CAMBRIDGE
International Examinations

Cambridge
IGCSE

SYLLABUS

Cambridge IGCSE®
Physics
0625

For examination in June and November 2015

This syllabus is approved for use in England, Wales and Northern Ireland as a Cambridge International Level 1/Level 2 Certificate (QN: 500/5660/8).

Cambridge Secondary 2

6. Syllabus content

All candidates should be taught the Core syllabus content. Candidates who are only taught the Core syllabus content can achieve a maximum grade C. Candidates aiming for grades A* to C should be taught the Extended syllabus content. The Extended syllabus content includes both the Core and the Supplement syllabus content.

Throughout the course, teachers should aim to show the relevance of concepts to the candidates' everyday life and current technology. To encourage this approach and to allow teachers to use flexible programs to meet the course's general aims, we have limited the specified content of the syllabus. The following material should therefore be regarded as an exam syllabus rather than a teaching syllabus.

1. General physics	
1.1 Length and time **Core** • Use and describe the use of rules and measuring cylinders to calculate a length or a volume • Use and describe the use of clocks and devices for measuring an interval of time	**Supplement** • Use and describe the use of a mechanical method for the measurement of a small distance (including use of a micrometer screw gauge) • Measure and describe how to measure a short interval of time (including the period of a pendulum)
1.2 Speed, velocity and acceleration **Core** • Define speed and calculate speed from $\frac{\text{total distance}}{\text{total time}}$ • Plot and interpret a speed/time graph or a distance/time graph • Recognise from the shape of a speed/time graph when a body is – at rest – moving with constant speed – moving with changing speed • Calculate the area under a speed/time graph to work out the distance travelled for motion with constant acceleration • Demonstrate some understanding that acceleration is related to changing speed • State that the acceleration of free fall for a body near to the Earth is constant	**Supplement** • Distinguish between speed and velocity • Recognise linear motion for which the acceleration is constant and calculate the acceleration • Recognise motion for which the acceleration is not constant • Describe qualitatively the motion of bodies falling in a uniform gravitational field with and without air resistance (including reference to terminal velocity)

1.3 Mass and weight **Core** • Show familiarity with the idea of the mass of a body • State that weight is a force • Demonstrate understanding that weights (and hence masses) may be compared using a balance	**Supplement** • Demonstrate an understanding that mass is a property that 'resists' change in motion • Describe, and use the concept of, weight as the effect of a gravitational field on a mass
1.4 Density **Core** • Describe an experiment to determine the density of a liquid and of a regularly shaped solid and make the necessary calculation	**Supplement** • Describe the determination of the density of an irregularly shaped solid by the method of displacement, and make the necessary calculation
1.5 Forces	
1.5 (a) Effects of forces **Core** • State that a force may produce a change in size and shape of a body • Plot extension/load graphs and describe the associated experimental procedure • Describe the ways in which a force may change the motion of a body • Find the resultant of two or more forces acting along the same line	**Supplement** • Interpret extension/load graphs • State Hooke's Law and recall and use the expression $F = kx$ • Recognise the significance of the term 'limit of proportionality' for an extension/load graph • Recall and use the relation between force, mass and acceleration (including the direction) • Describe qualitatively motion in a curved path due to a perpendicular force ($F = mv^2/r$ is *not* required)
1.5 (b) Turning effect **Core** • Describe the moment of a force as a measure of its turning effect and give everyday examples • Describe qualitatively the balancing of a beam about a pivot	**Supplement** • Perform and describe an experiment (involving vertical forces) to show that there is no net moment on a body in equilibrium • Apply the idea of opposing moments to simple systems in equilibrium
1.5 (c) Conditions for equilibrium **Core** • State that, when there is no resultant force and no resultant turning effect, a system is in equilibrium	

1.5 (d) Centre of mass **Core** • Perform and describe an experiment to determine the position of the centre of mass of a plane lamina • Describe qualitatively the effect of the position of the centre of mass on the stability of simple objects	
1.5 (e) Scalars and vectors	**Supplement** • Demonstrate an understanding of the difference between scalars and vectors and give common examples • Add vectors by graphical representation to determine a resultant • Determine graphically the resultant of two vectors
1.6 Energy, work and power	
1.6 (a) Energy **Core** • Demonstrate an understanding that an object may have energy due to its motion or its position, and that energy may be transferred and stored • Give examples of energy in different forms, including kinetic, gravitational, chemical, strain, nuclear, internal, electrical, light and sound • Give examples of the conversion of energy from one form to another, and of its transfer from one place to another • Apply the principle of energy conservation to simple examples	**Supplement** • Recall and use the expressions k.e. = ½ mv^2 and p.e. = mgh

1.6 (b) Energy resources **Core** • Distinguish between renewable and non-renewable sources of energy • 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) • Give advantages and disadvantages of each method in terms of cost, reliability, scale and environmental impact • Show a qualitative understanding of efficiency	**Supplement** • Show an understanding that energy is released by nuclear fusion in the Sun • Recall and use the equation: $\text{efficiency} = \frac{\text{useful energy output}}{\text{energy input}} \times 100\%$
1.6 (c) Work **Core** • Relate (without calculation) work done to the magnitude of a force and the distance moved	**Supplement** • Describe energy changes in terms of work done • Recall and use $\Delta W = Fd = \Delta E$
1.6 (d) Power **Core** • Relate (without calculation) power to work done and time taken, using appropriate examples	**Supplement** • Recall and use the equation $P = E/t$ in simple systems
1.7 Pressure **Core** • Relate (without calculation) pressure to force and area, using appropriate examples • Describe the simple mercury barometer and its use in measuring atmospheric pressure • Relate (without calculation) the pressure beneath a liquid surface to depth and to density, using appropriate examples • Use and describe the use of a manometer	**Supplement** • Recall and use the equation $p = F/A$ • Recall and use the equation $p = h\rho g$

2. Thermal physics	
2.1 Simple kinetic molecular model of matter	
2.1 (a) States of matter **Core** • State the distinguishing properties of solids, liquids and gases	
2.1 (b) Molecular model **Core** • Describe qualitatively the molecular structure of solids, liquids and gases • Interpret the temperature of a gas in terms of the motion of its molecules • Describe qualitatively the pressure of a gas in terms of the motion of its molecules • Describe qualitatively the effect of a change of temperature on the pressure of a gas at constant volume • Show an understanding of the random motion of particles in a suspension as evidence for the kinetic molecular model of matter • Describe this motion (sometimes known as Brownian motion) in terms of random molecular bombardment	**Supplement** • Relate the properties of solids, liquids and gases to the forces and distances between molecules and to the motion of the molecules • Show an appreciation that massive particles may be moved by light, fast-moving molecules
2.1 (c) Evaporation **Core** • Describe evaporation in terms of the escape of more-energetic molecules from the surface of a liquid • Relate evaporation to the consequent cooling	**Supplement** • Demonstrate an understanding of how temperature, surface area and draught over a surface influence evaporation
2.1 (d) Pressure changes **Core** • Relate the change in volume of a gas to change in pressure applied to the gas at constant temperature	**Supplement** • Recall and use the equation pV = constant at constant temperature

2.2 Thermal properties	
2.2 (a) Thermal expansion of solids, liquids and gases **Core** • Describe qualitatively the thermal expansion of solids, liquids and gases • Identify and explain some of the everyday applications and consequences of thermal expansion • Describe qualitatively the effect of a change of temperature on the volume of a gas at constant pressure	**Supplement** • Show an appreciation of the relative order of magnitude of the expansion of solids, liquids and gases
2.2 (b) Measurement of temperature **Core** • Appreciate how a physical property that varies with temperature may be used for the measurement of temperature, and state examples of such properties • Recognise the need for and identify fixed points • Describe the structure and action of liquid-in-glass thermometers	**Supplement** • Demonstrate understanding of sensitivity, range and linearity • Describe the structure of a thermocouple and show understanding of its use for measuring high temperatures and those that vary rapidly
2.2 (c) Thermal capacity **Core** • Relate a rise in the temperature of a body to an increase in internal energy • Show an understanding of the term thermal capacity	**Supplement** • Describe an experiment to measure the specific heat capacity of a substance
2.2 (d) Melting and boiling **Core** • Describe melting and boiling in terms of energy input without a change in temperature • State the meaning of melting point and boiling point • Describe condensation and solidification	**Supplement** • Distinguish between boiling and evaporation • Use the terms *latent heat of vaporisation* and *latent heat of fusion* and give a molecular interpretation of latent heat • Describe an experiment to measure specific latent heats for steam and for ice
2.3 Transfer of thermal energy	
2.3 (a) Conduction **Core** • Describe experiments to demonstrate the properties of good and bad conductors of heat	**Supplement** • Give a simple molecular account of heat transfer in solids

2.3 (b) Convection **Core** • Relate convection in fluids to density changes and describe experiments to illustrate convection	
2.3 (c) Radiation **Core** • Identify infra-red radiation as part of the electromagnetic spectrum	**Supplement** • Describe experiments to show the properties of good and bad emitters and good and bad absorbers of infra-red radiation
2.3 (d) Consequences of energy transfer **Core** • Identify and explain some of the everyday applications and consequences of conduction, convection and radiation	
3. Properties of waves, including light and sound	
3.1 General wave properties **Core** • Describe what is meant by wave motion as illustrated by vibration in ropes and springs and by experiments using water waves • Use the term *wavefront* • Give the meaning of *speed*, *frequency*, *wavelength* and *amplitude* • Distinguish between transverse and longitudinal waves and give suitable examples • Describe the use of water waves to show: – reflection at a plane surface – refraction due to a change of speed – diffraction produced by wide and narrow gaps	**Supplement** • Recall and use the equation $v = f\lambda$ • Interpret reflection, refraction and diffraction using wave theory
3.2 Light	
3.2 (a) Reflection of light **Core** • Describe the formation of an optical image by a plane mirror, and give its characteristics • Use the law angle of incidence = angle of reflection	**Supplement** • Perform simple constructions, measurements and calculations

3.2 (b) Refraction of light **Core** • Describe an experimental demonstration of the refraction of light • 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 • Give the meaning of *critical angle* • Describe internal and total internal reflection	**Supplement** • Recall and use the definition of refractive index *n* in terms of speed • Recall and use the equation $\sin i / \sin r = n$ • Describe the action of optical fibres particularly in medicine and communications technology
3.2 (c) Thin converging lens **Core** • Describe the action of a thin converging lens on a beam of light • Use the terms *principal focus* and *focal length* • Draw ray diagrams to illustrate the formation of a real image by a single lens	**Supplement** • Draw ray diagrams to illustrate the formation of a virtual image by a single lens • Use and describe the use of a single lens as a magnifying glass
3.2 (d) Dispersion of light **Core** • Give a qualitative account of the dispersion of light as shown by the action of a glass prism on light	
3.2 (e) Electromagnetic spectrum **Core** • Describe the main features of the electromagnetic spectrum and state that all e.m. waves travel with the same high speed *in vacuo* • Describe the role of electromagnetic waves in: – 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	**Supplement** • State the approximate value of the speed of electromagnetic waves • Use the term *monochromatic*

3.3 Sound **Core** • Describe the production of sound by vibrating sources • Describe the longitudinal nature of sound waves • State the approximate range of audible frequencies • Show an understanding that a medium is needed to transmit sound waves • Describe an experiment to determine the speed of sound in air • Relate the loudness and pitch of sound waves to amplitude and frequency • Describe how the reflection of sound may produce an echo	**Supplement** • Describe compression and rarefaction • State the order of magnitude of the speed of sound in air, liquids and solids
4. Electricity and magnetism	
4.1 Simple phenomena of magnetism **Core** • State the properties of magnets • Give an account of induced magnetism • Distinguish between ferrous and non-ferrous materials • Describe methods of magnetisation and of demagnetisation • Describe an experiment to identify the pattern of field lines around a bar magnet • Distinguish between the magnetic properties of iron and steel • Distinguish between the design and use of permanent magnets and electromagnets	

4.2 Electrical quantities	
4.2 (a) Electric charge **Core** • Describe simple experiments to show the production and detection of electrostatic charges • State that there are positive and negative charges • State that unlike charges attract and that like charges repel • Describe an electric field as a region in which an electric charge experiences a force • Distinguish between electrical conductors and insulators and give typical examples	**Supplement** • State that charge is measured in coulombs • State the direction of lines of force and describe simple field patterns, including the field around a point charge and the field between two parallel plates • Give an account of charging by induction • Recall and use the simple electron model to distinguish between conductors and insulators
4.2 (b) Current **Core** • State that current is related to the flow of charge • Use and describe the use of an ammeter	**Supplement** • Show understanding that a current is a rate of flow of charge and recall and use the equation $I = Q/t$ • Distinguish between the direction of flow of electrons and conventional current
4.2 (c) Electromotive force **Core** • State that the electromotive force (e.m.f.) of a source of electrical energy is measured in volts	**Supplement** • 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 (d) Potential difference **Core** • State that the potential difference across a circuit component is measured in volts • Use and describe the use of a voltmeter	

4.2 (e) Resistance **Core** • State that resistance = p.d./current and understand qualitatively how changes in p.d. or resistance affect current • Recall and use the equation $R = V/I$ • Describe an experiment to determine resistance using a voltmeter and an ammeter • Relate (without calculation) the resistance of a wire to its length and to its diameter	**Supplement** • Recall and use quantitatively the proportionality between resistance and length, and the inverse proportionality between resistance and cross-sectional area of a wire
4.2 (f) Electrical energy	**Supplement** • Recall and use the equations $P = IV$ and $E = IVt$
4.3 Electric circuits	
4.3 (a) Circuit diagrams **Core** • Draw and interpret circuit diagrams containing sources, switches, resistors (fixed and variable), lamps, ammeters, voltmeters, magnetising coils, transformers, bells, fuses and relays	**Supplement** • Draw and interpret circuit diagrams containing diodes and transistors
4.3 (b) Series and parallel circuits **Core** • Understand that the current at every point in a series circuit is the same • Give the combined resistance of two or more resistors in series • State that, for a parallel circuit, the current from the source is larger than the current in each branch • State that the combined resistance of two resistors in parallel is less than that of either resistor by itself • State the advantages of connecting lamps in parallel in a lighting circuit	**Supplement** • 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 • 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 • Calculate the effective resistance of two resistors in parallel

4.3 (c) Action and use of circuit components **Core** • Describe the action of a variable potential divider (potentiometer) • Describe the action of thermistors and light-dependent resistors and show understanding of their use as input transducers • Describe the action of a capacitor as an energy store and show understanding of its use in time-delay circuits • Describe the action of a relay and show understanding of its use in switching circuits	**Supplement** • Describe the action of a diode and show understanding of its use as a rectifier • Describe the action of a transistor as an electrically operated switch and show understanding of its use in switching circuits • Recognise and show understanding of circuits operating as light-sensitive switches and temperature-operated alarms (using a relay or a transistor)
4.3 (d) Digital electronics	**Supplement** • Explain and use the terms *digital* and *analogue* • State that logic gates are circuits containing transistors and other components • Describe the action of NOT, AND, OR, NAND and NOR gates • Design and understand simple digital circuits combining several logic gates • State and use the symbols for logic gates (candidates should use the American ANSI#Y 32.14 symbols)
4.4 Dangers of electricity **Core** • state the hazards of: – damaged insulation – overheating of cables – damp conditions • Show an understanding of the use of fuses and circuit-breakers	

4.5 Electromagnetic effects	
4.5 (a) Electromagnetic induction **Core** • Describe an experiment that shows that a changing magnetic field can induce an e.m.f. in a circuit	**Supplement** • 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
4.5 (b) a.c. generator **Core** • Describe a rotating-coil generator and the use of slip rings • Sketch a graph of voltage output against time for a simple a.c. generator	
4.5 (c) Transformer **Core** • Describe the construction of a basic iron-cored transformer as used for voltage transformations • Recall and use the equation $V_p/V_s = N_p/N_s$ • Describe the use of the transformer in high-voltage transmission of electricity • Give the advantages of high-voltage transmission	**Supplement** • Describe the principle of operation of a transformer • Recall and use the equation $V_p I_p = V_s I_s$ (for 100% efficiency) • Explain why energy losses in cables are lower when the voltage is high
4.5 (d) The magnetic effect of a current **Core** • Describe the pattern of the magnetic field due to currents in straight wires and in solenoids • Describe applications of the magnetic effect of current, including the action of a relay	**Supplement** • State the qualitative variation of the strength of the magnetic field over salient parts of the pattern • Describe the effect on the magnetic field of changing the magnitude and direction of the current
4.5 (e) Force on a current-carrying conductor **Core** • 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	**Supplement** • Describe an experiment to show the corresponding force on beams of charged particles • State and use the relative directions of force, field and current

4.5 (f) d.c. motor **Core** • 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 • Relate this turning effect to the action of an electric motor	**Supplement** • Describe the effect of increasing the current
4.6 Cathode-ray oscilloscopes	
4.6 (a) Cathode rays **Core** • Describe the production and detection of cathode rays • Describe their deflection in electric fields • State that the particles emitted in thermionic emission are electrons	
4.6 (b) Simple treatment of cathode-ray oscilloscope	**Supplement** • Describe (in outline) the basic structure and action of a cathode-ray oscilloscope (detailed circuits are **not** required) • Use and describe the use of a cathode-ray oscilloscope to display waveforms
5. Atomic physics	
5.1 Radioactivity	
5.1 (a) Detection of radioactivity **Core** • Show awareness of the existence of background radiation • Describe the detection of α-particles, β-particles and γ-rays (β^+ are not included and β-particles will be taken to refer to β^-)	
5.1 (b) Characteristics of the three kinds of emission **Core** • State that radioactive emissions occur randomly over space and time • State, for radioactive emissions: – their nature – their relative ionising effects – their relative penetrating abilities	• Describe their deflection in electric fields and magnetic fields • Interpret their relative ionising effects

5.1 (c) Radioactive decay **Core** • State the meaning of radioactive decay, using equations (involving words or symbols) to represent changes in the composition of the nucleus when particles are emitted	
5.1 (d) Half-life **Core** • Use the term *half-life* in simple calculations, which might involve information in tables or decay curves	
5.1 (e) Safety precautions **Core** • Describe how radioactive materials are handled, used and stored in a safe way	
5.2 The nuclear atom	
5.2 (a) Atomic model **Core** • Describe the structure of an atom in terms of a nucleus and electrons	**Supplement** • Describe how the scattering of α-particles by thin metal foils provides evidence for the nuclear atom
5.2 (b) Nucleus **Core** • Describe the composition of the nucleus in terms 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 ${}^{A}_{Z}X$	
5.2 (c) Isotopes	**Supplement** • Use the term *isotope* • Give and explain examples of practical applications of isotopes