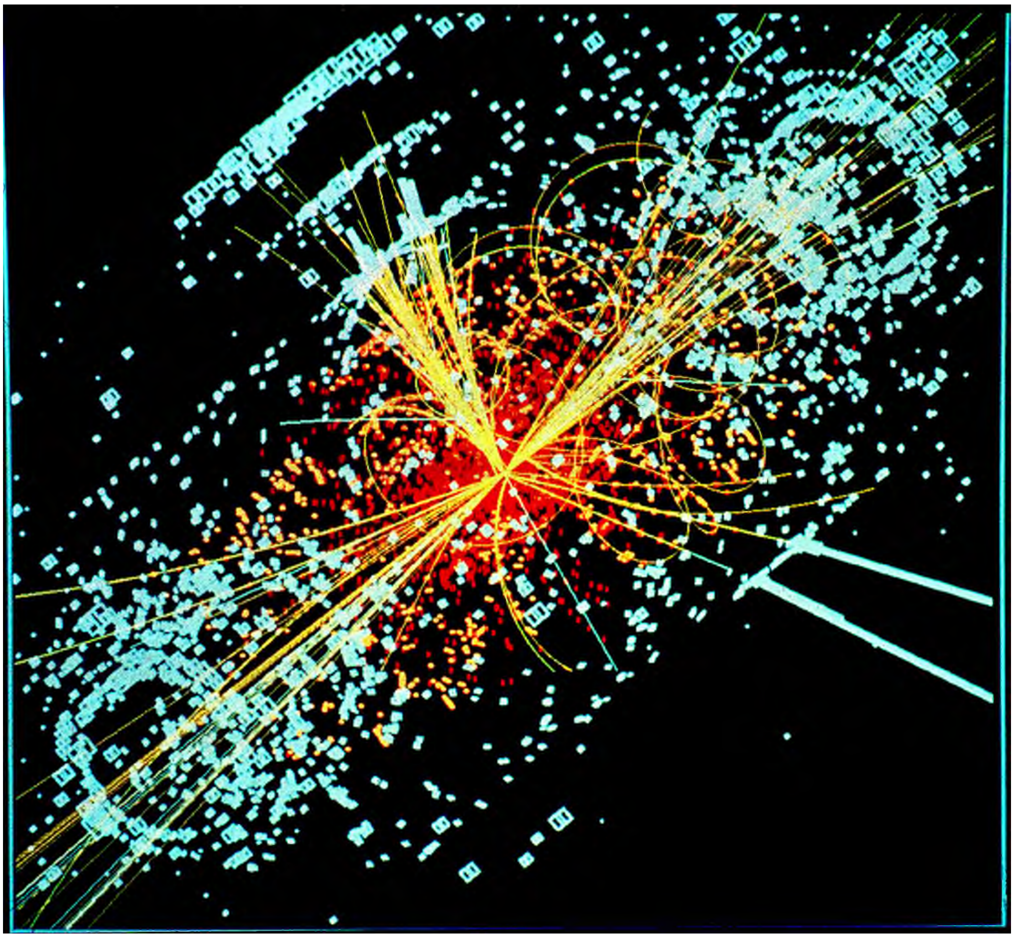
The Winchester Lower School

Physics Course



Following Cambridge IGCSE Physics (0625)

The page references given are for the following textbooks:

- **Physics Matters**, Nick England, 3rd edition
- **Complete Physics for IGCSE**, Stephen Pople, 2nd edition and 3rd edition

The references are neither guaranteed to be complete nor sufficient, but will hopefully help you find your way around the books when learning a particular topic.

The IGCSE syllabus splits material into Core and Supplement, but since you need to know the Supplement to access grades A*-C no distinction has been made here between the two parts of the syllabus. Sections in *italics* are material that is taught and examined internally but not examined at IGCSE.

The coloured bars down the edge of the table indicate the year in which the material is usually taught. Of course, material in earlier years will be assumed in later years (so in MP we might examine JP material, for instance).

Junior Part	JP post-CLT exam
Middle Part	MP post-CLT exam
V Book	

JAAB — Last updated 03/09/2017

		Physics Matters	Complete Physics for IGCSE 2nd Edition	Complete Physics for IGCSE 3rd Edition
1	**General Physics**			
1.1	**Length and time**			
	Use and describe the use of rules and measuring cylinders to find a length or a volume		12-17	12-17
	Understand that a micrometer screw gauge is used to measure very small distances		14	14
	Use and describe the use of clocks and devices, both analogue and digital, for measuring an interval of time		15	15
	Obtain an average value for a small distance and for a short interval of time by measuring multiples (including the period of a pendulum)		15	15
1.2	**Motion**			
	Define speed and calculate average speed from $\frac{\text{total distance}}{\text{total time}}$	26	26	26
	Distinguish between speed and velocity			
	Plot and interpret a speed-time graph or a distance-time graph	26-29	28-29	28-29
	Calculate speed from the gradient of a distance-time graph	27		
	Recognise from the shape of a speed-time graph when a body is – at rest – moving with constant speed – moving with changing speed	28-29	29	29
	Calculate the area under a speed-time graph to work out the distance travelled for motion with constant acceleration	42		
	Demonstrate understanding that acceleration and deceleration are related to changing speed including qualitative analysis of the gradient of a speed-time graph	29	28-29 34-35	28-29 34-35
	Define and calculate acceleration using $\frac{\text{change in velocity}}{\text{time taken}}$	28-29	27	27
	Calculate acceleration from the gradient of a speed-time graph	29, 42	29	29
	Understand deceleration as a negative acceleration		34	34
	State that the acceleration of free fall for a body near to the Earth is constant	38-39	32-33	32-33
	Describe qualitatively the motion of bodies falling in a uniform gravitational field with and without air resistance (including reference to terminal velocity)		37	37
1.2*	***Motion – extension material***			
	Understand and use the SUVAT equations for constant acceleration $(v = u + at; s = \frac{1}{2}(u + v)t; s = ut + \frac{1}{2}at^2; s = vt - \frac{1}{2}at^2; v^2 = u^2 + 2as)$	*Notes*	*Notes*	*Notes*
	Simple calculations involving projectile motion (using the SUVAT equations)			
1.3	**Mass and Weight**			
	Show familiarity with the idea of the mass of a body	38-39	12	12
	Demonstrate an understanding that mass is a property that 'resists' change in motion			
	State that weight is a gravitational force		42-43	42-43
	Distinguish between mass and weight			
	Recall and use the equation $W = mg$			
	Demonstrate understanding that weights (and hence masses) may be compared using a balance		20	20
	Describe, and use the concept of, weight as the effect of a gravitational field on a mass		42-43	42-43
1.4	**Density**			
	Recall and use the equation $\rho = \frac{m}{V}$	2-3	16-17	16-17
	Describe an experiment to determine the density of a liquid and of a regularly shaped solid and make the necessary calculation		18-19	18-19
	Describe the determination of the density of an irregularly shaped solid by the method of displacement			
	Predict whether an object will float based on density data		21	21

1.5	**Forces**			
1.5.1	**Effects of forces**			
	Recognise that a force may produce a change in size and shape of a body	4-5	60-61	64-65
	Plot and interpret extension-load graphs and describe the associated experimental procedure	12-13		
	State Hooke's Law and recall and use the expression *F* = *k x*, where *k* is the spring constant			
	Recognise the significance of the 'limit of proportionality' for an extension-load graph			
	Describe the ways in which a force may change the motion of a body	32-35 36-37	38-39	38-39
	Recall and use the relation between force, mass and acceleration (including the direction), *F* = *ma*			
	Find the resultant of two or more forces acting along the same line		39	39
	Recognise that if there is no resultant force on a body it either remains at rest or continues at constant speed in a straight line		38	38
	Describe qualitatively motion in a circular path due to a perpendicular force ($F = mv^2/r$ is *not* required)	48-49	48-49	52-53
	Understand friction as the force between two surfaces which impedes motion and results in heating		40-41	40-41
	Recognise air resistance as a form of friction			
1.5.2	**Turning effect**			
	Describe the moment of a force as a measure of its turning effect and give everyday examples	14-15	54-55 58-59	58-59 62-63
	Understand that increasing force or distance from the pivot increases the moment of a force			
	Calculate moment using the product force × perpendicular distance from the pivot			
	Apply the principle of moments to the balancing of a beam about a pivot			
	Apply the principle of moments to different situations			
1.5.3	**Conditions for equilibrium**			
	Recognise that, when there is no resultant force and no resultant turning effect, a system is in equilibrium	16-17	54-55 58-59	58-59 62-63
	Perform and describe an experiment (involving vertical forces) to show that there is no net moment on a body in equilibrium			
1.5.4	**Centre of mass**			
	Perform and describe an experiment to determine the position of the centre of mass of a plane lamina	16-18	56-57	60-61
	Describe qualitatively the effect of the position of the centre of mass on the stability of simple objects			
1.5.5	**Scalars and vectors**			
	Understand that vectors have a magnitude and direction	20-21	46-47	50-51
	Demonstrate an understanding of the difference between scalars and vectors and give common examples			
	Determine graphically the resultant of two vectors			
1.5.5*	***Scalars and vectors – extension material***			
	Add vectors using trigonometry rather than scale drawing	*Notes*	*Notes*	*Notes*
	Resolve vectors into components in two perpendicular directions	*Notes*	*47*	*51*
1.6	**Momentum**			
	Understand the concepts of momentum and impulse	50-51	Not in second edition (see notes)	46-49
	Recall and use the equation momentum = mass × velocity, *p=mv*			
	Recall and use the equation for impulse *Ft* = *mv* – *mu*			
	Apply the principle of the conservation of momentum to solve simple problems in one dimension			
1.7	**Energy, work and power**			
1.7.1	**Energy**			
	Identify changes in kinetic, gravitational potential, chemical, elastic (strain), nuclear and internal energy that have occurred as a result of an event or process	100-101	78-81	82-85
	Recall and use the expressions kinetic energy = $\frac{1}{2}mv^2$ and change in gravitational potential energy = $mg\Delta h$	102-103	82-83	86-87
	Recognise that energy is transferred during events and processes, including examples of transfer by forces (mechanical working), by electrical currents (electrical working), by heating and by waves	100-103	78-81	82-85
	Apply the principle of conservation of energy to examples involving multiple stages		83	87
	Explain that in any event or process the energy tends to become more spread out among the objects and surroundings (dissipated)		80	84

1.7.2	**Energy resources**			
	Describe how electricity or other useful forms of energy may be obtained from: – chemical energy stored in fuel – water, including the energy stored in waves, in tides, and in water behind hydroelectric dams – geothermal resources – nuclear fission – heat and light from the Sun (solar cells and panels) – wind	110-113	86-93	90-97
	Give advantages and disadvantages of each method in terms of renewability, cost, reliability, scale and environmental impact		86-93	90-97
	Understand that the Sun is the source of energy for all our energy resources except geothermal, nuclear and tidal		92-93	96-97
	Show an understanding that energy is released by nuclear fusion in the Sun			
	Recall and use the equations: $\text{efficiency} = \frac{\text{useful energy output}}{\text{energy input}} \times 100\%$ $\text{efficiency} = \frac{\text{useful power output}}{\text{power input}} \times 100\%$	108-109	84-85	88-89
1.7.3	**Work**			
	Demonstrate understanding that work done = energy transferred	98-100	81	85
	Recall and use $W = Fd = \Delta E$		78-81	82-85
1.7.4	**Power**			
	Recall and use the equation $P = \Delta E / t$ in simple systems	104-105	84-85	88-89
1.8	**Pressure**			
	Recall and use the equation $p = F / A$	6-7	62-63	66-67
	Relate pressure to force and area, using appropriate examples			
	Describe the simple mercury barometer and its use in measuring atmospheric pressure	10-11	68-69	72-73
	Relate the pressure beneath a liquid surface to depth and to density, using appropriate examples	9	64-69	68-73
	Recall and use the equation $p = h\rho g$		65	69
	Use and describe the use of a manometer		69	73
1.8*	***Pressure – extension material***			
	Understand that objects in a fluid experience an upthrust or buoyancy force	18-19		
	Recall and use the fact that the buoyancy force on an object is equal to the weight of the fluid displaced (Archimedes' Principle)			
2	**Thermal Physics**			
2.1	**Simple kinetic molecular model of matter**			
2.1.1	**States of matter**			
	State the distinguishing properties of solids, liquids and gases	124-125	98	102
2.1.2	**Molecular model**			
	Describe qualitatively the molecular structure of solids, liquids and gases in terms of the arrangement, separation and motion of the molecules	124-125	98	102
	Relate the properties of solids, liquids and gases to the forces and distances between molecules and to the motion of the molecules			
	Interpret the temperature of a gas in terms of the motion of its molecules		101	105
	Describe qualitatively the pressure of a gas in terms of the motion of its molecules	125	70-71	74-75
	Explain pressure in terms of the change of momentum of the particles striking the walls creating a force			
	Show an understanding of the random motion of particles in a suspension as evidence for the kinetic molecular model of matter	122-123	99	103
	Describe this motion (sometimes known as Brownian motion) in terms of random molecular bombardment			
	Show an appreciation that massive particles may be moved by light, fast-moving molecules			
2.1.3	**Evaporation**			
	Describe evaporation in terms of the escape of more-energetic molecules from the surface of a liquid	126-127	114-115	118-119
	Demonstrate an understanding of how temperature, surface area and draught over a surface influence evaporation			
	Relate evaporation to the consequent cooling of the liquid			
	Explain the cooling of a body in contact with an evaporating liquid			

2.1.4	**Pressure changes**			
	Describe qualitatively, in terms of molecules, the effect on the pressure of a gas of: – a change of temperature at constant volume – a change of volume at constant temperature	130-131	106-107	110-111
	Recall and use the equation *pV* = constant for a fixed mass of gas at constant Temperature		71	75
2.1*	***Gas Laws – extension***			
	Recall and use Charles' Law ($V \propto T$)	130-131	107	111
	Recall that 0K (-273° C) is absolute zero and that at this temperature, particles have the lowest possible energy		101	105
	Recall and use the gas equation $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2} (= constant)$		107	
	Describe qualitatively the effect of a change in number of particles in a gas on pressure (for instance, after rapid condensation)			
2.2	**Thermal properties and temperature**			
2.2.1	**Thermal expansion of solids, liquids and gases**			
	Describe qualitatively the thermal expansion of solids, liquids, and gases at constant pressure	142-143	104-107	108-111
	Identify and explain some of the everyday applications and consequences of thermal expansion			
	Explain, in terms of the motion and arrangement of molecules, the relative order of the magnitude of the expansion of solids, liquids and gases			
2.2.2	**Measurement of temperature**			
	Appreciate how a physical property that varies with temperature may be used for the measurement of temperature, and state examples of such properties		100-103	104-107
	Recognise the need for and identify fixed points			
	Describe and explain the structure and action of liquid-in-glass thermometers			
	Demonstrate understanding of sensitivity, range and linearity			
	Describe the structure of a thermocouple and show understanding of its use as a thermometer for measuring high temperatures and those that vary rapidly			
	Describe and explain how the structure of a liquid-in-glass thermometer relates to its sensitivity, range and linearity			
2.2.3	**Thermal capacity (heat capacity)**			
	Relate a rise in the temperature of a body to an increase in its internal energy	144-145	116-117	120-121
	Give a simple molecular account of an increase in internal energy			
	Show an understanding of what is meant by the thermal capacity of a body			
	Recall and use the equation thermal capacity = *mc*			
	Define specific heat capacity			
	Describe an experiment to measure the specific heat capacity of a substance			
	Recall and use the equation change in energy = $mc\Delta T$			
2.2.4	**Melting and boiling**			
	Describe melting and boiling in terms of energy input without a change in temperature	146-147	114-115 118-119	118-119 122-123
	State the meaning of melting point and boiling point			
	Distinguish between boiling and evaporation			
	Describe condensation and solidification in terms of molecules			
	Use the terms latent heat of vaporisation and latent heat of fusion and give a molecular interpretation of latent heat			
	Define specific latent heat			
	Describe an experiment to measure specific latent heats for steam and for ice			
	Recall and use the equation energy = *mL*			
2.3	**Thermal processes**			
2.3.1	**Conduction**			
	Describe experiments to demonstrate the properties of good and bad thermal conductors	148-149	108-109	112-113
	Give a simple molecular account of conduction in solids including lattice vibration and transfer by electrons			
2.3.2	**Convection**			
	Recognise convection as an important method of thermal transfer in fluids	150-151	110-111	114-115
	Relate convection in fluids to density changes and describe experiments to illustrate convection			

2.3.3	**Radiation**			
	Identify infra-red radiation as part of the electromagnetic spectrum	152-153	112-113	116-117
	Recognise that thermal energy transfer by radiation does not require a medium			
	Describe the effect of surface colour (black or white) and texture (dull or shiny) on the emission, absorption and reflection of radiation			
	Describe experiments to show the properties of good and bad emitters and good and bad absorbers of infra-red radiation			
	Show understanding that the amount of radiation emitted also depends on the surface temperature and surface area of a body			
2.3.4	**Consequences of energy transfer**			
	Identify and explain some of the everyday applications and consequences of conduction, convection and radiation	148-155	108-113	112-117
3	**Properties of waves, including light and sound**			
3.1	**General wave properties**			
	Demonstrate understanding that waves transfer energy without transferring matter	162	124	128
	Describe what is meant by wave motion as illustrated by vibration in ropes and springs and by experiments using water waves	162-167		
	Use the term wavefront	165-167	124, 129	128, 131
	Give the meaning of speed, frequency, wavelength and amplitude	163-164	125	129
	Recall and use the equation $v = f\lambda$		125	129
	Distinguish between transverse and longitudinal waves and give suitable examples	162	124	128
	Describe how waves can undergo: – reflection at a plane surface – refraction due to a change of speed – diffraction through a narrow gap	165-169	126-127	130-131
	Describe how wavelength and gap size affects diffraction through a gap	168-169	127	131
	Describe how wavelength affects diffraction at an edge		127	131
	Describe the use of water waves to demonstrate reflection, refraction and diffraction	165-169	126-127	130-131
3.1*	***General wave properties – extension material***			
	Show an understanding of the fundamentals of wave superposition and resonance	169, 190		
3.2	**Light**			
3.2.1	**Reflection of light**			
	Describe the formation of an optical image by a plane mirror, and give its characteristics	202-203	142-145	146-149
	Recall that the image in a plane mirror is virtual		142	146
	Recall and use the law angle of incidence = angle of reflection		145	149
	Perform simple constructions, measurements and calculations for reflection by plane mirrors		144-145	148-149
3.2.2	**Refraction of light**			
	Describe an experimental demonstration of the refraction of light	204-205	146	150
	Use the terminology for the angle of incidence *i* and angle of refraction *r* and describe the passage of light through parallel-sided transparent material		150	154
	Recall and use the definition of refractive index *n* in terms of speed		147	151
	Recall and use the equation $\frac{\sin i}{\sin r} = n$ [N.B. it is much more general to use $n_1 \sin\theta_1 = n_2 \sin\theta_2$]		150-151	154-155
	Give the meaning of critical angle		148-151	152-155
	Recall and use $n = \frac{1}{\sin c}$		151	155
	Describe and explain the action of optical fibres particularly in medicine and communications technology	206-207	149	153
3.2.3	**Thin converging lens**			
	Describe the action of a thin converging lens on a beam of light	208-209	152-155	156-159
	Use the terms principal focus and focal length			
	Draw ray diagrams for the formation of a real image by a single lens			
	Draw and use ray diagrams for the formation of a virtual image by a single lens			
	Describe the nature of an image using the terms enlarged/same size/diminished and upright/inverted			
	Use and describe the use of a single lens as a magnifying glass			
	Show understanding of the terms real image and virtual image	202		
3.2.4	**Dispersion of light**			
	Give a qualitative account of the dispersion of light as shown by the action on light of a glass prism including the seven colours of the spectrum in their correct order	214-215	147	151
	Recall that light of a single frequency is described as monochromatic		141	145

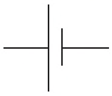
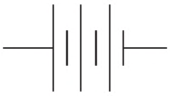
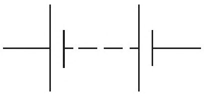
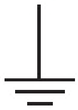
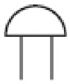
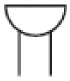
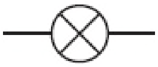
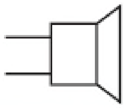
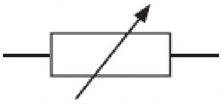
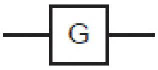
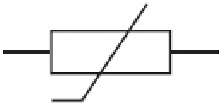
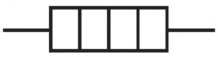
3.2*	***Light - Extension material***			
	Describe and explain image formation in a pinhole camera *Magnification = image height/object height = image distance/object distance*	200-201		
	Explain the formation of shadows			
	Describe and explain how solar and lunar eclipses occur			
	Reflections in curved mirrors			
	The thin lens equation			
3.3	**Electromagnetic spectrum**			
	Describe the main features of the electromagnetic spectrum in order of wavelength	177-179	160-163	162-165
	State that the speed of electromagnetic waves in a vacuum is 3.0×10^8 m / s and is approximately the same in air			
	Describe typical properties and uses of radiations in all the different regions of the electromagnetic spectrum including: – radio and television communications (radio waves) – satellite television and telephones (microwaves) – electrical appliances, remote controllers for televisions and intruder alarms (infra-red) – medicine and security (X-rays)			
	Demonstrate an awareness of safety issues regarding the use of microwaves and X-rays			
3.4	**Sound**			
	Describe the production of sound by vibrating sources	170	128	132
	Describe the longitudinal nature of sound waves			
	Describe compression and rarefaction			
	State that the approximate range of audible frequencies for a healthy human ear is 20 Hz to 20 000 Hz		132	136
	Show an understanding of the term ultrasound	171	134-135	138-139
	Show an understanding that a medium is needed to transmit sound waves	170	128	132
	Describe an experiment to determine the speed of sound in air		130-131	134-135
	State typical values of the speed of sound in gases, liquids and solids		130	134
	Relate the loudness and pitch of sound waves to amplitude and frequency	172-173	132-133	136-137
	Describe how the reflection of sound may produce an echo	170-171	131	135
4	**Electricity and magnetism**			
4.1	**Simple phenomena of magnetism**			
	Describe the forces between magnets, and between magnets and magnetic materials	258	202-203	200-201
	Explain that magnetic forces are due to interactions between magnetic fields		204	202
	Give an account of induced magnetism	262	202	200
	Distinguish between magnetic and non-magnetic materials		203	201
	Describe methods of magnetisation, to include stroking with a magnet, use of d.c. in a coil and hammering in a magnetic field	263	203, 207	201,205
	Describe methods of demagnetisation, to include hammering, heating and use of a.c. in a coil			
	Draw the pattern of magnetic field lines around a bar magnet	258	204-205	202-203
	Describe an experiment to identify the pattern of magnetic field lines, including the direction		204	202
	Distinguish between the magnetic properties of soft iron and steel		202-203	200-201
	Distinguish between the design and use of permanent magnets and electromagnets		208-209	206-207
4.2	**Electrical quantities**			
4.2.1	**Electric charge**			
	State that there are positive and negative charges	220-223	170	172
	State that unlike charges attract and that like charges repel		170	172
	Describe simple experiments to show the production and detection of electrostatic charges		171-172	173-174
	State that charging a body involves the addition or removal of electrons		170-171	172-173
	State that charge is measured in coulombs	228	173	175
	State that the direction of an electric field at a point is the direction of the force on a positive charge at that point		174-175	176-177
	Describe an electric field as a region in which an electric charge experiences a force			
	Describe simple field patterns, including the field around a point charge, the field around a charged conducting sphere and the field between two parallel plates (not including end effects)			

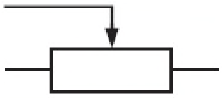
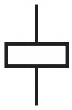
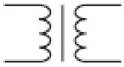
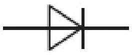
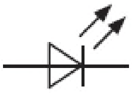
	Give an account of charging by induction		172	174
	Distinguish between electrical conductors and insulators and give typical examples	224	171	173
	Recall and use a simple electron model to distinguish between conductors and Insulators			
4.2.2	**Current**			
	State that current is related to the flow of charge	228	176-177	178-179
	Show understanding that a current is a rate of flow of charge and recall and use the equation $I = Q / t$		177	179
	Use and describe the use of an ammeter, both analogue and digital		176	178
	State that current in metals is due to a flow of electrons	225	176	178
	Distinguish between the direction of flow of electrons and conventional current	225	177	179
4.2.3	**Electromotive force**			
	State that the e.m.f. of an electrical source of energy is measured in volts		178	180
	Show understanding that e.m.f. is defined in terms of energy supplied by a source in driving charge round a complete circuit			
4.2.4	**Potential difference**			
	State that the potential difference (p.d.) across a circuit component is measured in volts	229	178	180
	Recall that 1 V is equivalent to 1 J / C			
	Use and describe the use of a voltmeter, both analogue and digital			
4.2.5	**Resistance**			
	State that resistance = p.d. / current and understand qualitatively how changes in p.d. or resistance affect current	231	180-181	182-183
	Recall and use the equation $R = V / I$			
	Describe an experiment to determine resistance using a voltmeter and an ammeter		182	184
	Sketch and explain the current-voltage characteristic of an ohmic resistor and a filament lamp	234-235	182-183	184-185
	Recall and use quantitatively the proportionality between resistance and length, and the inverse proportionality between resistance and cross-sectional area of a wire	q 233	184-185	186-187
4.2.6	**Electrical working**			
	Understand that electric circuits transfer energy from the battery or power source to the circuit components then into the surroundings	236-237	190-191	192-193
	Recall and use the equations $P = IV$ and $E = IVt$			
4.3	**Electric circuits**			
4.3.1	**Circuit diagrams**			
	Draw and interpret circuit diagrams containing sources, switches, resistors (fixed and variable), heaters, thermistors, light-dependent resistors, lamps, ammeters, voltmeters, galvanometers, magnetising coils, transformers, bells, fuses and relays.	See electrical circuit symbols below		
	Draw and interpret circuit diagrams containing diodes	289	181, 232	183, 230
4.3.2	**Series and parallel circuits**			
	Understand that the current at every point in a series circuit is the same	228	186-187	188-189
	Give the combined resistance of two or more resistors in series	232	188-189	190-191
	State that, for a parallel circuit, the current from the source is larger than the current in each branch	228	187	189
	State that the combined resistance of two resistors in parallel is less than that of either resistor by itself	233	188-189	190-191
	State the advantages of connecting lamps in parallel in a lighting circuit		186	188
	Calculate the combined e.m.f. of several sources in series		187	189
	Recall and use the fact that the sum of the p.d.s across the components in a series circuit is equal to the total p.d. across the supply	229		
	Recall and use the fact that the current from the source is the sum of the currents in the separate branches of a parallel circuit	228		
	Calculate the effective resistance of two resistors in parallel	233	188-189	190-191
4.3.3	**Action and use of circuit components**			
	Describe the action of a variable potential divider (potentiometer)		233	231
	Describe the action of thermistors and light dependent resistors and show understanding of their use as input transducers	294-295	236-237	229, 232-233
	Describe the action of a relay and show understanding of its use in switching circuits		233,237	206, 229, 231
	Describe the action of a diode and show understanding of its use as a rectifier	289	232	230
	Recognise and show understanding of circuits operating as light-sensitive switches and temperature-operated alarms (to include the use of a relay)	294-295	236-237	232-233

4.4	**Digital electronics**			
	Explain and use the terms analogue and digital in terms of continuous variation and high/low states	298-301	238-241	234-237
	Describe the action of NOT, AND, OR, NAND and NOR gates			
	Recall and use the symbols for logic gates			
	Design and understand simple digital circuits combining several logic gates			
	Use truth tables to describe the action of individual gates and simple combinations of gates			
4.5	**Dangers of electricity**			
	State the hazards of: – damaged insulation – overheating of cables – damp conditions	244-245	192-195	194-195
	State that a fuse protects a circuit			
	Explain the use of fuses and circuit breakers and choose appropriate fuse ratings and circuit-breaker settings			
	Explain the benefits of earthing metal cases			
4.5*	***Extension material***			
	Know how to correctly wire a plug and the colours of the live, neutral and earth wires	245	193	
4.6	**Electromagnetic effects**			
4.6.1	**Electromagnetic induction**			
	Show understanding that a conductor moving across a magnetic field or a changing magnetic field linking with a conductor can induce an e.m.f. in the conductor	270-271	214-215	212-213
	Describe an experiment to demonstrate electromagnetic induction			
	State the factors affecting the magnitude of an induced e.m.f.			
	Show understanding that the direction of an induced e.m.f. opposes the change causing it		216-217	214-215
	State and use the relative directions of force, field and induced current			
4.6.2	**a.c. generator**			
	Distinguish between direct current (d.c.) and alternating current (a.c.)	273-275	192, 218-219	194, 216-217
	Describe and explain a rotating-coil generator and the use of slip rings		218	216-217
	Sketch a graph of voltage output against time for a simple a.c. generator			
	Relate the position of the generator coil to the peaks and zeros of the voltage output		218-219	
4.6.3	**Transformer**			
	Describe the construction of a basic transformer with a soft-iron core, as used for voltage transformations	276-277	220-221	218-219
	Describe the principle of operation of a transformer			
	Recall and use the equation $(V_p / V_s) = (N_p / N_s)$			
	Recall and use the equation $I_pV_p = I_sV_s$ (for 100% efficiency)	278	222-223	220-221
	Understand the terms step-up and step-down	277		
	Describe the use of the transformer in high-voltage transmission of electricity	278-279	224-225	222-223
	Give the advantages of high-voltage transmission			
	Explain why power losses in cables are lower when the voltage is high			
4.6.4	**The magnetic effect of a current**			
	Describe the pattern of the magnetic field (including direction) due to currents in straight wires and in solenoids	260-261	206-207	204-205
	Describe applications of the magnetic effect of current, including the action of a relay	268-269	208-209	206-207
	State the qualitative variation of the strength of the magnetic field over salient parts of the pattern	260-261	206	202
	State that the direction of a magnetic field line at a point is the direction of the force on the N pole of a magnet at that point		204	202
	Describe the effect on the magnetic field of changing the magnitude and direction of the current		207	205
4.6.5	**Force on a current-carrying conductor**			
	Describe an experiment to show that a force acts on a current-carrying conductor in a magnetic field, including the effect of reversing: – the current – the direction of the field	264-265	210-211	208-209
	State and use the relative directions of force, field and current			
	Describe an experiment to show the corresponding force on beams of charged particles		243	239

4.6.6	**d.c. motor**			
	State that a current-carrying coil in a magnetic field experiences a turning effect and that the effect is increased by: – increasing the number of turns on the coil – increasing the current – increasing the strength of the magnetic field	266-267	212-213	210-211
	Relate this turning effect to the action of an electric motor including the action of a split-ring commutator			
5	**Atomic Physics**			
5.1	**The Nuclear Atom**			
5.1.1	**Atomic model**			
	Describe the structure of an atom in terms of a positive nucleus and negative electrons	312	250	244
	Describe how the scattering of α-particles by thin metal foils provides evidence for the nuclear atom	320	266-267	260-261
5.1.2	**Nucleus**			
	Describe the composition of the nucleus in terms of protons and neutrons	312-313	250-251	244-245
	State the charges of protons and neutrons			
	Use the term proton number *Z*			
	Use the term nucleon number *A*			
	Use the term nuclide and use the nuclide notation $^{A}_{Z}X$			
	Use and explain the term isotope			
	Balance equations involving nuclide notation	314	256-257	250-251
	State the meaning of nuclear fission and nuclear fusion	322,326	260-263	254-257
5.2	**Radioactivity**			
5.2.1	**Detection of radioactivity**			
	Demonstrate understanding of background radiation	315	254	248
	Describe the detection of α-particles, β-particles and γ-rays (β+ are not included: β-particles will be taken to refer to β-)	316-317	254-255	248-249
5.2.2	**Characteristics of the three kinds of emission**			
	Discuss the random nature of radioactive emission	318	258	252
	Identify α, β and γ-emissions by recalling – their nature – their relative ionising effects – their relative penetrating abilities	314-317	252-253	246-247
	Describe their deflection in electric fields and in magnetic fields			
	Interpret their relative ionising effects			
	Give and explain examples of practical applications of α, β and γ-emissions	319, 328-329	264-265	258-259
5.2.3	**Radioactive decay**			
	State the meaning of radioactive decay	318-319	256-257	250-251
	State that during α- or β-decay the nucleus changes to that of a different element	314		
	Use equations involving nuclide notation to represent changes in the composition of the nucleus when particles are emitted			
5.2.4	**Half-life**			
	Use the term half-life in simple calculations, which might involve information in tables or decay curves	318-319	258-259	252-253
	Calculate half-life from data or decay curves from which background radiation has not been subtracted			
	Recall the effects of ionising radiations on living things	315, 324-325	254	248
	Describe how radioactive materials are handled, used and stored in a safe way		255	249
5.2*	***Extension material***			
	Describe and explain how the nuclear fission reactor works	322-323	260-261	254-255

Electrical Symbols (from CIE Syllabus)

cell		switch	
battery of cells	 or 	earth or ground	
power supply		electric bell	
a.c. power supply		buzzer	
junction of conductors		microphone	
lamp		loudspeaker	
fixed resistor		motor	
variable resistor		generator	
thermistor		ammeter	
light dependent resistor		voltmeter	
heater		galvanometer	

potential divider		oscilloscope	
relay coil		AND gate	
transformer		OR gate	
diode		NAND gate	
light-emitting diode		NOR gate	
fuse		NOT gate	

Symbols and Units for Physical Quantities (from CIE Syllabus)

Core			Supplement		
Quantity	***Usual symbol***	***Usual unit***	***Quantity***	***Usual symbol***	***Usual unit***
length	l, h …	km, m, cm, mm			
area	A	m^2, cm^2			
volume	V	m^3, cm^3			
weight	W	N			
mass	m, M	kg, g	mass	m, M	mg
time	t	h, min, s	time	t	ms
density	ρ	g/cm^3, kg/m^3			
speed	u, v	km/h, m/s, cm/s			
acceleration	a		acceleration	a	m/s^2
acceleration of free fall	g		acceleration of free fall	g	m/s^2
force	F	N			
gravitational field strength	g	N/kg			
			momentum	p	kg m/s
			impulse		N s
moment of a force		N m			
work done	W, E	J, kJ, MJ			
energy	E	J, kJ, MJ			
power	P	W, kW, MW			
pressure	p	N/m^2	pressure	p	Pa
atmospheric pressure		mm Hg			
temperature	θ, T	°C			
			thermal capacity (heat capacity)	C	J/°C
			specific heat capacity	c	J/(g °C), J/(kg °C)

Core			Supplement		
Quantity	***Usual symbol***	***Usual unit***	***Quantity***	***Usual symbol***	***Usual unit***
latent heat	L	J			
			specific latent heat	l	J/kg, J/g
frequency	f	Hz, kHz			
wavelength	λ	m, cm			
focal length	f	cm			
angle of incidence	i	degree (°)			
angle of reflection, refraction	r	degree (°)			
critical angle	c	degree (°)			
			refractive index	n	
potential difference/voltage	V	V, mV			
current	I	A, mA			
e.m.f.	E	V			
resistance	R	Ω			
			charge	Q	C

Experimental Skills (from CIE Syllabus)

Experimental skills tested in Paper 5: Practical Test and Paper 6: Alternative to Practical

Candidates may be asked questions on the following experimental contexts:

- measurement of physical quantities such as length or volume or force
- cooling and heating
- springs and balances
- timing motion or oscillations
- electric circuits
- optics equipment such as mirrors, prisms and lenses
- procedures using simple apparatus, in situations where the method may not be familiar to the candidate.

Candidates may be required to do the following:

- use, or describe the use of, common techniques, apparatus and materials, for example ray-tracing equipment or the connection of electric circuits
- select the most appropriate apparatus or method for a task and justify the choice made
- draw, complete or label diagrams of apparatus
- explain the manipulation of the apparatus to obtain observations or measurements, for example:
  - when determining a derived quantity, such as the extension per unit load for a spring
  - when testing/identifying the relationship between two variables, such as between the p.d. across a wire and its length
  - when comparing physical quantities, such as two masses using a balancing method
- make estimates or describe outcomes which demonstrate their familiarity with an experiment, procedure or technique
- take readings from an appropriate measuring device or from an image of the device (for example thermometer, rule, protractor, measuring cylinder, ammeter, stopwatch), including:
  - reading analogue and digital scales with accuracy and appropriate precision
  - interpolating between scale divisions when appropriate
  - correcting for zero errors, where appropriate
- plan to take a sufficient number and range of measurements, repeating where appropriate to obtain an average value
- describe or explain precautions taken in carrying out a procedure to ensure safety or the accuracy of observations and data, including the control of variables
- identify key variables and describe how, or explain why, certain variables should be controlled
- record observations systematically, for example in a table, using appropriate units and to a consistent and appropriate degree of precision
- process data, using a calculator where necessary
- present and analyse data graphically, including the use of best-fit lines where appropriate, interpolation and extrapolation, and the determination of a gradient, intercept or intersection
- draw an appropriate conclusion, justifying it by reference to the data and using an appropriate explanation
- comment critically on a procedure or point of practical detail and suggest an appropriate improvement
- evaluate the quality of data, identifying and dealing appropriately with any anomalous results
- identify possible causes of uncertainty, in data or in a conclusion
- plan an experiment or investigation including making reasoned predictions of expected results and suggesting suitable apparatus and techniques.