PHYSICS IGCSE REVISION GUIDE.

This is to help you cover all the parts of the course. Use this with the syllabus and your notes. When you need to use your books use the index to find the relevant chapters.

Strength of Solids.

Stretching springs, Hookes Law (F = k x ext), Elastic behaviour means returning to shape. Plastic behaviour not returning to shape. Elastic Limit. Forces between atoms are like springs, Using Hookes law for wires. Tension and compression in bridges and other simple structures.
Turning Effects (moments) = F x D , unit Nm, Newtonmetres. No overall moment if clockwise moment = anticlockwise moments. Questions for see-saws and other structures.
Vectors having size and direction (e.g. forces). Scalars only having size (e.g. mass). Adding vectors as nose to tail arrows or as the sides of a parallelogram with the diagonal the total vector.

Particles in Motion.

Kinetic theory meaning particles in motion. Hotter means faster. Increasing heat and molecular speed breaking bonds to change state. Cooling, losing heat and decreasing speed to make bonds to change state. Names of 6 state changes. Diagrams of solids, liquids and gases. Evaporation causing cooling, losing particles at the surface of the liquid.
Evaporation increased by temperature, surface area and wind with reasons why in terms of particles leaving the liquid.
Density units, water as I g/cm^3 =1000 kg/m^3. Volume of irregular shapes found by immersion.
How movement of gas particles causes air pressure. Why hotter, faster molecules cause more pressure at the same volume, and cause expansion by making the same pressure at higher volume. Pressure is proportional to Kelvin temperature.(p= k x T). Changing Kelvin into Celcius. (C+273=K). Absolute zero as still gas molecules with zero kinetic energy at -273° C and zero Kelvin.

Motion.

Equations of speed = distance $^{\text{covered./time}}$ taken, and acceleration = change of speed/time taken with units of metres, seconds, m/s and rn/s^2. Average speed as middle speed between two extremes. Deceleration with negative acceleration values.
Distance-time graphs showing stationary and steady speeds with constant slopes. Meaning of gradient of graph as speed.
Speed-time graphs showing stopped, steady speeds, acceleration and deceleration.
Distance as area under the speed-time graph in the units used. Gradient as acceleration.
Distance travelled for accelerating objects as $^1/_2$acc. x time2. Used for falling objects with acc = 1ON/kg= $10m/s^2$.
Velocity changing for objects moving in circles at a steady speed, with an acceleration to the centre of the circle due to a centripetal force.
Times for experiments always inaccurate so repeating and averaging giving more accuracy.
Ticker timers making dots every 0.02s, examples showing steady speed and acceleration and used to measure speed.

Force and Motion.

How opposing forces cause acceleration, deceleration or constant speed (including stopped) in their direction. Forces on moving cars and falling objects (parachute) affecting their motion. F = mass x acceleration, mass in kilograms, force in Newtons, with F = difference between opposing forces. Top speed due to air resistance and friction increasing to equal engine forces.
Forces act in pairs with equal size but opposite directions, so forces must act on two objects.

Energy Transfer.

Energy never created or destroyed, only changed to other forms. Energy in Joules. Active energies: Heat, Sound, Kinetic, Electric, Light.
Potential energies: Gravitational, Elastic, Chemical, Nuclear, (Magnetic).
Difference and definition of each of these.
Machines (transducers) changing energy type but with waste to other forms. Efficiency as useful output/ total input x 100%. Common objects as energy change devices.
Energy changed = work done = F x D in the direction of the force, so 1 Joule = 1 Newtonmetre.
Gravitational potential energy changed = mass x g(10) x height fallen.
Force multipliers increasing the force put in, e.g. spanners, jacks, pulleys, levers, although useful energy output still decreases (inefficient)
Pressure in different units. 1 Pascal as $1N/m^2$. Sharp objects with high pressure as low area. Hydraulic machines as force multipliers if their piston area increases as the pressure of internal liquid stays the same at each piston.
Power = energy changed/time taken (in Watts or Joules per second).
Engines examples as petrol/diesel (internal combustion), muscles, jet, steam all changing chemical-kinetic.

Transferring Energy by Heating.

Heat travels from Hot to Cold by Conduction, Convection or Radiation. Temperature as amount of hotness.
Conduction as kinetic energy transferred from particle collisions. Metals as good conductors using electrons to carry energy. Non metals, liquids, gases as poor conductors (insulators). Vacuum as a perfect insulator as no collision is possible.
Convection as movement of liquids and gases due to expansion and fall in density causing rising. Cooler liquids and gases falling causing convection currents. Currents in cookers and fridges. Radiation as electromagnetic Infra Red rays being beamed from objects. Black is best at emission and absorption. Shiny surfaces radiate less, and reflect better so absorb less.
IR cameras used to spot hotter objects in the dark.
Design of houses, clothes, engines, to increase or decrease heat loss by these processes.
Latent heat as heat given to liquid at boiling point or solid at melting point to break bonds and change state instead of increasing temperature. Graphs of time against temperature for this.
E = m x c x T for specific heat. Materials with large c taking more heat to warm but releasing more to cool, water as an example. Unit of c as J/Kg/ ˚C.

Using Electricity.

Current as the movement of negative electrons through electrical conductors from negative (excess of electrons) to positive (lack of electrons). Conventional current from positive to negative. Current as charge passing per second. Charge in Coulombs.
Ammeters placed in series with the circuit. Current the same at all points in a series circuit. Sum of current before a junction always equal to sum of current after the junction in a parallel circuit.
Electrostatics as the charging of insulators by friction. Charged objects able to attract neutral conductors by " charging by induction" by making the conductor oppositely charged near to them, and similarly charged further away so overall force is attractive. Uses and dangers of electrostatics, painting, photocopying, collecting smoke, causing sparks.

Energy and Electricity.

Potential difference or voltage measured in Volts as Joules per Coulomb given to current by supplies or cells, or used by bulbs, resistors or motors.
P.d. in series: sum of voltages added together = supply voltage.
P.d. in parallel: all voltages = supply voltage (as each electron in the current only passes through one component).
Voltmeters placed in parallel with components, and have high resistance so no current passes through them.
R=V/1 as the ease current passes through an object. Ohms law as Resistance is constant for resistors at the same temperature so voltage is proportional to current. For a set voltage(supply) high R means low current. Graph of V, I for a resistor.
R_{total} = R1 +R_2 for 2 resistors in series. R_{tow} = (R_1 x R_2)/(R_i+ R_2) for parallel. Always smaller than the smallest of the two so more current can flow.
Power= V x I = V^2/R= I^2 x R.
Resistance of wire proportional to length and decreases with increasing area/diameter. Temperature increasing the resistance of metal resistors by increasing atomic vibration to make current flow more difficult.

Waves.

Waves as time delayed oscillations that transfer energy without the transfer of the oscillating material. Energy transfer perpendicular to wavefront.
Wavefront a line of similar oscillation (e.g. peak, trough, compression).
Amplitude as maximum distance of movement (oscillation) from the central position.
Wavelength (metres)as length of wave from similar positions on adjacent waves. Wave speed as speed of movement of wavefront/energy.
Frequency (Hertz) as number of oscillations per second.
Frequency =^{1}/time of one oscillation. Wavespeed = f xX. Higher frequencies having shorter wavelengths as the waves have less time to travel away.
Transverse and longitudinal waves, definitions(energy transfer and oscillation directions) and examples. Reflection, refraction and total internal reflection as wave properties. Refraction due to the speed change of waves at a boundary of materials.

Light and Sound, Making Use of Waves.

i) Light.
Angle of incidence = angle of reflection. Formation and position of images due to reflection. Normal as line perpendicular to mirror. Direction of refraction at fast/slow and slow/fast changes, depending on which side of ray slows first. Refraction of light at a rectangular glass block (with some reflection), at a triangular prism (with light spectrum formed due to difference of light speeds in glass), at a convex lens. How refraction moves images for straight boundaries. Real image as picture of an object through a lens that can be projected onto a screen. How the lens refracts light to converge rays. Total internal reflection for rays travelling from slow to fast materials if the angle between incident ray and normal is large (for glass to air >42°). Diagrams of total reflecting prisms for 90° and 180° deviations. Use of T.I.R. in optical fibres and uses in communication and medicine.
Red, green, blue as primary colours. R+G+B= white. Secondary colours:R+G= Yellow, R+B= Magenta, B+G= Cyan. How filters block light, how objects appear the colour they are in white light. How coloured objects appear in different colour lights.
Electromagnetic spectrum having the same wavespeed as light (300,000km/s), but with different frequencies and wavelength. Higher frequencies with more energy making them more dangerous to humans. Radio for communication. Infra red as heat radiation and used in remote controllers. Ultra violet as sun burn and banknote identity. X-rays for detecting breaks in bones and other solid objects. Gamma as nuclear radiation.

ii) Sound.
Sound having reflection, refraction and TIR properties. Frequency as pitch with close waves on a CRO. Amplitude as loudness (if pitch is audible), taller waves on CRO. Wavelength as distance between compressions or rarefactions. Audible frequencies between 20Hz and 20kHz. Above this ultrasound. Noise measured in decibels, decreased by distance, soft absorbent materials and reflective surfaces. Speed of sound through solids faster than liquids, liquids faster than gases. There must be a medium to oscillate, so a vacuum does not allow sound to pass through it.
Earthquakes having seismic P (primary waves) that travel faster than S(secondary waves). P waves longitudinal. S waves transverse, that cannot pass through the liquid central core of the Earth.

Kinetic Energy and Momentum.
K.E. as energy due to movement $= ^1/_2$ mass x (velocity)^2. For an accelerating object work done = F x D = gain in K.E. For falling objects change of gravitational energy = mass x g x height difference = K.E. change.
Momentum = mass x velocity. For recoil the momentum of fired object = momentum of recoiling object, so larger object moves slower.
For a collision, the total momentum before the collision = total momentum after, so things slow down when they hit other things.

Gravity.
Mass is the amount of material in an object, and does not vary with position. Mass of a object attracts the mass of other objects. The more mass, the more force. As the separation of centres of masses increases, the force decreases.
Weight is the force of gravity, acting to the centre of the attracting mass. This alters with position in the universe. W = mass x g where g = gravitational field strength, the force on lkg, N/kg or the acceleration due to gravity caused with no opposing forces. On Earth g = ION/kg = $_{IOM}/_{S}2$. Air resistance as the friction force opposing movement due to the motion of air over the object. Air resistance increasing with speed and area of object. Aerodynamics as the lessening of this force. Air resistance = weight for objects falling at a steady speed. Satellites orbiting due to gravity changing their direction of movement exactly enough to form a circle. The lower the orbit the faster the movement. Geostationary or geosynchronous satellites orbiting over the equator with a 24 hour orbit time used for communication and satellite television broadcast.

Magnetism and Electricity.
Magnetic field as an area of magnetic effect, field lines showing the way the N pole of a compass would point if placed there. North poles pointing to the geographical north of the Earth if free to rotate. Lines never crossing, going from the N to S of magnets. Similar poles repelling, opposite poles attracting. Both poles attracting iron and steel by inducing magnetism into the metal. An electromagnet as a coil of current carrying wire wrapped around an iron core. Able to be controlled and much stronger than permanent magnets. Strength depending on number of coils, core and current. Same field shape as bar magnet. Relay as a magnetic switch using low currents to control (dangerous) high currents. Fleming's left hand motor rule showing direction of force on wire at right angles to field lines and current (from + to -). Motor construction and factors increasing strength.
Electromagnet induction as the creation of electric current when a conductor cuts a field line or a magnet is moved into a coil. Alternators producing alternating current (a.c.) as a rectangular coil rotates in a parallel magnetic field.

Energy Distribution.
Power stations using a fuel or nuclear reactor to produce steam to rotate a turbine that drives an alternator/ generator. Transformers using electromagnetic induction to change voltages and currents. A.C. must be used to change magnetism and cut field lines. Power lines with high voltages and low currents to reduce power loss in the wires.
Hydraulics used in jacks and car braking systems with constant pressure at both pistons to increase force.

Communication.

Communication largely as transfer of sound wave. Analogue as sound transferred to current sizes in wires. Digital as sound converted to a 0 orl code, sent down an electrical cable or a light signal sent down a fibre optic cable. Digital giving higher quality signals and with more signals able to be sent down a similar sized cable. Microphone inducing current by the oscillation of a diaphragm by the sound. Speaker oscillating due to changing size of force between a magnet and a current varying electromagnet. A. M. radio carrying an analogue signal on a much higher frequency carrier wave.

Electrons.

Electrons can be given off by a hot filament due to heat increasing the atomic vibration. These electrons can be repelled if the filament is a cathode (negative) and there is a anode(positive) to attract them at high voltage through a vacuum. This current can only flow in one direction so it is a diode (electric one-way valve). These electrons can be made into a beam by passing through a hole in the cathode, and this negatively charged beam can be moved by + and - plates, or magnetic fields as it is also a current of electrons. **CRO** uses + and - plates. Television uses electromagnets to make the beam produce pictures as they give off light when they strike the fluorescent screen.

Movement of electrons causing electrostatics and electric current and useful in electronics and computing.

Radioactivity.

Unstable nuclei (nucleuses) of atoms change by throwing out alpha, beta and gamma radiation. Each one can knock off electrons from atoms to cause ions and so are called ionising radiation. They have different compositions, penetrating powers and ionising powers. The radiation is detected by causing ionisation in a Geiger-Muller(GM) tube which counts the individual electric currents produced, giving a rate in counts per second. There is always background radiation, due to rocks, the sun, nuclear testing and nuclear waste. A nucleus will decay randomly, so for large numbers half of the nuclei of any source will decay in a set time called the half life. The count rate from a source will also fall with the same half life. Radiation can be used for killing cancer cells, sterilising food and equipment, measuring the thickness of things, and tracing movement. The source will need the correct penetration and half life. The ionisation caused by radiation can increase the risk of cancer and birth defects if it alters DNA.

Energy Resources.

Sources supply us with the energy we need in our life. Fossil fuels (coal, oil, gas) and nuclear fission (uranium) as major sources of electricity. Non-renewable and causing problems. Alternative sources (biomass, solar, hydroelectric, wave, tidal, geothermal) renewable but with their own problems.
Nuclear fission as the splitting of large nuclei in power stations. Nuclear fusion as the joining of smaller nuclei, as in stars, as the alternative that will solve the world's energy problem if developed (being researched).

Electronics.

Electrons can detect changes in sensors due to changes in their resistance, and can be used logically in gates and chips solve problems.

LDR, light dependent resistor with high resistance at low light levels. Thermistor having high resistance when cold. Moisture sensor with low resistance when wet. Pressure sensor as a switch with low resistance when pressed. **AND** gates giving a 1 output if A and **B** inputs are 1. **OR** gates giving a 1 output if A or **B** inputs are 1. **NOT** gate giving a 1 output if the input is not 1(0).

The reed switch taking the small currents given off by sensors or logic gates and using magnetism to control large currents to operate devices like lights or machinery. Computers using silicon chips as an essential part of our modern lives

REMEMBER.

Learn all the equations or their triangles, but only write Equation
Numbers in the correct unit
Calculate using your calculator to 3 s.f and
adding the correct
Unit to the anwer.