International General Certificate
of Secondary Education

Syllab

PHYSICS 0625

For examination in June and November 2010

Physics

Syllabus code: 0625

CONTENTS

Notes

Conventions (e.g. signs, symbols, terminology and nomenclature)
Syllabuses and question papers will conform with generally accepted international practice. In particular, attention is drawn to the following documents, published in the UK, which will be used as guidelines.

(a) Reports produced by the Association for Science Education (ASE):
SI Units, Signs, Symbols and Abbreviations (1981),
Chemical Nomenclature, Symbols and Terminology for use in School Science (1985),
Signs, Symbols and Systematics: The ASE Companion to 16-19 Science (2000).

(b) Reports produced by the Institute of Biology (in association with the ASE):
Biological Nomenclature, Recommendations on Terms, Units and Symbols (1989).

It is intended that, in order to avoid difficulties arising out of the use of l as the symbol for litre, usage of cm^3 in place of l or litre will be made.

Exclusions

This syllabus must not be offered in the same session with any of the following syllabuses:

0652 Physical Science
0653 Combined Science
0654 Co-ordinated Sciences (Double)
5054 Physics
5124 Science (Physics, Chemistry)
5125 Science (Physics, Biology)
5129 Combined Science
5130 Additional Combined Science

INTRODUCTION

International General Certificate of Secondary Education (IGCSE) syllabuses are designed as two-year courses for examination at age 16-plus.

All IGCSE syllabuses follow a general pattern. The main sections are:

Aims
Assessment Objectives
Assessment
Curriculum Content.

The IGCSE subjects have been categorised into groups, subjects within each group having similar Aims and Assessment Objectives.

Physics falls into Group III, Science, of the International Certificate of Education (ICE) subjects.

AIMS

The aims of the syllabus are the same for all students. The aims are set out below and describe the educational purposes of a course in Physics for the IGCSE examination. They are not listed in order of priority.

The aims are to:

1. provide, through well designed studies of experimental and practical science, a worthwhile educational experience for all students, whether or not they go on to study science beyond this level and, in particular, to enable them to acquire sufficient understanding and knowledge

   1.1 to become confident citizens in a technological world, to take or develop an informed interest in matters of scientific import;

   1.2 to recognise the usefulness, and limitations, of scientific method and to appreciate its applicability in other disciplines and in everyday life;

   1.3 to be suitably prepared for studies beyond the IGCSE level in pure sciences, in applied sciences or in science-dependent vocational courses.

2. develop abilities and skills that

   2.1 are relevant to the study and practice of Physics;

   2.2 are useful in everyday life;

   2.3 encourage safe practice;

   2.4 encourage effective communication.

3. develop attitudes relevant to Physics such as

   3.1 concern for accuracy and precision;

   3.2 objectivity;

   3.3 integrity;

   3.4 enquiry;

   3.5 initiative;

   3.6 inventiveness.

4. stimulate interest in, and care for, the environment.

5. promote an awareness that
   - 5.1 scientific theories and methods have developed, and continue to develop, as a result of co-operative activities of groups and individuals;
   - 5.2 the study and practice of science are subject to social, economic, technological, ethical and cultural influences and limitations;
   - 5.3 the applications of science may be both beneficial and detrimental to the individual, the community and the environment;
   - 5.4 science transcends national boundaries and that the language of science, correctly and rigorously applied, is universal.

ASSESSMENT OBJECTIVES

The three assessment objectives in Physics are:

A Knowledge with understanding
B Handling information and solving problems
C Experimental skills and investigations.

A description of each assessment objective follows.

A KNOWLEDGE WITH UNDERSTANDING

Students should be able to demonstrate knowledge and understanding in relation to:

1. scientific phenomena, facts, laws, definitions, concepts and theories;
2. scientific vocabulary, terminology, conventions (including symbols, quantities and units);
3. scientific instruments and apparatus, including techniques of operation and aspects of safety;
4. scientific quantities and their determination;
5. scientific and technological applications with their social, economic and environmental implications.

The Curriculum Content defines the factual material that candidates may be required to recall and explain. Questions testing these objectives will often begin with one of the following words: *define, state, describe, explain* or *outline*.

B HANDLING INFORMATION AND SOLVING PROBLEMS

Students should be able, in words or using other written forms of presentation (e.g. symbolic, graphical and numerical), to:

1. locate, select, organise and present information from a variety of sources;
2. translate information from one form to another;
3. manipulate numerical and other data;
4. use information to identify patterns, report trends and draw inferences;
5. present reasoned explanations for phenomena, patterns and relationships;
6. make predictions and hypotheses;
7. solve problems, including some of a quantitative nature.

These skills cannot be precisely specified in the Curriculum Content because questions testing such skills are often based on information which is unfamiliar to the candidate. In answering such questions, candidates are required to use principles and concepts that are within the syllabus and apply them in a logical, deductive manner to a novel situation. Questions testing these objectives will often begin with one of the following words: *predict, suggest, calculate* or *determine*.

C EXPERIMENTAL SKILLS AND INVESTIGATIONS

Students should be able to:

1. use techniques, apparatus and materials (including following a sequence of instructions where appropriate);
2. make and record observations and measurements;
3. interpret and evaluate experimental observations and data;
4. plan and carry out investigations, evaluate methods and suggest possible improvements (including the selection of techniques, apparatus and materials).

SPECIFICATION GRID

Assessment Objective		Weighting
A	Knowledge with Understanding	50% (not more than 25% recall)
B	Handling Information and Problem Solving	30%
C	Experimental Skills and Investigations	20%

WEIGHTING OF ASSESSMENT OBJECTIVES

The relationship between the assessment objectives and the scheme of assessment is set out in the table below.

	Paper 1 (marks)	Paper 2 or 3 (marks)	Paper 4, 5 or 6 (marks)	Whole assessment (%)
AO1: Knowledge with understanding	25-30	44-50	0	46-54
AO2: Handling information and problem solving	10-15	30-36	0	26-34
AO3: Experimental skills and Investigations	0	0	40	20

ASSESSMENT

All candidates must enter for three Papers. These will be Paper 1, one from either Paper 2 or Paper 3, and one from Papers 4, 5 or 6.

Candidates who have only studied the Core curriculum or who are expected to achieve a grade D or below should normally be entered for Paper 2. Candidates who have studied the Extended curriculum and who are expected to achieve a grade C or above should be entered for Paper 3.

All candidates must take a practical paper, chosen from Paper 4 (School-based Assessment of Practical Skills), or Paper 5 (Practical Test), or Paper 6 (Alternative to Practical).

<table>
<tr><td>Core curriculum
Grades C to G available</td><td>Extended curriculum
Grades A* to G available</td></tr>
<tr><td colspan="2">Paper 1 (45 minutes)
Compulsory A multiple-choice paper consisting of forty items of the four-choice type.
The questions will be based on the Core curriculum, will be of a difficulty appropriate to grades C to G, and will test skills mainly in Assessment Objectives A and B.
This paper will be weighted at 30% of the final total available marks.</td></tr>
<tr><td>Either:
Paper 2 (1 hour 15 minutes)
Core theory paper consisting of 80 marks of short-answer and structured questions.
The questions will be of a difficulty appropriate to grades C to G and will test skills mainly in Assessment Objectives A and B.
The questions will be based on the Core curriculum.
This Paper will be weighted at 50% of the final total available marks.</td><td>Or:
Paper 3 (1 hour 15 minutes)
Extended theory paper consisting of 80 marks of short-answer and structured questions.
The questions will be of a difficulty appropriate to the higher grades and will test skills mainly in Assessment Objectives A and B.
A quarter of the marks available will be based on Core material and the remainder on the Supplement.
This Paper will be weighted at 50% of the final total available marks.</td></tr>
<tr><td colspan="2">Practical Assessment
Compulsory The purpose of this component is to test appropriate skills in assessment Objective C. Candidates will not be required to use knowledge outside the Core curriculum.
Candidates must be entered for one of the following:
Either: Paper 4 Coursework (school-based assessment of practical skills)*
Or: Paper 5 Practical Test (1 hour 15 minutes), with questions covering experimental and observational skills.
Or: Paper 6 Alternative to Practical Paper (1 hour). This is a written paper designed to test familiarity with laboratory based procedures.
The practical assessment will be weighted at 20% of the final total available marks.</td></tr>
</table>

*Teachers may not undertake school-based assessment without the written approval of CIE. This will only be given to teachers who satisfy CIE requirements concerning moderation and they will have to undergo special training in assessment before entering candidates. CIE offers schools in-service training in the form of occasional face-to-face courses held in countries where there is a need, and also through the IGCSE Coursework Training Handbook, available from CIE Publications.

CURRICULUM CONTENT

Students can follow either the Core curriculum only or they may follow the Extended curriculum, which includes both the Core and the Supplement. Students aiming for grades A* to C must follow the Extended curriculum. Students are expected to have adequate mathematical skills to cope with the curriculum.

Reference should also be made to the summary list of symbols, units and definitions of quantities.

Throughout the course, attention should be paid to showing the relevance of concepts to the students' everyday life and to the natural and man-made world. In order to encourage such an approach and to allow flexibility in teaching programmes to meet the more generalised Aims, the specified content of the syllabus has been limited. In this wider sense, as well as in the literal sense, the following material should be regarded as an examination syllabus rather than a teaching syllabus.

TOPIC	CORE	SUPPLEMENT
	All students should be able to:	*In addition to what is required for the Core, students following the Extended curriculum should be able to:*
1. General Physics		
1.1 Length and time	-use and describe the use of rules and measuring cylinders to determine a length or a volume -use and describe the use of clocks and devices for measuring an interval of time	-use and describe the use of a mechanical method for the measurement of a small distance -measure and describe how to measure a short interval of time (including the period of a pendulum)
1.2 Speed, velocity and acceleration	-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 (a) at rest, (b) moving with constant speed, (c) moving with changing speed -calculate the area under a speed/time graph to determine the distance travelled for motion with constant acceleration -demonstrate some understanding that acceleration is related to changing speed	-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
	-state that the acceleration of free fall for a body near to the Earth is 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	-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	-demonstrate an understanding that mass is a property which 'resists' change in motion -describe, and use the concept of, weight as the effect of a gravitational field on a mass
1.4 Density	-describe an experiment to determine the density of a liquid and of a regularly shaped solid and make the necessary calculation	-describe the determination of the density of an irregularly shaped solid by the method of displacement and make the necessary calculation

TOPIC	CORE	SUPPLEMENT
1.5 Forces		
(a) Effects of forces	-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	-interpret extension/load graphs -state Hooke's Law and recall and use the expression $F = k\,x$ -recognise the significance of the term 'limit of proportionality' for an extension/load graph
	-describe the ways in which a force may change the motion of a body	-recall and use the relation between force, mass and acceleration (including the direction)
	-find the resultant of two or more forces acting along the same line	-describe, qualitatively, motion in a curved path due to a perpendicular force ($F = mv^2 / r$ is *not* required)
(b) Turning effect	-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	-perform and describe an experiment (involving vertical forces) to verify that there is no net moment on a body in equilibrium -apply the idea of opposing moments to simple systems in equilibrium
(c) Conditions for equilibrium	-state that, when there is no resultant force and no resultant turning effect, a system is in equilibrium	
(d) Centre of mass	-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	
(e) Scalars and vectors		-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 a resultant of two vectors
1.6 Energy, work and power (a) Energy	-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	-recall and use the expressions k.e.= $\frac{1}{2}mv^2$ and p.e. = mgh
	-give examples of the conversion of energy from one form to another and of its transfer from on place to another	
	-apply the principle of energy conservation to simple examples	

TOPIC	CORE	SUPPLEMENT
(b) Energy resources	-describe how electricity or other useful forms of energy may be obtained from (i) chemical energy stored in fuel (ii) water, including the energy stored in waves, in tides, and in water behind hydroelectric dams (iii) geothermal resources (iv) nuclear fission (v) heat and light from the Sun	-show an understanding that energy is released by nuclear fusion in the Sun -show a qualitative understanding of efficiency
(c) Work	-relate, without calculation, work done to the magnitude of a force and the distance moved	-describe energy changes in terms of work done -recall and use $\Delta W = Fd = \Delta E$
(d) Power	-relate, without calculation, power to work done and time taken, using appropriate examples	-recall and use the equation $P = E/t$ in simple systems
1.7 Pressure	-relate, without calculation, pressure to force and area, using appropriate examples	-recall and use the equation $p = F/A$
	-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	-recall and use the equation $p = h\rho g$
	-use and describe the use of a manometer	
2. Thermal Physics		
2.1 Simple kinetic molecular model of matter		
(a) States of matter	-state the distinguishing properties of solids, liquids and gases	
(b) Molecular model	-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	-relate the properties of solids, liquids and gases to the forces and distances between molecules and to the motion of the molecules
	-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
(c) Evaporation	-describe evaporation in terms of the escape of more-energetic molecules from the surface of a liquid -relate evaporation and the consequent cooling	-demonstrate an understanding of how temperature, surface area and draught over a surface influence evaporation
(d) Pressure changes	-relate the change in volume of a gas to change in pressure applied to the gas at constant temperature	-recall and use the equation pV = constant at constant temperature

TOPIC	CORE	SUPPLEMENT
2.2 Thermal properties		
(a) Thermal expansion of solids, liquids and gases	-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	-show an appreciation of the relative order of magnitude of the expansion of solids, liquids and gases
(b) Measurement of temperature	-appreciate how a physical property which 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	-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 which vary rapidly
(c) Thermal capacity	-relate a rise in temperature of a body to an increase in internal energy -show an understanding of the term thermal capacity	-describe an experiment to measure the specific heat capacity of a substance
(d) Melting and boiling	-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	-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		
(a) Conduction	-describe experiments to demonstrate the properties of good and bad conductors of heat	-give a simple molecular account of heat transfer in solids
(b) Convection	-relate convection in fluids to density changes and describe experiments to illustrate convection	
(c) Radiation	-identify infra-red radiation as part of the electromagnetic spectrum	-describe experiments to show the properties of good and bad emitters and good and bad absorbers of infra-red radiation
(d) Consequences of energy transfer	-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	-describe what is meant by wave motion as illustrated by vibration in ropes, springs and by experiments using water waves -use the term wavefront -give the meaning of speed, frequency, wavelength and amplitude	-recall and use the equation $v = f\lambda$

TOPIC	CORE	SUPPLEMENT
	-distinguish between transverse and longitudinal waves and give suitable examples	
	-describe the use of water waves to show (i) reflection at a plane surface (ii) refraction due to a change of speed (iii) diffraction produced by wide and narrow gaps	-interpret reflection, refraction and diffraction using wave theory
3.2 Light		
(a) Reflection of light	-describe the formation, and give the characteristics, of an optical image by a plane mirror	
	-use the law angle of incidence = angle of reflection	-perform simple constructions, measurements and calculations
(b) Refraction of light	-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	-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
	-give the meaning of critical angle	
	-describe internal and total internal reflection	
(c) Thin converging lens	-describe the action of a thin converging lens on a beam of light	
	-use the term principal focus and focal length	
	-draw ray diagrams to illustrate the formation of a real image by a single lens	-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
(d) Dispersion of light	-give a qualitative account of the dispersion of light as illustrated by the action on light of a glass prism	
(e) Electromagnetic spectrum	-describe the main features of the electromagnetic spectrum and state that all e.m. waves travel with the same high speed *in vacuo*	-state the approximate value of the speed of electro-magnetic waves -use the term monochromatic
3.3 Sound	-describe the production of sound by vibrating sources	
	-describe the longitudinal nature of sound waves	-describe compression and rarefaction
	-state the approximate range of audible frequencies	
	-show an understanding that a medium is required in order to transmit sound waves	
	-describe an experiment to determine the speed of sound in air	-state the order of magnitude of the speed of sound in air, liquids and solids
	-relate the loudness and pitch of sound waves to amplitude and frequency	
	-describe how the reflection of sound may produce an echo	

TOPIC	CORE	SUPPLEMENT
4. Electricity and magnetism		
4.1 Simple phenomena of magnetism	-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 round 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		
(a) Electric charge	-describe simple experiments to show the production and detection of electrostatic charges	
	-state that there are positive and negative charges	-state that charge is measured in coulombs
	-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	-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
	-distinguish between electrical conductors and insulators and give typical examples	-give an account of charging by induction -recall and use the simple electron model to distinguish between conductors and insulators
(b) Current	-state that current is related to the flow of charge -use and describe the use of an ammeter	-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
(c) Electro-motive force	-state that the e.m.f. of a source of electrical energy is measured in volts	-show understanding that e.m.f. is defined in terms of energy supplied by a source in driving charge round a complete circuit
(d) Potential difference	-state that the potential difference across a circuit component is measured in volts -use and describe the use of a voltmeter	
(e) Resistance	-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	-recall and use quantitatively the proportionality between resistance and the length and the inverse proportionality between resistance and cross-sectional area of a wire
(f) Electrical energy		-recall and use the equations $P = I\,V$ and $E = I\,V\,t$

TOPIC	CORE	SUPPLEMENT
4.3 Electric circuits		
(a) Circuit diagrams	-draw and interpret circuit diagrams containing sources, switches, resistors (fixed and variable), lamps, ammeters voltmeters, magnetising coils, transformers, bells, fuses and relays	-draw and interpret circuit diagrams containing diodes and transistors
(b) Series and parallel circuits	-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	-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
	-state that, for a parallel circuit, the current from the source is larger than the current in each branch	-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
	-state that the combined resistance of two resistors in parallel is less than that of either resistor by itself	-calculate the effective resistance of two resistors in parallel
(c) Action and use of circuit components	-state the advantages of connecting lamps in parallel in a lighting circuit -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	
		-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)
(d) Digital electronics		-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 (the American ANSI#Y 32.14 symbols will be used)

TOPIC	CORE	SUPPLEMENT
4.4 Dangers of electricity	-state the hazards of (i) damaged insulation (ii) overheating of cables (iii) damp conditions -show an understanding of the use of fuses and circuit-breakers	
4.5 Electromagnetic effects		
(a) Electromagnetic induction	-describe an experiment which shows that a changing magnetic field can induce an e.m.f. in a circuit	-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
(b) a.c. generator	-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	
(c) Transformer	-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	-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
(d) The magnetic effect of a current	- 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	-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
(e) 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: (i) the current (ii) the direction of the field	-describe an experiment to show the corresponding force on beams of charged particles -state and use the relative directions of force, field and current
(f) 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 -relate this turning effect to the action of an electric motor	-describe the effect of increasing the current
4.6 Cathode ray oscilloscopes		
(a) Cathode rays	-describe the production and detection of cathode rays -describe their deflection in electric fields -state that the particles emitted in thermionic emission are electrons	
(b) Simple treatment of cathode-ray oscilloscope		-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

TOPIC	CORE	SUPPLEMENT
5. Atomic Physics		
5.1 Radioactivity		
(a) Detection of radioactivity	-show awareness of the existence of background radiation -describe the detection of α-particles, β-particles and γ-rays (β^+ is not included: β-particles will be taken to refer to β^-.)	
(b) Characteristics of the three kinds of emission	-state that radioactive emissions occur randomly over space and time -state, for radioactive emissions: (i) their nature (ii) their relative ionising effects (iii) their relative penetrating abilities	-describe their deflection in electric fields and magnetic fields -interpret their relative ionising effects
(c) Radioactive decay	-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	
(d) Half-life	-use the term half-life in simple calculations which might involve information in tables or decay curves	
(e) Safety precautions	-describe how radioactive materials are handled, used and stored in a safe way	
5.2 The nuclear atom		
(a) Atomic model	-describe the structure of an atom in terms of a nucleus and electrons	-describe how the scattering of α-particles by thin metal foils provides evidence for the nuclear atom
(b) Nucleus	-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 $^{A}_{Z}\mathrm{X}$	
(c) Isotopes		-use the term isotope -give and explain examples of practical applications of isotopes

SYMBOLS, UNITS AND DEFINITIONS OF PHYSICAL QUANTITIES

Students should be able to state the symbols for the following physical quantities and, where indicated, state the units in which they are measured. Students should be able to define those items indicated by an asterisk (*). The list for 'extended' includes both the Core and the Supplement.

CORE (for all students)			**SUPPLEMENT** (for students who are following the Extended Curriculum)		
Quantity	*Symbol*	*Unit*	*Quantity*	*Symbol*	*Unit*
length	*l, h ...*	km, m, cm, mm			
area	*A*	m^2, cm^2			
volume	*V*	m^3, cm^3			
weight	*W*	N			N*
mass	*m, M*	kg, g			mg
time	*t*	h, min, s			ms
density*		g/cm^3, kg/m^3			
speed*	*u, v*	km/h, m/s, cm/s			
acceleration	*a*		acceleration*		m/s^2
acceleration of free fall	*g*				
force	*F, P ...*	N	force*		N*
			moment of a force*		N m
work done	*W, E*	J	work done by a force*		J*
energy	*E*	J			J*, kW h*
power	*P*	W	power*		W*
pressure	*p, P*		pressure*		Pa*, N/m^2
			atmospheric pressure		millibar
temperature	θ, *t*	°C			
specific heat capacity	*c*	J/(g °C), J/(kg °C)	specific heat capacity*		
latent heat	*L*	J	specific latent heat*	l	J/kg, J/g
			frequency*	*f*	Hz
			wavelength*	λ	m, cm
focal length	*f*				
angle of incidence	*i*	degree (°)	refractive index	*n*	
angle of reflection, refraction	*r*	degree (°)			
critical angle	*c*	degree (°)			
potential difference /voltage	*V*	V, mV	potential difference*		V*
current	*I*	A, mA	current*		
			charge		C, A s
e.m.f.	*E*	V	e.m.f.*		
resistance	*R*	Ω			

ASSESSMENT CRITERIA FOR PRACTICALS

PRACTICAL ASSESSMENT – PAPERS 4 OR 5 OR 6

Scientific subjects are, by their nature, experimental. It is accordingly important that an assessment of a student's knowledge and understanding of Physics should contain a component relating to practical work and experimental skills (as identified by Assessment Objective C). In order to accommodate, within IGCSE, differing circumstances – such as the availability of resources – three different means of assessing Assessment Objective C are provided, namely school-based assessment, a formal practical test, or a written alternative-to-practical paper, as outlined in the Scheme of Assessment.

Paper 4, Coursework (School-based assessment of experimental skills and abilities)

Teachers may not undertake school-based assessment without the written approval of CIE. This will only be given to teachers who satisfy CIE requirements concerning moderation. Teachers will have to undergo special training in assessment before entering candidates.

CIE offers schools in-service training in the form of courses held at intervals in Cambridge and elsewhere, and also via distance training.

Paper 5, Practical Test

Candidates should be able to:

- follow written instructions for the assembly and use of provided apparatus, e.g. for using ray-tracing equipment, for wiring up simple electrical circuits
- select, from given items, the measuring device suitable for the task
- carry out the specified manipulation of the apparatus, e.g.:
  - 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 the thermal capacity of two metals
- take readings from a measuring device, including:
  - reading a scale with appropriate precision/accuracy;
  - consistent use of significant figures;
  - interpolating between scale divisions;
  - allowing for zero errors, where appropriate;
  - taking repeated measurements to obtain an average value
- record their observations systematically, with appropriate units
- process their data as required
- present their data graphically, using suitable axes and scales (appropriately labelled) and plotting the points accurately
- take readings from a graph by interpolation and extrapolation
- determine a gradient, intercept or intersection on a graph
- draw and report a conclusion or result clearly
- indicate how they carried out a required instruction
- describe precautions taken in carrying out a procedure
- give reasons for making a choice of items of apparatus
- comment on a procedure used in an experiment and suggest an improvement.

Note The examination will not allow the use of textbooks nor will candidates be allowed to have access to their own records of laboratory work carried out during their course: candidates will be expected to carry out the experiments from the instructions given in the paper. Candidates will answer on the question paper.

Paper 6, Alternative to Practical

This paper is designed to test candidates' familiarity with laboratory practical procedure. Questions may be set requesting candidates to do the following:

- describe in simple terms how they would carry out practical procedures
- explain and/or comment critically on described procedures or points of practical detail
- follow instructions for drawing diagrams
- draw, complete and/or label diagrams of apparatus
- take readings from their own diagrams, drawn as instructed, and/or from printed diagrams including:
  reading a scale with appropriate precision/accuracy with consistent use of significant figures and with appropriate units;
  interpolating between scale divisions;
  taking repeat measurements to obtain an average value
- process data as required
- present data graphically, using suitable axes and scales (appropriately labelled) and plotting the points accurately
- take readings from a graph by interpolation and extrapolation
- determine a gradient, intercept or intersection on a graph
- draw and report a conclusion or result clearly
- identify and/or select, with reasons, items of apparatus to be used for carrying out practical procedures
- explain, suggest and/or comment critically on precautions taken and/or possible improvements to techniques and procedures.

COURSEWORK (SCHOOL-BASED ASSESSMENT (PAPER 4))

The experimental skills and abilities C1 to C4 to be assessed are given below

C1 Using and organising techniques, apparatus and materials

C2 Observing, measuring and recording

C3 Handling experimental observations and data

C4 Planning investigations

The four skills carry equal weighting.

All assessments must be based upon experimental work carried out by the candidates.

It is expected that the teaching and assessment of experimental skills and abilities will take place throughout the course.

Teachers must ensure that they can make available to CIE evidence of two assessments of each skill for each candidate. For skills C1 to C4 inclusive, information about the tasks set and how the marks were awarded will be required. In addition, for skills C2, C3 and C4, the candidate's written work will also be required.

The assessment scores finally recorded for each skill must represent the candidate's best performances.

For candidates who miss the assessment of a given skill through no fault of their own, for example because of illness, and who cannot be assessed **on another occasion**, CIE procedure for special consideration should be followed. However, candidates who for no good reason absent themselves from an assessment of a given skill should be given a mark of zero for that assessment.

CRITERIA FOR ASSESSMENT OF EXPERIMENTAL SKILLS AND ABILITIES

Each skill must be assessed on a six-point scale, level 6 being the highest level of achievement. Each of the skills is defined in terms of three levels of achievement at scores of 2, 4, and 6.

A score of 0 is available if there is no evidence of positive achievement for a skill.

For candidates who do not meet the criteria for a score of 2, a score of 1 is available if there is some evidence of positive achievement.

A score of 3 is available for candidates who go beyond the level defined for 2, but who do not meet fully the criteria for 4.

Similarly, a score of 5 is available for those who go beyond the level defined for 4, but do not meet fully the criteria for 6.

SKILL C1 USING AND ORGANISING TECHNIQUES, APPARATUS AND MATERIALS

1

2 - Follows written, diagrammatic or oral instructions to perform a single practical operation.
Uses familiar apparatus and materials adequately, needing reminders on points of safety.

3

4 - Follows written, diagrammatic or oral instructions to perform an experiment involving a series of step-by-step practical operations.
Uses familiar apparatus, materials and techniques adequately and safely.

5

6 - Follows written, diagrammatic or oral instructions to perform an experiment involving a series of practical operations where there may be a need to modify or adjust one step in the light of the effect of a previous step.
Uses familiar apparatus, materials and techniques safely, correctly and methodically.

SKILL C2 OBSERVING, MEASURING AND RECORDING

1

2 - Makes observations or readings given detailed instructions.
Records results in an appropriate manner given a detailed format.

3

4 - Makes relevant observations or measurements given an outline format or brief guidelines.
Records results in an appropriate manner given an outline format.

5

6 - Makes relevant observations or measurements to a degree of accuracy appropriate to the instruments or techniques used.
Records results in an appropriate manner given no format.

SKILL C3 HANDLING EXPERIMENTAL OBSERVATIONS AND DATA

1

2 - Processes results in an appropriate manner given a detailed format.
Draws an obvious qualitative conclusion from the results of an experiment.

3

4 - Processes results in an appropriate manner given an outline format.
Recognises and comments on anomalous results.
Draws qualitative conclusions which are consistent with obtained results and deduces patterns in data.

5

6 - Processes results in an appropriate manner given no format.
Deals appropriately with anomalous or inconsistent results.
Recognises and comments on possible sources of experimental error.
Expresses conclusions as generalisations or patterns where appropriate.

<u>SKILL C4 PLANNING, CARRYING OUT AND EVALUATING INVESTIGATIONS</u>

1
2 - Suggests a simple experimental strategy to investigate a given practical problem.
Attempts 'trial and error' modification in the light of the experimental work carried out.

3
4 - Specifies a sequence of activities to investigate a given practical problem.
In a situation where there are two variables, recognises the need to keep one of them constant while the other is being changed.
Comments critically on the original plan, and implements appropriate changes in the light of the experimental work carried out.

5
6 - Analyses a practical problem systematically and produces a logical plan for an investigation.
In a given situation, recognises that there are a number of variables and attempts to control them.
Evaluates chosen procedures, suggests/implements modifications where appropriate and shows a systematic approach in dealing with unexpected results.

NOTES FOR GUIDANCE

The following notes are intended to provide teachers with information to help them to make valid and reliable assessments of the skills and abilities of their candidates.

The assessments should be based on the principle of positive achievement: candidates should be given opportunities to demonstrate what they understand and can do.

It is expected that candidates will have had opportunities to acquire a given skill before assessment takes place.

It is not expected that all of the practical work undertaken by a candidate will be assessed.

Assessments can be carried out at any time during the course. However, at whatever stage assessments are done, the standards applied must be those expected at the end of the course as exemplified in the criteria for the skills.

Assessments should normally be made by the person responsible for teaching the candidates.

It is recognised that a given practical task is unlikely to provide opportunities for all aspects of the criteria at a given level for a particular skill to be satisfied, for example, there may not be any anomalous results (Skill C3). However, by using a range of practical work, teachers should ensure that opportunities are provided for all aspects of the criteria to be satisfied during the course.

The educational value of extended experimental investigations is widely recognised. Where such investigations are used for assessment purposes, teachers should make sure that candidates have ample opportunity for displaying the skills and abilities required by the scheme of assessment.

It is not necessary for all candidates in a Centre, or in a teaching group within a Centre, to be assessed on exactly the same practical work, although teachers may well wish to make use of work that is undertaken by all of their candidates.

When an assessment is carried out on group work the teacher must ensure that the individual contribution of each candidate can be assessed.

Skill C1 may not generate a written product from the candidates. It will often be assessed by watching the candidates carrying out practical work.

Skills C2, C3 and C4 will usually generate a written product from the candidates. This product will provide evidence for moderation.

Raw scores for individual practical assessments should be recorded on the Individual Candidate Record Card. The final, internally moderated, total score should be recorded on the Coursework Assessment Summary Form. Examples of both forms, plus the Sciences Experiment Form, are provided at the back of this syllabus.

Raw scores for individual practical assessments may be given to candidates as part of the normal feedback from the teacher. The final, internally moderated, total score, which is submitted to CIE, should not be given to the candidate.

MODERATION

(a) Internal Moderation

When several teachers in a Centre are involved in internal assessments, arrangements must be made within the Centre for all candidates to be assessed to a common standard.

It is essential that within each Centre the marks for each skill assigned within different teaching groups (e.g. different classes) are moderated internally for the whole Centre entry. The Centre assessments will then be subject to external moderation.

(b) External Moderation

External moderation of internal assessment will be carried out by CIE.

The internally moderated marks for all candidates must be received at CIE by 30 April for the May/June examination and by 31 October for the November examination. These marks may be submitted either by using MS1 mark sheets or by using Cameo as described in the Handbook for Centres.

Once CIE has received the marks, CIE will select a sample of candidates whose work should be submitted for external moderation. CIE will communicate the list of candidates to the Centre, and the Centre should despatch the coursework of these candidates to CIE immediately. For each candidate on the list, every piece of work which has contributed to the final mark should be sent to CIE. Individual Candidate Record Cards and Coursework Assessment Summary Forms (copies of which may be found at the back of this syllabus booklet) must be enclosed with the coursework.

Further information about external moderation may be found in the Handbook for Centres and the Administrative Guide for Centres.

A further sample of work may subsequently be required. All records and supporting written work should therefore be retained until after publications of results.

Centres may find it convenient to use loose-leaf A4 file paper for assessed written work. This is because samples will be sent through the post for moderation and postage bills are likely to be large if whole exercise books are sent. Authenticated photocopies of the sample required would be acceptable.

The individual pieces of work should **not** be stapled together. Each piece of work should be labelled with the skill being assessed, the Centre number and candidate name and number, title of the experiment, a copy of the marking scheme used, and the mark awarded. This information should be attached securely, mindful that adhesive labels tend to peel off some plastic surfaces.

GRADE DESCRIPTIONS

The scheme of assessment is intended to encourage positive achievement by all candidates

A **Grade A** candidate must show mastery of the Core curriculum and the Extended curriculum.

A **Grade C** candidate must show mastery in answering questions based on the Core curriculum plus some ability to answer questions which are pitched at a higher level.

A **Grade F** candidate must show competence in answering questions based on the Core curriculum.

A **Grade A** candidate is likely to:

- relate facts to principles and theories and vice versa;
- state why particular techniques are preferred for a procedure or operation;
- select and collate information from a number of sources and present it in a clear logical form;
- solve problems in situations which may involve a wide range of variables;
- process data from a number of sources to identify any patterns or trends;
- generate a hypothesis to explain facts, or find facts to support a hypothesis.

A **Grade C** candidate is likely to:

- link facts to situations not specified in the syllabus;
- describe the correct procedure(s) for a multi-stage operation;
- select a range of information from a given source and present it in a clear logical form;
- identify patterns or trends in given information;
- solve a problem involving more than one step, but with a limited range of variables;
- generate a hypothesis to explain a given set of facts or data.

A **Grade F** candidate is likely to:

- recall facts contained in the syllabus;
- indicate the correct procedure for a single operation;
- select and present a single piece of information from a given source;
- solve a problem involving one step, or more than one step if structured help is given;
- identify a pattern or trend where only a minor manipulation of data is needed;
- recognise which of two given hypotheses explains a set of facts or data.

GLOSSARY OF TERMS USED IN SCIENCE PAPERS

It is hoped that the glossary (which is relevant only to Science subjects) will prove helpful to candidates as a guide, i.e. it is neither exhaustive nor definitive. The glossary has been deliberately kept brief not only with respect to the number of terms included but also to the descriptions of their meanings. Candidates should appreciate that the meaning of a term must depend, in part, on its context.

1. *Define* (the term(s)...) is intended literally, only a formal statement or equivalent paraphrase being required.
2. *What do you understand by/What is meant by* (the term (s)...) normally implies that a definition should be given, together with some relevant comment on the significance or context of the term(s) concerned, especially where two or more terms are included in the question. The amount of supplementary comment intended should be interpreted in the light of the indicated mark value.
3. *State* implies a concise answer with little or no supporting argument (e.g. a numerical answer that can readily be obtained 'by inspection').
4. *List* requires a number of points, generally each of one word, with no elaboration. Where a given number of points is specified this should not be exceeded.
5. *Explain* may imply reasoning or some reference to theory, depending on the context.
6. *Describe* requires the candidate to state in words (using diagrams where appropriate) the main points of the topic. It is often used with reference either to particular phenomena or to particular experiments. In the former instance, the term usually implies that the answer should include reference to (visual) observations associated with the phenomena.

   In other contexts, *describe* should be interpreted more generally, i.e. the candidate has greater discretion about the nature and the organisation of the material to be included in the answer. *Describe and explain* may be coupled, as may *state and explain*.
7. *Discuss* requires the candidate to give a critical account of the points involved in the topic.
8. *Outline* implies brevity, i.e. restricting the answer to giving essentials.
9. *Predict* implies that the candidate is not expected to produce the required answer by recall but by making a logical connection between other pieces of information. Such information may be wholly given in the question or may depend on answers extracted in an earlier part of the question.

   Predict also implies a concise answer with no supporting statement required.
10. *Deduce* is used in a similar way to *predict* except that some supporting statement is required, e.g. reference to a law, principle, or the necessary reasoning should be included in the answer.
11. *Suggest* is used in two main contexts, i.e. either to imply that there is no unique answer (e.g. in Physics, there are several examples of energy resources from which electricity, or other useful forms of energy, may be obtained), or to imply that candidates are expected to apply their general knowledge to a 'novel' situation, one that may be formally 'not in the syllabus' – many data response and problem solving questions are of this type.
12. *Find* is a general term that may variously be interpreted as *calculate, measure, determine*, etc.
13. *Calculate* is used when a numerical answer is required. In general, working should be shown, especially where two or more steps are involved.
14. *Measure* implies that the quantity concerned can be directly obtained from a suitable measuring instrument, e.g. length, using a rule, or mass, using a balance.
15. *Determine* often implies that the quantity concerned cannot be measured directly but is obtained by calculation, substituting measured or known values of other quantities into a standard formula.

16. *Estimate* implies a reasoned order of magnitude statement or calculation of the quantity concerned, making such simplifying assumptions as may be necessary about points of principle and about the values of quantities not otherwise included in the question.

17. *Sketch*, when applied to graph work, implies that the shape and/or position of the curve need only be qualitatively correct, **but** candidates should be aware that, depending on the context, some quantitative aspects may be looked for, e.g. passing through the origin, having an intercept.

    In diagrams, *sketch* implies that simple, freehand drawing is acceptable; nevertheless, care should be taken over proportions and the clear exposition of important details.

MATHEMATICAL REQUIREMENTS

Calculators may be used in all parts of the examination.

Candidates should be able to:

1. add, subtract, multiply and divide;
2. use averages, decimals, fractions, percentages, ratios and reciprocals;
3. recognise and use standard notation;
4. use direct and inverse proportion;
5. use positive, whole number indices;
6. draw charts and graphs from given data;
7. interpret charts and graphs;
8. select suitable scales and axes for graphs;
9. make approximate evaluations of numerical expressions;
10. recognise and use the relationship between length, surface area and volume and their units on metric scales;
11. use usual mathematical instruments (ruler, compasses, protractor, set square);
12. understand the meaning of angle, curve, circle, radius, diameter, square, parallelogram, rectangle and diagonal;
13. solve equations of the form $x = yz$ for any one term when the other two are known;
14. recognise and use points of the compass (N, S, E, W).

RESOURCE LIST

The following books have been endorsed by CIE for use with this syllabus. They have been through an independent quality assurance process and match the syllabus content closely.

Duncan, T & Kennett, H	*IGCSE Physics* John Murray ISBN 0 7195 7849 3 http://johnmurray.co.uk
Folland, M	*IGCSE Study Guide for Physics* (2005) Hodder Murray ISBN 0 7195 7903 1 http://www.hodderheadline.co.uk

Teachers may also find reference to the following books helpful. These are suitable for use with this syllabus. Content of the books does not necessarily match the CIE syllabus closely and examples may be British in focus.

Breithaupt, J	*Key Science – Physics* Stanley Thornes ISBN 0 7487 1674 2 http://www.heinemann.co.uk
Pople, S	*Explaining Physics* (GCSE Edition) Oxford University Press ISBN 0 1991 4272 6 http://www.oup.co.uk

These titles represent some of the texts available at the time of printing this booklet. Teachers are encouraged to choose texts for class use which they feel will be of interest to their students and will support their own teaching style.

SCIENCES
Experiment Form
IGCSE

Please read the instructions printed overleaf.

Centre Number						Centre Name	
Syllabus Code		0	6	2	5	Syllabus Title	**Physics**
Component Number		0		4		Component Title	**Coursework**
June/November	2	0	1	0			

Experiment Number	Experiment	Skill(s) Assessed

INSTRUCTIONS FOR COMPLETING SCIENCES EXPERIMENT FORM

1. Complete the information at the head of the form.
2. Use a separate form for each Syllabus.
3. Give a brief description of each of the experiments your students performed for assessment in the IGCSE Science Syllabus indicated. Use additional sheets as necessary.
4. Copies of the experiment forms and the corresponding worksheets/instructions and marking schemes will be required for each assessed task sampled, for each of Skills C1 to C4 inclusive.

SCIENCES
Individual Candidate Record Card
IGCSE

Please read the instructions printed overleaf and the General Coursework Regulations before completing this form.

Centre Number		Centre Name		June/November	2 0 1 0
Candidate Number		Candidate Name		Teaching Group/Set	
Syllabus Code	0 6 2 5	Syllabus Title	**PHYSICS**	Component Number	0 4
				Component Title	**COURSEWORK**

Date of Assessment	Experiment Number from Sciences Experiment Form	Assess at least twice: ring highest two marks for each skill (Max 6 each assessment)				Relevant comments (for example, if help was given)
		C1	C2	C3	C4	
Marks to be transferred to Coursework Assessment Summary Form		(max 12)	(max 12)	(max 12)	(max 12)	TOTAL (max 48)

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INSTRUCTIONS FOR COMPLETING INDIVIDUAL RECORD CARDS

1. Complete the information at the head of the form.
2. Mark each item of Coursework for each candidate according to instructions given in the Syllabus and Training Manual.
3. Enter marks and total marks in the appropriate spaces. Complete any other sections of the form required.
4. Ensure that the addition of marks is independently checked.
5. **It is essential that the marks of candidates from different teaching groups within each Centre are moderated internally.** This means that the marks awarded to all candidates within a Centre must be brought to a common standard by the teacher responsible for co-ordinating the internal assessment (i.e. the internal moderator), and a single valid and reliable set of marks should be produced which reflects the relative attainment of all the candidates in the Coursework component at the Centre.
6. Transfer the marks to the Coursework Assessment Summary Form in accordance with the instructions given on that document.
7. Retain all Individual Candidate Record Cards and Coursework which **will be required for external moderation.** Further detailed instructions about external moderation will be sent in late March of the year of the June examination and in early October of the year of the November examination. See also the instructions on the Coursework Assessment Summary Form.

   Note: These Record Cards are to be used by teachers only for students who have undertaken Coursework as part of their IGCSE.

SCIENCES
Coursework Assessment Summary Form
IGCSE

Please read the instructions printed overleaf and the General Coursework Regulations before completing this form.

Centre Number						Centre Name			June/November	**2**	**0**	**1**	**0**	
Syllabus Code	**0**	**6**	**2**	**5**		Syllabus Title	**PHYSICS**	Component Number	**0**	**4**	Component Title	**COURSEWORK**		

Candidate Number	Candidate Name	Teaching Group/ Set	C1 (max 12)	C2 (max 12)	C3 (max 12)	C4 (max 12)	Total Mark (max 48)	Internally Moderated Mark (max 48)

Name of teacher completing this form		Signature		Date	
Name of internal moderator		Signature		Date	

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A. INSTRUCTIONS FOR COMPLETING COURSEWORK ASSESSMENT SUMMARY FORMS

1. Complete the information at the head of the form.
2. List the candidates in an order which will allow ease of transfer of information to a computer-printed Coursework mark sheet MS1 at a later stage (i.e. in candidate index number order, where this is known; see item B1 below). Show the teaching group or set for each candidate. The initials of the teacher may be used to indicate group or set.
3. Transfer each candidate's marks from his or her Individual Candidate Record Card to this form as follows:
   (a) Where there are columns for individual skills or assignments, enter the marks initially awarded (i.e. before internal moderation took place).
   (b) In the column headed 'Total Mark', enter the total marks awarded before internal moderation took place.
   (c) In the column headed 'Internally Moderated Mark', enter the total mark awarded *after* internal moderation took place.
4. Both the teacher completing the form and the internal moderator (or moderators) should check the form and complete and sign the bottom portion.

B. PROCEDURES FOR EXTERNAL MODERATION

1. Cambridge International Examinations (CIE) sends a computer-printed Coursework mark sheet MS1 to each Centre (in late March for the June examination and in early October for the November examination) showing the names and index numbers of each candidate. Transfer the total internally moderated mark for each candidate from the Coursework Assessment Summary Form to the computer-printed Coursework mark sheet MS1.
2. The top copy of the computer-printed Coursework mark sheet MS1 must be despatched in the specially provided envelope to arrive as soon as possible at CIE but no later than 30 April for the June examination and 31 October for the November examination.
3. CIE will select a list of candidates whose work is required for external moderation. As soon as this list is received, send the candidates' work with the corresponding Individual Candidate Record Cards, this summary form and the second copy of MS1 to CIE.
4. Experiment Forms, Work Sheets and Marking Schemes must be included for each task **that has contributed to the final mark of these candidates**.
5. Photocopies of the samples may be sent **but** candidates' original work, with marks and comments from the teacher, is preferred.
6. (a) The pieces of work for each skill should **not** be stapled together, nor should individual sheets be enclosed in plastic wallets.
   (b) Each piece of work should be clearly labelled with the skill being assessed, Centre name, candidate name and index number and the mark awarded. For each task, supply the information requested in B4 above.
7. CIE reserves the right to ask for further samples of Coursework.

APPENDIX: ADDITIONAL INFORMATION

Spiritual, Ethical, Social, Legislative, Economic and Cultural Issues

Throughout, the syllabus fosters in candidates a sense of wonder at the simplicity and universality of physical laws and how these order and give meaning to our view of the workings of nature. There is the opportunity for candidates to study physical systems from atomic to solar system, helping them to develop an appreciation of the variety and immensity of the natural world.

Candidates, in the course of their practical work, will gain an understanding of the scientific method and the importance of integrity in reporting results.

There is the opportunity to discuss how scientific developments in the modern world (e.g. nuclear power, hydroelectric dams, 1.6(b)) often pose ethical as well as technological problems.

Throughout their learning practical experience candidates have the opportunity to develop their ability to work as a team, where appropriate, and to value the contribution of others' ideas.

Sustainable Development, Health and Safety Considerations and International Developments

This syllabus offers opportunities to develop ideas on sustainable development and environmental issues, health and safety, and the international dimension.

- Sustainable development and environmental issues
  There are many opportunities within the syllabus to explore the role of applications of physics, for good or ill, in the community and environment. In particular: radioactivity and issues of containment and disposal (5.1(e)); energy conversion, conservation and resources (1.6(a)(b), 2.3(d), 4.5(c)).

- Health and safety
  Candidates are required to adhere to good health and safety practice in the laboratory.

  The syllabus requires candidates to be able to describe hazards associated with electricity and to show an understanding of safety measures (4.4). Candidates should have a theoretical understanding of safety aspects relating to radioactive materials (5.1(e)).

- The International dimension
  Throughout, the syllabus develops the awareness that the laws and language of physics are universal and transcend national and cultural boundaries. Although not explicitly stated as a learning outcome, there is the opportunity to discuss how international collaboration in science is often required to tackle global problems, e.g. issues surrounding global warming (within Energy Resources,1.6(b)) and radioactive waste disposal (within Radioactivity, 5.1).

Avoidance of Bias

CIE has taken great care in the preparation of this syllabus and assessment materials to avoid bias of any kind.

Language

This syllabus and the associated assessment materials are available in English only.

Resources

Copies of syllabuses, the most recent question papers and Principal Examiners' reports are available on the Syllabus and Support Materials CD-ROM, which is sent to all CIE Centres.

Resources are also listed on CIE's public website at www.cie.org.uk.

Access to teachers' email discussion groups and suggested schemes of work may be found on the CIE Teacher Support website at http://teachers.cie.org.uk. This website is available to teachers at registered CIE Centres.