates a magnetic field that opposes the original change, either the movement of the conductor or the change in magnetic field. | The generator effect is used in an alternator to generate ac and in a dynamo to generate dc. Explain how a dynamo and an alternator work. |
| A graph of the output from an alternator looks like | Microphones use the generator effect to convert the |

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| this:<br> | pressure variations in sound waves into variations in current in electrical circuits. |
| A transformer consists of a primary coil and a secondary coil wound on an iron core. A step-up transformer increases potential difference and a step-down transformer decreases potential difference. | Use this equation (given on equation sheet):<br>$Vp/Vs = Np/Ns$<br>$Vp$ = potential difference across primary coil<br>$Vs$ = potential difference across secondary coil<br>$Np$ = number of coils on primary coil<br>$Ns$ = number of coils on secondary coil |
| An alternating current in the primary coil of a transformer has an alternating magnetic field around it. This causes an alternating magnetic field in the iron core. This then induces an alternating potential difference between the terminals of the secondary coil. | Use this equation (given on equation sheet):<br>$Vs \times Is = Vp \times Ip$<br>$Vs \times Is$ is the power output (secondary coil) (Watts)<br>$Vp \times Ip$ is the power input (primary coil) (Watts)<br><br>(for 100% efficient transformer) |
| Transmitting electrical power at a higher voltage is more efficient as it reduces the current, and therefore reduces heat losses. | |

| 8. SPACE PHYSICS | |
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| Our solar system is made of one star (the Sun), eight planets, the dwarf planets and the natural satellites (the moons that orbit planets) | Our solar system is part of the Milky Way galaxy |
| The Sun was formed from a cloud of dust and gas (nebula) pulled together by gravitational attraction. This then caused fusion reactions that led to equilibrium between the gravitational collapse of a star and the expansion of a star due to fusion energy. | Stars go through life cycles dependent on the size of the star:<br>Life cycle for a low mass star (eg the Sun) is:<br>Protostar→ main sequence star → red giant → white dwarf → black dwarf.<br>Life cycle for a high mass star is:<br>Protostar→ main sequence star → red super giant → supernova → neutron star or black hole (if v.high mass) |
| Fusion in stars produces all of the naturally occurring elements. Elements heavier than iron are produced in a supernova (the explosion of a massive star). This distributes the elements throughout the universe. | Gravity provides the force that keeps planets and satellites (artificial and natural) in circular orbits.<br>HT: The force of gravity causes changing velocity (due to change in direction) but unchanged speed |
| HT: for a stable orbit, the radius must change if the speed changes. | |
| There is an observed increase in the wavelength of light from most distant galaxies. The further away the galaxies, the faster they are moving and the bigger the observed increase in wavelength. This effect is called red-shift. | Red-shift provides evidence that the Universe is expanding and supports the Big Bang Theory (the Universe began from a very small region that was extremely hot and dense) |
| From 1998 onwards, observations of supernovae suggest that distant galaxies are receding ever faster. | There is still much about the universe that is not understood (e.g. dark mass and dark energy) |