

IMPORTANT NOTICE

Cambridge International Examinations (CIE) in the UK and USA

With effect from the June 2003 examination Cambridge International Examinations will only accept entries in the UK and USA from students registered on courses at CIE registered Centres.

UK and USA private candidates will not be eligible to enter CIE examinations unless they are repatriating from outside the UK/USA and are part way through a course leading to a CIE examination. In that case a letter of support from the Principal of the school which they had attended is required. Other UK and USA private candidates should not embark on courses leading to a CIE examination after June 2003.

This regulation applies only to entry by private candidates in the UK and USA. Entry by private candidates through Centres in other countries is not affected.

Further details are available from Customer Services at Cambridge International Examinations.

COMBINED SCIENCE 5125

GCE ORDINARY LEVEL

CONTENTS

	<i>Page</i>
NOTES	i
SCIENCE (PHYSICS, BIOLOGY) GCE O Level/SC 5125 (<i>November only</i>)	1
Aims	1
Assessment Objectives	1
Scheme of Assessment	2
Physics Section	3
Biology Section	10
RESOURCE LIST	16
MATHEMATICAL REQUIREMENTS	18
SYMBOLS, UNITS AND DEFINITIONS OF PHYSICAL QUANTITIES	19
GLOSSARY OF TERMS USED IN SCIENCE PAPERS	20

NOTE

Additional copies of this syllabus and/or the accompanying specimen paper booklet can be ordered from CIE Publications.

NOTES

Information for Teachers

This booklet relates to examinations taken in the year printed on the cover. It is the normal practice of CIE to print and distribute a new version of this booklet each year. Centres should receive copies well in advance of them being required for teaching purposes.

Teachers who are about to teach syllabuses in this booklet for the first time, should obtain and study the relevant past examination papers and Subject Reports.

Any queries relating to this booklet should be addressed to the Product Manager.

Nomenclature

The proposals in 'Signs, Symbols and Systematics (The Association for Science Education Companion to 5-16 Science, 1995)' and the recommendations on terms, units and symbols in 'Biological Nomenclature (1997)' published by the Institute of Biology, in conjunction with the ASE, will generally be adopted. Reference should be made to the joint statement on chemical nomenclature issued by the GCE boards. In particular, the traditional names sulphate, sulphite, nitrate, nitrite sulphurous and nitrous acids will be used in question papers.

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

Units and Significant Figures

Candidates should be aware that misuse of units and/or significant figures, i.e. failure to quote units where necessary, the inclusion of units in quantities defined as ratios or quoting answers to an inappropriate number of significant figures, is liable to be penalised.

Syllabus Revision

Attention is drawn to alterations in the syllabus by black vertical lines on either side of the text.

Exclusions

The *International Syllabus Synopses* booklet should be consulted for a full list of subject exclusions.

5125 SCIENCE (PHYSICS, BIOLOGY) GCE ORDINARY LEVEL/SCHOOL CERTIFICATE

(5125 is available in November only.)

AIMS

These 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 to
 - 1.1 become confident citizens in a technological world, able to take or develop an informed interest in matters of scientific import;
 - 1.2 recognise the usefulness, and limitations, of scientific method and to appreciate its applicability in other disciplines and in everyday life;
 - 1.3 be suitably prepared for studies beyond O/SC 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 science;
 - 2.2 are useful in everyday life;
 - 2.3 encourage efficient and safe practice;
 - 2.4 encourage effective communication.

3. develop attitudes relevant to science such as
 - 3.1 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 the study and practice of science are co-operative and cumulative activities, and are subject to social, economic, technological, ethical and cultural influences and limitations;
 - 5.2 the applications of science may be both beneficial and detrimental to the individual, the community and the environment.

ASSESSMENT OBJECTIVES

A Knowledge with Understanding

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

1. scientific phenomena, facts, laws, definitions, concepts, theories;
2. scientific vocabulary, terminology, conventions (including symbols, quantities and units contained in '*Signs, Symbols and Systematics*', *Association for Science Education, 1995*);
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 subject content defines the factual material that candidates need to recall and explain. Questions testing these objectives will often begin with one of the following words: *define, state, describe, explain or outline*. (See the glossary of terms.)

B Handling Information and Solving Problems

Students should be able - in words or by using other written, symbolic, graphical and numerical forms of presentation - 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.

These assessment objectives cannot be precisely specified in the subject content because questions testing such skills may be 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*. (See the glossary of terms.)

Weighting of Assessment Objectives

A Knowledge with Understanding, approximately 65% of the marks with approximately 30% allocated to recall.

B Handling Information and Solving Problems, approximately 35% of the marks.

SCHEME OF ASSESSMENT

Candidates are required to enter for Papers 1, 2 and 4.

Paper	Type of Paper	Duration	Marks	Weighting
1	Multiple Choice	1 h	40	24%
2	Structured and Free Response (Physics)	1 h 15 min	65	38%
4	Structured and Free Response (Biology)	1 h 15 min	65	38%

Paper 1 (1 h, 40 marks), consisting of 40 multiple choice questions of the direct choice type providing approximately equal coverage of the *two* appropriate sections of the syllabus. This paper will be set at the same time for all *three* subjects, 5124, 5125 and 5126.

Paper 2 (1 h 15 min, 65 marks), consisting of *two* sections.

Section A will carry 45 marks and will contain a number of compulsory structured questions of variable mark value.

Section B will carry 20 marks and will contain *three* free response questions, each of 10 marks. Candidates are required to answer any *two* questions.

The questions will be based on the Physics section of the syllabus.

Paper 4 (1 h 15 min, 65 marks), consisting of *two* sections.

This Paper will each have the same structure as Paper 2 but will be based on the Biology section of the syllabus.

Science (Physics, Biology), Syllabus 5125

Paper 1 will be based on the Physics and Biology sections of the syllabus.

Paper 2 will be based on the Physics section of the syllabus.

Paper 4 will be based on the Biology section of the syllabus.

SUBJECT CONTENT

PHYSICS SECTION

Students are expected to have adequate mathematical skills to cope with the curriculum. 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.

1. Physical Quantities and Units

Content

- 1.1 Measurement of length, time and volume

Learning Outcomes:

Candidates should be able to:

- (a) use and describe how to use rules, micrometers, vernier scales and calipers to determine lengths
- (b) use and describe how to use clocks and other devices for measuring an interval of time, including the period of a pendulum
- (c) use and describe how to use a measuring cylinder to measure a volume

2. Kinematics

Content

- 2.1 Speed, velocity and acceleration
 2.2 Graphical analysis of motion
 2.3 Free fall

Learning Outcomes:

Candidates should be able to:

- (a) state what is meant by *speed*, *velocity* and *acceleration*
- (b) recognise motion for which the acceleration is constant and calculate the acceleration
- (c) recognise motion for which the acceleration is not constant
- (d) plot and interpret a speed-time graph
- (e) recognise from the shape of a speed-time graph when a body is
 - (i) at rest
 - (ii) moving with constant speed
 - (iii) moving with constant acceleration
 - (iv) moving with an acceleration that is not constant
- (f) calculate the area under a speed-time graph to determine the distance travelled for motion with constant speed or constant acceleration
- (g) show understanding that the acceleration of free fall for a body near to the Earth is constant
- (h) describe qualitatively the motion of bodies falling in a uniform gravitational field with and without air resistance (including reference to terminal velocity)

3. Dynamics

Content

- 3.1 Motion
 3.2 Friction

Learning Outcomes:

Candidates should be able to:

- (a) describe the ways in which a force may change the motion of a body
- (b) use the relation between force, mass and acceleration
- (c) demonstrate an understanding of the effects of friction on the motion of a body

4. Mass, Weight and Density**Content**

- 4.1 Mass and weight
- 4.2 Density

Learning Outcomes:

Candidates should be able to:

- (a) demonstrate an understanding that mass is a measure of the amount of substance in a body
- (b) demonstrate an understanding of inertia as the property of a mass which resists change from its state of rest or motion
- (c) describe, and use the concept of, weight as the effect of a gravitational field on a mass
- (d) demonstrate understanding that two weights, and therefore masses, can be compared using a balance
- (e) use appropriate balances to measure mass and weight
- (f) describe experiments to determine the density of a liquid, of a regularly shaped solid and of an irregularly shaped solid (by the method of displacement) and make the necessary calculations

5. Turning Effect of Forces**Content**

- 5.1 Moments
- 5.2 Centre of mass
- 5.3 Stability

Learning Outcomes:

Candidates should be able to:

- (a) describe the moment of a force in terms of its turning effect and give everyday examples
- (b) perform and describe an experiment to verify the principle of moments
- (c) make calculations involving the principle of moments
- (d) perform and describe an experiment to determine the position of the centre of mass of a plane lamina
- (e) describe qualitatively the effect of the position of the centre of mass on the stability of simple objects

6. Deformation**Content**

- 6.1 Elastic deformation

Learning Outcomes:

Candidates should be able to:

- (a) state that a force may produce a change in size and shape of a body
- (b) plot, draw and interpret extension-load graphs for elastic solids and describe the associated experimental procedure
- (c) recognise the significance of the term *limit of proportionality* for an extension-load graph of an elastic solid
- (d) use proportionality of an elastic solid in simple calculations involving extension or force required

7. Energy, Work and Power**Content**

- 7.1 Energy conversion and conservation
- 7.2 Major sources of energy
- 7.3 Work
- 7.4 Power

Learning Outcomes:

Candidates should be able to:

- (a) give examples of energy in different forms, its conversion and conservation, and apply the principle of energy conservation to simple examples
- (b) use the terms *kinetic energy* and *potential energy in context*
- (c) calculate kinetic energy and gravitational potential energy

- (d) describe, and express a qualitative understanding of, processes by which energy is converted from one form to another, including reference to
- (i) chemical/fuel energy (a re-grouping of atoms)
 - (ii) hydroelectric generation (emphasising the mechanical energies involved)
 - (iii) solar energy (nuclei of atoms in the Sun)
 - (iv) nuclear energy
 - (v) geothermal energy
 - (vi) wind energy
- (e) show a qualitative understanding of *efficiency*
- (f) relate work done to the magnitude of a force and the distance moved and make calculations involving $F \times d$
- (g) relate power to energy transferred and time taken, using appropriate examples and using the equation $P=E/t$ in simple systems

8. Transfer of Thermal Energy

Content

- 8.1 Conduction
- 8.2 Convection
- 8.3 Radiation

Learning Outcomes:

Candidates should be able to:

- (a) describe experiments to distinguish between good and bad conductors of heat
- (b) give a simple molecular account of heat transfer in solids
- (c) relate convection in fluids to density changes and describe experiments to illustrate convection
- (d) describe experiments to distinguish between good and bad emitters and good and bad absorbers of infra-red radiation
- (e) identify and explain some of the everyday applications and consequences of conduction, convection and radiation

9. Temperature

Content

- 9.1 Principles of thermometry
- 9.2 Liquid-in-glass thermometers

Learning Outcomes:

Candidates should be able to:

- (a) appreciate how a physical property which varies with temperature may be used for the measurement of temperature and state examples of such properties
- (b) recognise the need for, and identify, fixed points
- (c) show understanding of *sensitivity* and *range*
- (d) apply a given property to the measurement of temperature
- (e) describe the structure and action of liquid-in-glass thermometers (laboratory and clinical) and of a thermocouple thermometer, showing an appreciation of its use for measuring high temperatures and those which vary rapidly

10. Thermal Properties of Matter

Content

- 10.1 Thermal expansion of solids, liquids and gases
- 10.2 Melting, boiling and evaporation

Learning Outcomes:

Candidates should be able to:

- (a) describe qualitatively the thermal expansion of solids, liquids and gases
- (b) show an appreciation of the relative order of magnitude of the expansion of solids, liquids and gases
- (c) identify and explain some of the everyday applications and consequences of thermal expansion
- (d) describe melting/solidification and boiling/condensation in terms of energy transfer without a change in temperature
- (e) state the meaning of *melting point* and of *boiling point*
- (f) distinguish between *boiling* and *evaporation*

11. General Wave Properties

Content

- 11.1 Describing wave motion

- 11.2 Wave terms
11.3 Longitudinal and transverse waves

Learning Outcomes:

Candidates should be able to:

- (a) describe what is meant by *wave motion* as illustrated by vibration in ropes, springs and by experiments using a ripple tank
(b) give the meaning of *speed, frequency, wavelength* and *amplitude* and use the equation $c = f \times \lambda$
(c) distinguish between *longitudinal* and *transverse* waves and give suitable examples

12. Light**Content**

- 12.1 Reflection of light
12.2 Refraction of light
12.3 Thin converging lens

Learning Outcomes:

Candidates should be able to:

- (a) perform and describe experiments to illustrate the laws of reflection
(b) describe an experiment to find the position of an optical image formed by a plane mirror
(c) use the law $i = r$ in reflection
(d) perform simple constructions, measurements and calculations for reflection
(e) describe and perform experiments to demonstrate refraction of light through glass blocks
(f) use the terminology for the angles i and r in refraction and describe the passage of light through parallel-sided transparent material
(g) use the equation $\sin i / \sin r = n$ (refractive index)
(h) give the meaning of *refractive index*
(i) describe the action of a thin converging lens on a beam of light
(j) use and understand the term *focal length*
(k) draw ray diagrams to illustrate the formation of real and virtual images of an object by a lens
(l) use and describe the use of a single lens as a magnifying glass

13. Electromagnetic Spectrum**Content**

- 13.1 Properties of electromagnetic waves

Learning Outcomes:

Candidates should be able to:

- (a) state that all electromagnetic waves are transverse waves that travel with the same high speed *in vacuo* and state the magnitude of this speed
(b) describe the main components of the electromagnetic spectrum

14. Sound**Content**

- 14.1 Sound waves
14.2 Speed of sound

Learning Outcomes:

Candidates should be able to:

- (a) describe the production of sound by vibrating sources
(b) describe the longitudinal nature of sound waves and describe compression and rarefaction
(c) state the approximate range of audible frequencies
(d) show understanding that a medium is required in order to transmit sound waves
(e) describe an experiment to determine the speed of sound in air and make the necessary calculation
(f) state the order of magnitude of the speed of sound in air, liquids and solids

15. Static Electricity**Content**

15.1 Principles of electrostatics

Learning Outcomes:

Candidates should be able to:

- (a) show understanding that there are positive and negative charges and that charge is measured in coulombs
- (b) show understanding that unlike charges attract and that like charges repel

16. Current Electricity**Content**

16.1 Electric current

16.2 Electromotive force

16.3 Potential difference

16.4 Resistance

Learning Outcomes:

Candidates should be able to:

- (a) show understanding that a current is a rate of flow of charge and is measured in amperes
- (b) use the equation $I = Q/t$
- (c) use and describe the use of an ammeter
- (d) use the concept that the e.m.f. is measured by the energy dissipated by a source in driving charge round the complete circuit
- (e) show appreciation that the volt is given by J/C
- (f) show understanding that the potential difference across a circuit component is measured in volts
- (g) use and describe the use of a voltmeter
- (h) state that $\text{resistance} = \text{p.d./current}$ and use the equation $R = V/I$
- (i) describe an experiment to determine resistance using a voltmeter and an ammeter and make the necessary calculation
- (j) use quantitatively the relationship between resistance and the length and the cross-sectional area of a wire
- (k) sketch and interpret the V/I characteristic graphs for metallic (ohmic) and non-ohmic conductors
- (l) appreciate the limitations of Ohm's Law

17. d.c. Circuits**Content**

17.1 Current and potential difference in circuits

17.2 Series and parallel circuits

Learning Outcomes:

Candidates should be able to:

- (a) draw and interpret circuit diagrams containing sources, switches, resistors (fixed and variable), ammeters, voltmeters, magnetising coils, bells, fuses and relays
- (b) show understanding that the current at every point in a series circuit is the same
- (c) use the fact that the sum of the p.d.s in a series circuit is equal to the p.d. across the whole circuit
- (d) calculate the combined resistance of two or more resistors in series
- (e) use the fact that the current from the source is the sum of the currents in the separate branches of a parallel circuit, the current from the source being larger than the current in each branch
- (f) calculate the effective resistance of two resistors in parallel

18. Practical Electricity**Content**

- 18.1 Electric power and energy
- 18.2 Dangers of electricity
- 18.3 Safe use of electricity in the home

Learning Outcomes:

Candidates should be able to:

- (a) describe the use of electricity in heating, lighting (including lamps in parallel) and motors
- (b) use the equations $P = VI$ and $E = VIt$
- (c) calculate the cost of using electrical appliances
- (d) state the hazards of
 - (i) damaged insulation
 - (ii) overheating of cables
 - (iii) damp conditions
- (e) show understanding of the use of fuses and fuse ratings
- (f) explain the need for earthing metal cases and for double insulation
- (g) give the meaning of the terms *live*, *neutral* and *earth*
- (h) wire, and describe how to wire, a mains plug
- (i) give the reasons for switches and fuses in live leads

19. Magnetism**Content**

- 19.1 Laws of magnetism
- 19.2 Magnetic properties of matter

Learning Outcomes:

Candidates should be able to:

- (a) state the properties of magnets
- (b) give an account of *induced magnetism*
- (c) distinguish between *magnetic* and *non-magnetic* materials
- (d) describe methods of magnetisation and of demagnetisation
- (e) describe the use of a plotting compass to plot the field lines of magnetic field (Earth's field excluded)
- (f) distinguish between the magnetic properties of iron and steel
- (g) distinguish between the design and use of permanent magnets and electromagnets

20. Electromagnetic Induction**Content**

- 20.1 Principles of electromagnetic induction
- 20.2 The a.c. generator
- 20.3 The transformer

Learning Outcomes:

Candidates should be able to:

- (a) describe an experiment which shows that a changing magnetic field can induce an e.m.f. in a circuit
- (b) state the factors affecting the magnitude of the induced e.m.f
- (c) show understanding that the direction of the induced e.m.f. opposes the change producing it
- (d) describe a simple form of generator (e.g. rotating coil or rotating magnet) and the use of slip rings
- (e) sketch a graph of voltage output against time for a simple a.c. generator
- (f) describe the structure and principle of operation of a basic iron-cored transformer as used for voltage transformations
- (g) use the equations $(V_p/V_s) = (N_p/N_s)$ and $V_p I_p = V_s I_s$ (for 100% efficiency)

21. The Nuclear Atom**Content**

- 21.1 Atomic model
- 21.2 Composition of a nucleus
- 21.3 Proton number and nucleon number
- 21.4 Nuclide notation

Learning Outcomes:

Candidates should be able to:

- (a) describe the structure of an atom in terms of a nucleus and electrons
- (b) describe the composition of the nucleus in terms of protons and neutrons
- (c) use the term *nucleon number, A*
- (d) use the term *proton number, Z*
- (e) use the term *nuclide* and use the nuclide notation ${}^A_Z X$

22. Radioactivity**Content**

- 22.1 Detection of radioactivity
- 22.2 Characteristics of the three types of emission
- 22.3 Nuclear reactions
- 22.4 Half-life
- 22.5 Safety precautions

Learning Outcomes:

Candidates should be able to:

- (a) describe the detection of alpha-particles, beta-particles and gamma-rays
- (b) show understanding that radioactive emissions occur randomly over space and time
- (c) state, for radioactive emissions,
 - (i) their nature
 - (ii) their relative ionising effects
 - (iii) their relative penetrating powers
- (d) show understanding of the meaning of *radioactive decay*, using equations (involving symbols) to represent changes in the composition of the nucleus when particles are emitted
- (e) use the term *half-life* in simple calculations which might involve information in tables or in decay curves
- (f) describe how radioactive materials are handled, used, stored and disposed of, in a safe way

BIOLOGY SECTION

1. Cell Structure and Organisation

Content

- 1.1 Plant and animal cells
- 1.2 Specialised cells

Learning Outcomes:

Candidates should be able to:

- (a) examine under the microscope an animal cell (e.g. from fresh liver) and a plant cell (e.g. from Elodea, a moss, or any suitable locally available material), using an appropriate temporary staining technique
- (b) draw diagrams to represent these observations (cell membrane, nucleus and cytoplasm for animal cells; cell wall, cell membrane, nucleus, cytoplasm, sap vacuole and chloroplasts for plant cells)
- (c) compare the visible differences in structure of the animal and plant cells examined
- (d) state the function of the cell membrane in controlling the passage of substances into and out of the cell
- (e) state, in simple terms, the relationship between cell structure and cell function for
 - (i) root hair cells – absorption
 - (ii) xylem vessels – conduction and support
 - (iii) red blood cells – transport of oxygen
- (f) identify these cells from fresh or preserved materials under the microscope, from diagrams and from photomicrographs

2. Diffusion and Osmosis

Content

- 2.1 Diffusion
- 2.2 Osmosis

Learning Outcomes:

Candidates should be able to:

- (a) define *diffusion* as the movement of molecules from a region of their higher concentration to a region of their lower concentration, down a concentration gradient
- (b) define *osmosis* as the passage of water molecules from a region of their higher concentration to a region of their lower concentration, through a partially permeable membrane
- (c) describe the importance of water potential gradient in the uptake of water by plants and the effects of osmosis on plant and animal tissues

3. Enzymes

Content

- 3.1 Enzyme action
- 3.2 Effects of temperature and of pH

Learning Outcomes:

Candidates should be able to:

- (a) define *enzymes* as proteins which function as biological catalysts
- (b) investigate and describe the effect of temperature and of pH on enzyme activity
- (c) state the effect of enzymes on the germination of seeds

4. Plant Nutrition

Content

- 4.1 Photosynthesis
- 4.2 Leaf structure
- 4.3 Mineral nutrition

Learning Outcomes:

Candidates should be able to:

- (a) understand that photosynthesis is the fundamental process by which plants manufacture carbohydrates from raw materials
- (b) investigate the necessity for chlorophyll, light and carbon dioxide for photosynthesis using appropriate controls, and derive, as far as is possible, the equation (in words or symbols) for photosynthesis

- (c) investigate and state the effect of varying light intensity and temperature on the rate of photosynthesis (e.g. in submerged aquatic plants, such as *Elodea*)
- (d) describe the intake of carbon dioxide and water by plants, the trapping of light energy by chlorophyll, the conversion of light energy into chemical energy, the formation of carbohydrates, their subsequent storage, and the release of oxygen
- (e) explain why most forms of life are completely dependent on photosynthesis
- (f) identify and label the cellular and tissue structure of a dicotyledonous leaf, as seen in cross-section under the microscope, and describe the significance of these features in terms of functions (i.e. distribution of chloroplasts -photosynthesis; stomata and mesophyll cells - gaseous exchange; vascular bundles – transport)
- (g) investigate and state the effect of insufficient nitrogen on plant growth and state the importance of nitrogen-containing ions for protein synthesis and their use in nitrogen-containing fertilisers for agriculture

5. Animal Nutrition

Content

- 5.1 Diet
- 5.2 Human alimentary canal
- 5.3 Mechanical and physical digestion
- 5.4 Chemical digestion
- 5.5 Absorption and assimilation

Learning Outcomes:

Candidates should be able to:

- (a) define a *balanced diet* as a diet supplying sufficient quantities of protein, carbohydrates, fat, vitamins, minerals, fibre, water and energy to sustain a healthy life
- (b) explain why diet, especially energy intake, should be related to age, sex, and activity of an individual
- (c) state the effects of malnutrition in relation to constipation and obesity
- (d) identify, on diagrams and photographs, and name the main regions of the alimentary canal and the associated organs: mouth, salivary glands, oesophagus, stomach, duodenum, pancreas, gall bladder, liver, ileum, colon, rectum and anus
- (e) describe the main functions of these parts in relation to ingestion, digestion, absorption, assimilation and egestion of food, as appropriate
- (f) describe the function of the teeth in reducing the size of food particles
- (g) state the causes of dental decay and describe the proper care of teeth
- (h) describe chewing and peristalsis
- (i) state the reason why most foods must be digested
- (j) describe the function of a typical amylase, listing the substrate and end products as an example of extracellular digestion in the alimentary canal
- (k) describe absorption as the passage of soluble products of digestion through the wall of the small intestine and into the blood capillaries (Structure of villi is **not** required.)
- (l) state
 - (i) the role of the liver in the metabolism of glucose and amino acids
 - (ii) the role of fat as a storage substance
- (m) state that the formation of urea and the breakdown of alcohol occur in the liver

6. Transport in Flowering Plants

Content

- 6.1 Water and ion uptake
- 6.2 Transpiration and translocation

Learning Outcomes:

Candidates should be able to:

- (a) describe the structure and function of root hairs in relation to their surface area, and to water and ion uptake (topic 1.2(e))
- (b) define *transpiration* as the loss of water vapour from stomata
- (c) investigate, using a suitable stain, the pathway of water in a cut stem
- (d) describe how wilting occurs
- (e) state the functions of xylem (support and conduction of water and mineral salts, topic 1.2(e)) and phloem (movement of sugars throughout the plant) (Details of root and stem structure are **not** required.)

7. Transport in Humans**Content**

7.1 Circulatory system

Learning Outcomes:

Candidates should be able to:

- (a) describe the circulatory system as a system of tubes with a pump and valves to ensure one-way flow of blood
- (b) describe the structure and function of the heart in terms of muscular contraction and the working of valves
- (c) compare the structure and function of arteries, veins and capillaries
- (d) describe coronary heart disease in terms of blockage of coronary arteries and list the possible causes
- (e) identify red and white blood cells as seen under the microscope on prepared slides, and in diagrams and photomicrographs
- (f) list the components of blood as red blood cells, white blood cells, platelets and plasma
- (g) state the functions of blood
 - (i) red blood cells – haemoglobin and oxygen transport
 - (ii) white blood cells – phagocytosis, antibody formation and tissue rejection
 - (iii) platelets – fibrinogen to fibrin causing clotting
 - (iv) plasma – transport of blood cells, ions, soluble food substances, hormones, carbon dioxide, urea, vitamins and plasma proteins

8. Respiration**Content**

8.1 Aerobic respiration

8.2 Anaerobic respiration

8.3 Human gaseous exchange

Learning Outcomes:

Candidates should be able to:

- (a) define *respiration* as the release of energy from food substances in living cells
- (b) define *aerobic respiration* as the release of a relatively large amount of energy by the breakdown of food substances in the presence of oxygen
- (c) state the equation for aerobic respiration, using words only
- (d) define *anaerobic respiration* as the release of a relatively small amount of energy by the breakdown of food substances in the absence of oxygen
- (e) state the equation for anaerobic respiration, using words only
- (f) describe the production of lactic acid in muscles during exercise
- (g) state the differences between inspired and expired air
- (h) investigate and state the effect of physical activity on rate and depth of breathing
- (i) identify on diagrams and name the larynx, trachea, bronchi, bronchioles, alveoli and associated capillaries
- (j) describe the role of the exchange surface of the alveoli in gaseous exchange (Details of the role of the diaphragm, ribs and intercostal muscles in breathing are **not** required.)

9. Excretion**Learning Outcomes:**

Candidates should be able to:

- (a) define *excretion* as the removal of toxic materials and the waste products of metabolism from organisms
- (b) describe the removal of carbon dioxide from the lungs, and of water and urea through the kidneys (Details of kidney structure and nephron are **not** required.)

10. Co-ordination and Response**Content**

- 10.1 Receptors
- 10.2 Reflex action
- 10.3 Hormones

Learning Outcomes:

Candidates should be able to:

- (a) state the principal functions of component parts of the eye in producing a focused image of near and distant objects on the retina
- (b) describe the pupil reflex in response to bright and dim light
- (c) outline the functions of sensory neurones in relaying information from receptors to the brain and/or spinal cord, relay neurones in transferring information to other parts of the brain and/or spinal cord, and motor neurones in relaying information to muscles and glands
- (d) define a *hormone* as a chemical substance, produced by a gland, carried by the blood, which alters the activity of one or more specific target organs and is then destroyed by the liver
- (e) state the role of the hormone adrenaline in boosting blood glucose levels and give examples of situations in which this may occur

11. The Use and Abuse of Drugs**Content**

- 11.1 Antibiotics
- 11.2 Effects of heroin
- 11.3 Effects of alcohol

Learning Outcomes:

Candidates should be able to:

- (a) define a *drug* as an externally administered substance which modifies or affects chemical reactions in the body
- (b) describe the medicinal use of antibiotics (e.g. penicillin) for the treatment of bacterial infections
- (c) describe a drug such as heroin as a drug of abuse and its related effects such as a powerful depressant, problems of addiction, severe withdrawal symptoms, associated problems such as crime and infection (e.g. AIDS/HIV)
- (d) describe the effects of excessive consumption of alcohol: reduced self-control, depressant, problems of addiction, severe withdrawal symptoms, associated problems such as crime and infection (e.g. AIDS/HIV)

12. Relationships of Organisms with One Another and with the Environment**Content**

- 12.1 Energy flow
- 12.2 Food chains and food webs
- 12.3 Carbon and water cycles
- 12.4 Effects of Man on the ecosystem
- 12.5 Pollution
- 12.6 Conservation

Learning Outcomes:

Candidates should be able to:

- (a) state that the Sun is the principal source of energy input to biological systems
- (b) describe the non-cyclical nature of energy flow
- (c) define *food chain*, *food web*, *producer*, *consumer*, *herbivore*, *carnivore* and *decomposer*
- (d) describe energy losses between trophic levels and the advantages of short food chains
- (e) describe the carbon cycle in terms of photosynthesis, animal nutrition, respiration and combustion
- (f) describe the water cycle
- (g) describe the effects of Man on the ecosystem with emphasis on examples of international importance (tropical rain forests, oceans and rivers)
- (h) describe the consequences of deforestation in terms of *effects* on: soil stability, climate (water cycle) and local human populations
- (i) describe the problems which contribute to famine (unequal distribution of food, drought and flooding and increasing population)
- (j) describe the undesirable effects of
 - (i) water pollution by sewage and by inorganic waste
 - (ii) air pollution by sulphur dioxide (acid rain)
 - (iii) pollution due to insecticides

- (k) state reasons for the conservation of species with reference to plants as sources of useful products such as drugs, timbers, oils, fibres, chemicals (e.g. pyrethrum), and products such as rubber, and to the need to investigate threatened species before they become extinct
- (l) state reasons for the recycling of materials such as water (sewage) and paper (from trees)

13. Development of Organisms and Continuity of Life

Content

- 13.1 Asexual reproduction
- 13.2 Sexual reproduction in plants
- 13.3 Sexual reproduction in humans
- 13.4 Sexually transmitted diseases

Learning Outcomes:

Candidates should be able to:

- (a) define *asexual reproduction* as the process resulting in the production of genetically identical offspring from one parent
- (b) describe *sexual reproduction* as the process involving the fusion of nuclei to form a zygote and the production of genetically dissimilar offspring
- (c) identify and draw, using a hand lens if necessary, the sepals, petals, stamens and carpels of one, locally available, named dicotyledonous flower
- (d) state the functions of the sepals, petals, anthers and carpels
- (e) outline the process of pollination and describe the growth of the pollen tube and its entry into the ovule followed by fertilisation (Production of endosperm and details of development are **not** required.)
- (f) investigate and describe the structure of a non-endospermic seed in terms of the embryo (radicle, plumule and cotyledons) and the testa, protected by the pericarp (fruit wall)
- (g) state that seed and fruit dispersal by wind and animals provides a means of colonising new areas
- (h) investigate and state the environmental conditions which affect germination of seeds (suitable temperature, water and oxygen)
- (i) identify on diagrams of the male reproductive system and give the functions of testes, scrotum, sperm ducts, prostate gland, urethra and penis
- (j) identify on diagrams of the female reproductive system and give the functions of: ovaries, oviducts, uterus, cervix and vagina
- (k) compare male and female gametes in terms of size, numbers and mobility
- (l) describe the menstrual cycle with reference to the alternation of menstruation and ovulation, the natural variation in its length, and the fertile and infertile phases of the cycle
- (m) state the effect of factors, such as diet and emotional state, which affect the menstrual cycle
- (n) describe fertilisation and the early development of the zygote simply in terms of the formation of a ball of cells which becomes implanted in the wall of the uterus, where it develops as the fetus
- (o) describe the advantages of breast milk compared with bottle-feeding
- (p) describe the following methods of birth control: natural, chemical (spermicides), mechanical, hormonal and surgical
- (q) describe the symptoms, signs, effects and treatment of gonorrhoea and syphilis
- (r) discuss the spread of human immuno-deficiency virus (HIV) and methods by which it may be controlled

14. Inheritance

Content

14.1 Variation

14.2 Chromosomes and genes

Learning Outcomes:

Candidates should be able to:

- (a) describe the difference between *continuous* and *discontinuous* variation and give examples of each
- (b) define a *gene* as a unit of inheritance and distinguish clearly between the terms *gene* and *allele*
- (c) state that genes are carried on chromosomes
- (d) describe complete dominance using the terms *dominant*, *recessive*, *phenotype* and *genotype*
- (e) describe mutation as a change in the structure of a gene (sickle cell anaemia) or in the chromosome number (Down's syndrome)
- (f) name radiation and chemicals as factors which may increase the rate of mutation
- (g) describe the determination of sex in Man (XX and XY chromosomes)

RESOURCE LIST

Resources – Combined Sciences Ordinary Level

Science (Physics, Chemistry) 5124
 (Physics, Biology) 5125
 (Chemistry, Biology) 5126

Combined Science 5129

Additional Combined Science 5130

BOOKS

Brian Samuel Beckett; Illustrated Biology; Oxford University Press; 0 19 914044 8;

Beckett & Gallagher; Co-ordinated Science: Biology; Oxford University Press; 0 19 914653 5;

Kevin Byrne; Revise GCSE in a week – Science Double & Single Award; BPP (Letts Educational) Ltd; 1 85758 702 2;

Gallagher, Ingram & Whitehead; Co-ordinated Science: Chemistry; Oxford University Press; 0 19 914652 7;

Pople and Whitehead; Co-ordinated Science: Physics; Oxford University Press; 0 19 914651 9
 Activities Books and Teacher's Guides are also available for this series;

K Foulds; GCSE Science Double Award Physics; John Murray; 07195 7159;

S Gater & V Wood-Robinson; GCE Science Double Award Biology; John Murray; 07195 7157 X;

G Hill; Science for GCSE Double Award 2nd ed (June '01); Hodder & Stoughton; Text 0340800445 Pupils' Handbook 034073079X

Existing edition has been very highly praised by international teachers teaching IGCSE;

K Hirst; The Complete A-Z Double Award Science Handbook; Hodder & Stoughton; 0340730609;

Jones & Jones, et al; Balanced Science; Cambridge University Press; Book 1 - 0521 59979 2 Book 2 – 0521 59980 6;

Also available as a three volume set:

Jones & Jones; Cambridge Co-ordinated Science: Biology (2nd ed); Cambridge University Press; 0 521 59981 4;

Jones, Jones & Acaster; Cambridge Co-ordinated Science: Chemistry; Cambridge University Press; 0 521 59983 0;

Jones, Jones & Marchington; Cambridge Co-ordinated Science: Physics (2nd ed); Cambridge University Press; 0 521 59982 2;

Jones & Jones; Biology; Cambridge University Press; 0 521 45618 5;

Terry Parkin Series Editor; Longman Co-ordinated Science Series; Longman;

Terry Parkin Series Editor; Biology; Longman; 0582 276535;

Terry Parkin Series Editor; Chemistry; Longman; 0582 279852;

Terry Parkin Series Editor; Physics; Longman; 0582 279844;

Terry Parkin Series Editor; Biology Copymasters; Longman; 0582 287332;

Terry Parkin Series Editor; Chemistry Copymasters; Longman; 0582 287340;

Terry Parkin Series Editor; Physics Copymasters; Longman; 0582 287367;

Terry Parkin Series Editor; Teachers' and Technicians' Guide; Longman; 0582 287359;

V Slaughter; Living Things 2nd Ed (Sept '01); Hodder & Stoughton; 03407 72816;

TEACHERS' RESOURCES

BOOKS

K Everett & E W Jenkins; A Safety Handbook for Science Teachers; John Murray; 0 7195 4645 1

WEBSITES

Coordination Group Publications; www.cgpbooks.co.uk; (a useful and extensive set of resources available at an economical price);

PROFESSIONAL ASSOCIATIONS

Royal Society of Chemistry; Burlington House, Piccadilly, London W1J 0BA, UK; tel +44 (0) 20 7437 8656; fax +44 (0) 20 7437 8883; website www.rsc.org;

Institute of Physics; 76 Portland Place, London W1B 1NT. UK; tel +44 (0)20 7470 4800; fax: +44 (0)20 7470 4848; Email: physics@iop.org; website www.iop.org;

Institute of Biology; 20 Queensberry Place, London SW7 2DZ, UK; tel +44(020) 7581-8333; fax: +44(020) 7823-9409; Email: info@iob.org; website www.iob.org;

MATHEMATICAL REQUIREMENTS

Calculators may be used in all parts of the examination.

Candidates should be able to:

1. add, subtract, multiply and divide;
2. understand and 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).

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.

<i>Quantity</i>	<i>Symbol</i>	<i>Unit</i>
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, mg
time	t	h, min, s
density	d, ρ	$g/cm^3, kg/m^3$
speed	u, v	km/h, m/s, cm/s
acceleration	a	m/s^2
acceleration of free fall	g	
force	$F, P...$	N
moment of a force		Nm
work done	W, E	J
energy	E	J, kW h
power	P	W
pressure	p, P	Pa, N/m^2
atmospheric pressure		use of millibar
temperature	t	$^{\circ}C$
frequency	f	Hz
wavelength	λ	m, cm
focal length	f	
angle of incidence.	i	degree ($^{\circ}$)
angles of reflection, refraction	r	degree ($^{\circ}$)
critical angle	c	degree ($^{\circ}$)
potential difference/voltage	V	V, mV
current	I	A, mA
charge		C, A s
e.m.f.	E	V
resistance	R	Ω

GLOSSARY OF TERMS USED IN SCIENCE PAPERS

During the moderation of a question paper, care is taken to try and ensure that the paper and its individual questions are, in relation to the syllabus, fair as regards balance, overall difficulty and suitability. Attention is also paid to wording to make questions as concise and yet as unambiguous as possible. In many instances, Examiners are able to make appropriate allowance for an interpretation that differs, but acceptably so, from the one intended.

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 their definitions. 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. *State and explain normally also implies conciseness; 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 the latter instance, the answer may often follow a standard pattern (e.g. Apparatus, Method, Measurements, Results and Precautions).*

In other contexts, *describe* and *give an account of* 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 in a similar way to *state and explain* - see paragraph 5.

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 is to 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 chemistry, two or more substances may satisfy the given conditions describing an 'unknown'), 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'.
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 (e.g. Young modulus, relative molecular mass).
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, asymptote or discontinuity at a particular value).

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