Important Equations in Physics for IGCSE course

General Physics:

1	*For constant motion:*	$v = \frac{s}{t}$	*'v' is the velocity in m/s, 's' is the distance or displacement in meters and 't' is the time in seconds*
2	*For acceleration 'a'*	$a = \frac{v - u}{t}$	*u is the initial velocity, v is the final velocity and t is the time.*
3	*Graph*	*Area of a rectangular shaped graph = base × height.* *Area of triangular shaped graph = ½ × base × height*	*In velocity-time graph the area under the graph is the total distance covered by an object.*
4	*Weight and mass*	$w = m \times g$	*w is the weight in newton (N), m is the mass in kg and g is acceleration due to gravity = 10* m/s^2
5	*Density 'ρ' in* kg/m^3	$\rho = \frac{m}{V}$	*m is the mass and V is the volume*
6	*Force F in newton (N)*	$F = m \times a$	*m is the mass and a is the acceleration*
7	*Terminal Velocity*	$Weight\ of\ an\ object (downward) = air\ resistance\ (upwards)$	
8	*Hooke's Law*	$F = k \times x$	*F is the force, x is the extension in meters and k is the spring constant.*
9	*Moment of a force in N.m*	$moment\ of\ force = F \times d$	*F is the force and d is the distance from the pivot*
10	*Law of moment or equilibrium:*	$Total\ clockwise\ moment = total\ anticlockwise\ moment$ $=> F_1 \times d_1 = F_2 \times d_2$	
11	*Work done W joules (J)*	$W = F \times d$	*F is the force and d is the distance covered by an object*
12	*Kinetic Energy* E_k *in joules (J)*	$E_k = \frac{1}{2} \times m \times v^2$	*m is the mass(kg) and v is the velocity (m/s)*
13	*Potential Energy* E_p *in joules (J)*	$E_p = m \times g \times h$	*m is the mass (kg) and g is the acceleration due to gravity and h is the height from the ground.*
14	*Law of conservation of energy:*	$Loss\ of\ E_p = gain\ of\ E_k$ $m \times g \times h = \frac{1}{2} \times m \times v^2$	
15	*Power in watts (W)*	$P = \frac{work\ done}{time\ taken}$ $P = \frac{Energy\ transfer}{time\ taken}$	*Power is the rate of doing work*
16	*Pressure p in pascal (Pa)*	$p = \frac{F}{A}$	*F is the force in newton(N) and A is the area in* m^2
17	*Pressure p due to liquid*	$p = \rho \times g \times h$	*ρ is the density in* kg/m^3*, g is the acceleration due to garvity and h is the height or depth of liquid in meters.*
18	*Atmospheric pressure*	*P=760mmHg = 76cm Hg =*1.01×10^5 *Pa*	

Thermal Physics:

1	*Pressure and volume relationship (Boyle's law)*	$pV = constant$ $p_1 \times V_1 = p_2 \times V_2$	p_1 and p_2 are the two pressures in Pa and V_1 and V_2 are the two volumes in m^3
2	*Thermal Expansion (Linear)*	$\Delta L = \alpha \times L_o \times \Delta\theta$ L_o is the original length in meters, $\Delta\theta$ is the change in temperature in ^oC, ΔL is the change in length in meters ($L_1 - L_o$) and α is the linear expansivity of the material	
3	*Thermal Expansion (Cubical)*	$\Delta V = \gamma\ Vo\ \ \Delta\theta$ V_o is the original volume in m^3, $\Delta\theta$ is the change in temperature in ^oC, ΔV is the change in volume in m^3 ($V_1 - V_o$) and γ is the cubical expansivity of the material.	
4	*Relationship between linear and cubical expansivities*	$\gamma = 3\alpha$	
5	*Charle's Law:* Volume is directly proportional to absolute temperature $V \propto T$	$\frac{V}{T} = constant$ $\frac{V_1}{T_1} = \frac{V_2}{T_2}$	V is the volume in m^3 and T is the temperature in Kelvin (K).
6	*Pressure Law:* Pressure of a gas is directly proportional to the absolute temperature $p \propto T$	$\frac{p}{T} = constant$ $\frac{p_1}{T_1} = \frac{p_2}{T_2}$	p is the pressure in Pa and T is the temperature in Kelvin (K).
7	*Gas Law:* $\frac{pV}{T} = constant$	$\frac{p_1V_1}{T_1} = \frac{p_2V_2}{T_2}$	In thermal physics the symbol θ is used of celsius scale and T is used for Kelvin scale.
8	*Specific Heat Capacity:* The amount of heat required to raise the temperature of 1 kg mass by 1^oC.	$c = \frac{Q}{m \times \Delta\theta}$	c is the specific heat capacity in J/kg^oC, Q is the total heat in joules (J), m is the mass in kg and $\Delta\theta$ is the change in temperature
9	*Thermal Capacity:* amount of heat require to raise the temperature of a substance of any mass by 1^oC	Thermal capacity=$m \times c$ $Thermal\ capacity = \frac{Q}{\Delta\theta}$	The unit of thermal capacity is $J/^oC$.
10	*Specific latent heat of fusion (from Ice to liquid)*	$L_f = \frac{Q}{m}$	L_f is the specific latent heat of fusion in J/kg or J/g, Q is the total heat in joules (J), m is the mass of liquid change from ice in kg or g.
11	*Specific latent heat of vaporization (from liquid to vapour)*	$L_v = \frac{Q}{m}$	L_v is the specific latent heat of vaporization in J/kg or J/g, Q is the total heat in joules (J), m is the mass of vapour change from liquid in kg or g.
12	*Thermal or heat transfer*	In solid = conduction In liquid and gas = convection and also convection current In vacuum = radiation	
13	*Emitters and Radiators*	Dull black surface = good emitter, good radiator, bad reflector Bright shiny surface = poor emitter, poor radiator, good reflector	

Waves, light and sound:

1	Wave equation 1	$v = f \times \lambda$	v is the speed of wave in m/s f is the frequency in Hz λ is the wavelength in meters
2	Wave equation 2	$f = \frac{1}{T}$	T is the time period of wave in seconds
3	Movement of the particles of the medium	Longitudinal waves=> back and forth in the direction of the waves Transverse waves=> perpendicular to the direction of the waves	
4	Law of reflection	Angle of incidence i = angel of reflection $angle\ i^o = angle\ r^o$	
5	Refraction	From lighter to denser medium → light bend towards the normal From denser to lighter medium →light bend away from the normal	
6	Refractive index n	$n = \frac{\sin \angle i}{\sin \angle r}$	Refractive index has no unit
7	Refractive index n	$n = \frac{speed\ of\ light\ in\ air\ or\ vacuum}{speed\ of\ light\ in\ any\ other\ medium}$	
8	Image from a plane mirror	Virtual, upright, same size and laterally inverted, same distance from the mirror inside	
9	Image from a convex lens	When close: virtual, enlarge, upright When far: real, small, upside down	
10	Image from a concave lens	Virtual, upright, small	
11	Critical angle	When light goes from denser to lighter medium, the incident angle at which the reflected angle is 90^o,is called critical angle.	
12	Total internal reflection(TIR)	When light goes from denser to lighter medium, the refracted ray bend inside the same medium then this is called (TIR)	
13	Electromagnetic Spectrum:→ this way the frequency decreases and wavelength increases Gamma rays ↔ X-rays ↔ UV ↔ Visible light ↔ IR ↔ Micro waves ↔ Radio waves		
14	Colours of visible spectrum (light)	VIBGYOR (from bottom-up)	
15	Speed of light	In air: 3×10^8m/s	In glass: 2×10^8m/s
16	Light wave	Electromagnetic waves	
17	Sound wave	longitudinal waves particle of the medium come close → compression particles of the medium far apart → rarefaction	
18	Echo	$v = \frac{2 \times d}{t}$	v is the speed of sound waves, d is the distance in meters between source and the reflection surface and t is the time for echo
19	Properties of sound waves	Pitch means the frequency of the wave Loudness means the amplitude of the wave	
20	Speed of sound waves	Air : 330-340 m/s Water: 1400 m/s Concrete : 5000 m/s Steel: 6000 – 7000 m/s	

Electricity and magnetism:

1	*Ferrous Materials*	*Attracted by magnet and can be magnetized*	*Eg. iron, steel, nickel and cobalt*
2	*Non-ferrous materials*	*Not attracted by magnet and cannot be magnetized*	*copper, silver, aluminum, wood, glass*
3	*Electric field intensity*	*force exerted by the field on a unit charge placed at a point around another charge*	*E is the electric field intensity in N/C* $E = \frac{F}{q}$
4	*Current: Rate of flow of charges in a conductor*	$I = \frac{Q}{t}$	*I is the current in amperes (A),* *Q is the charge in coulombs (C)* *t is the time in seconds (s)*
5	*Current*	*In circuits the current always choose the easiest path*	
6	*Ohms law*	*Voltage across the resistor is directly proportional to current,* $V \propto I$ *or* $\frac{V}{I} = R$	*V is the voltage in volts (V),* *I is the current in amperes (A) and* *R is resistance in ohms (Ω)*
7	*Voltage*	*Energy per unit charge* $V = \frac{Energy}{Q}$	*Q is the charge in coulombs (C),* *V is the voltage in volts (V)* *Energy is in joules (J)*
8	*E.M.F.* *Electromotive force*	*e.m.f. = lost volts + terminal potential difference* *EMF=Ir+IR*	
9	*Resistance and resistivity*	$R = \rho \frac{L}{A}$ *ρ is the resistivity of resistor in Ω.m*	*R is the resistance a resistor,* *L is the length of a resistor in meters* *A is the area of cross-section of a resistor in* m^2
10	*Circuit*	*In series circuit→ the current stays the same and voltage divides* *In parallel circuit → the voltage stays the same and current divides*	
11	*Resistance in series*	$R = R_1 + R_2 + R_3$	*R,* R_1*,* R_2 *and* R_3 *are resistances of resistor in ohms*
12	*Resistance in parallel*	$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$	
13	*Potential divider*	$\frac{V_1}{V_2} = \frac{R_1}{R_2}$	
14	*Potential divider*	$V_2 = (\frac{R_2}{R_1 + R_2}) \times V$	$V_1 = (\frac{R_1}{R_1 + R_2}) \times V$
15	*Power*	$P = I \times V$ | $P = I^2 \times R$ | $P = \frac{V^2}{R}$	*P is the power in watts (W)*
16	*Power*	$P = \frac{Energy}{time}$	*The unit of energy is joules (J)*
17	*Transformer*	$\frac{V_p}{V_s} = \frac{n_p}{n_s}$	V_p *is the voltage in primary coil,* V_s *is the voltage in secondary coil* n_p *is the no of turns in primary and* n_s *is the no of turns in secondary*
18	*Transformer*	*Power of primary coil = power of secondary coil* $P_p = P_s$ $I_p \times V_p = I_s \times V_s$ $\frac{V_p}{V_s} = \frac{I_s}{I_p}$ I_p *is the current in primary coil and* I_s *the current in secondary coil*	
19	*Cathode rays*	*Stream of electrons emitted from heated metal (cathode). This process is called thermionic emission.*	
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Atomic Physics:

1	*Alpha particles* *α-particles*	*Helium nucleus* *Stopped by paper* *Highest ionization potential*	
2	*Beta-particles* *β-particles*	*Fast moving electrons* *Stopped by aluminum* *Less ionization potential*	
3	*Gamma-particles* *γ-rays*	*Electromagnetic radiation* *Only stopped by thick a sheet of lead* *Least ionization potential*	
4	*Half-life*	*Time in which the activity or mass becomes half*	
5	*Atomic symbol*	$^{A}_{Z}X$	*A is the total no of protons and neutrons* *Z is the total no of protons*
6	*Isotopes*	*Same number of protons but different number of neutrons*	