CAMBRIDGE
International Examinations

Cambridge
IGCSE

SYLLABUS

Cambridge IGCSE®
Agriculture
0600

For examination in November 2017, 2018 and 2019

Cambridge Secondary 2

Version 1

Changes to syllabus for 2017, 2018 and 2019

This syllabus has been updated, but there are no significant changes.

You are advised to read the whole syllabus before planning your teaching programme.

Contents

1. Introduction

1.1 Why choose Cambridge?

Cambridge International Examinations is part of the University of Cambridge. We prepare school students for life, helping them develop an informed curiosity and a lasting passion for learning. Our international qualifications are recognised by the world's best universities and employers, giving students a wide range of options in their education and career. As a not-for-profit organisation, we devote our resources to delivering high-quality educational programmes that can unlock learners' potential.

Our programmes set the global standard for international education. They are created by subject experts, are rooted in academic rigour, and provide a strong platform for progression. Over 10 000 schools in 160 countries work with us to prepare nearly a million learners for their future with an international education from Cambridge.

Cambridge learners

Cambridge programmes and qualifications develop not only subject knowledge but also skills. We encourage Cambridge learners to be:

- **confident** in working with information and ideas – their own and those of others
- **responsible** for themselves, responsive to and respectful of others
- **reflective** as learners, developing their ability to learn
- **innovative** and equipped for new and future challenges
- **engaged** intellectually and socially, ready to make a difference.

Recognition

Cambridge IGCSE is recognised by leading universities and employers worldwide, and is an international passport to progression and success. It provides a solid foundation for moving on to higher level studies. Learn more at **www.cie.org.uk/recognition**

Support for teachers

A wide range of materials and resources is available to support teachers and learners in Cambridge schools. Resources suit a variety of teaching methods in different international contexts. Through subject discussion forums and training, teachers can access the expert advice they need for teaching our qualifications. More details can be found in Section 2 of this syllabus and at **www.cie.org.uk/teachers**

Support for exams officers

Exams officers can trust in reliable, efficient administration of exams entries and excellent personal support from our customer services. Learn more at **www.cie.org.uk/examsofficers**

Our systems for managing the provision of international qualifications and education programmes for learners aged 5 to 19 are certified as meeting the internationally recognised standard for quality management, ISO 9001:2008. Learn more at **www.cie.org.uk/ISO9001**

1.2 Why choose Cambridge IGCSE?

Cambridge IGCSEs are international in outlook, but retain a local relevance. The syllabuses provide opportunities for contextualised learning and the content has been created to suit a wide variety of schools, avoid cultural bias and develop essential lifelong skills, including creative thinking and problem-solving.

Our aim is to balance knowledge, understanding and skills in our programmes and qualifications to enable students to become effective learners and to provide a solid foundation for their continuing educational journey.

Through our professional development courses and our support materials for Cambridge IGCSEs, we provide the tools to enable teachers to prepare learners to the best of their ability and work with us in the pursuit of excellence in education.

Cambridge IGCSEs are considered to be an excellent preparation for Cambridge International AS and A Levels, the Cambridge AICE (Advanced International Certificate of Education) Group Award, Cambridge Pre-U, and other education programmes, such as the US Advanced Placement program and the International Baccalaureate Diploma programme. Learn more about Cambridge IGCSEs at **www.cie.org.uk/cambridgesecondary2**

Guided learning hours

Cambridge IGCSE syllabuses are designed on the assumption that learners have about 130 guided learning hours per subject over the duration of the course, but this is for guidance only. The number of hours required to gain the qualification may vary according to local curricular practice and the learners' prior experience of the subject.

1.3 Why choose Cambridge IGCSE Agriculture?

Cambridge IGCSE Agriculture is accepted by universities and employers as proof of knowledge and understanding. By considering agriculture as an applied science, candidates learn basic agricultural principles and skills through extensive practical experience.

The syllabus develops candidates' ability to apply a scientific approach to the study of topics such as:

- crop and livestock husbandry
- farm structure and machinery
- agricultural economics

As a result, students gain a positive attitude towards farming and rural development, and appreciate the ways in which improved agricultural practice can be used to alleviate the problems of famine and malnutrition.

Prior learning

Candidates beginning this course are not expected to have studied Agriculture previously.

Progression

Cambridge IGCSE Certificates are general qualifications that enable candidates to progress either directly to employment, or to proceed to further qualifications.

1.4 Cambridge ICE (International Certificate of Education)

Cambridge ICE is a group award for Cambridge IGCSE. It gives schools the opportunity to benefit from offering a broad and balanced curriculum by recognising the achievements of learners who pass examinations in a number of different subjects.

Learn more about Cambridge ICE at **www.cie.org.uk/cambridgesecondary2**

1.5 How can I find out more?

If you are already a Cambridge school

You can make entries for this qualification through your usual channels. If you have any questions, please contact us at **info@cie.org.uk**

If you are not yet a Cambridge school

Learn about the benefits of becoming a Cambridge school at **www.cie.org.uk/startcambridge**. Email us at **info@cie.org.uk** to find out how your organisation can register to become a Cambridge school.

2. Teacher support

2.1 Support materials

We send Cambridge syllabuses, past question papers and examiner reports to cover the last examination series to all Cambridge schools.

You can also go to our public website at **www.cie.org.uk/igcse** to download current and future syllabuses together with specimen papers or past question papers and examiner reports from one series.

For teachers at registered Cambridge schools a range of additional support materials for specific syllabuses is available from Teacher Support, our secure online support for Cambridge teachers. Go to **http://teachers.cie.org.uk** (username and password required).

2.2 Endorsed resources

We work with publishers providing a range of resources for our syllabuses including print and digital materials. Resources endorsed by Cambridge go through a detailed quality assurance process to ensure they provide a high level of support for teachers and learners.

We have resource lists which can be filtered to show all resources, or just those which are endorsed by Cambridge. The resource lists include further suggestions for resources to support teaching.

2.3 Training

We offer a range of support activities for teachers to ensure they have the relevant knowledge and skills to deliver our qualifications. See **www.cie.org.uk/events** for further information.

3. Syllabus content at a glance

The content of this syllabus is designed to encourage a broad, applied and practical science-based study of agriculture. It includes:

1.	**General agriculture**
1.1	General principles of land use
1.2	Principles of agricultural economics
2.	**Soil**
2.1	Soil formation
2.2	Soil types, composition, texture and temperature
2.3	Soil fertility
2.4	Soil erosion and soil conservation
2.5	Drainage and irrigation
2.6	Water cycle
3.	**Principles of plant growth**
3.1	Movement of materials through plants
3.2	Reproduction in plants
3.3	Germination
4.	**Crop production**
4.1	Land preparation
4.2	Cultivation of cash crops
5.	**Crop protection**
5.1	Weed control
5.2	Pest control
5.3	Disease control
5.4	The use of farm chemicals
6.	**Livestock anatomy and physioloy**
6.1	Digestion in ruminants and non-ruminants
7.	**Livestock production and health**
7.1	Livestock housing
7.2	Livestock nutrition
7.3	Livestock health
7.4	Study of **one** ruminant and **one** non-ruminant animal

8. Pasture management
8.1 Extensive pasture management 8.2 Intensive pasture management
9. Livestock and crop breeding
9.1 Monohybrid inheritance 9.2 Selective breeding in animals and plants
10. Farm structures and tools
10.1 Fencing 10.2 Farm buildings 10.3 Farm water supplies 10.4 Farm tools 10.5 Farm machinery

4. Assessment at a glance

For the Cambridge IGCSE in agriculture, candidates take two compulsory components: Paper 1 and Paper 2. Candidates are eligible for grades A* to G.

Paper 1: Theory	**1 hour 45 minutes**

This paper has two sections:

Section A: A number of compulsory, short, structured questions. Worth 70 marks.

Section B: Candidates answer two out of five free-response questions. Each question is worth 15 marks.

Total marks: 100

Weighting: 70%

Paper 2: Practical Coursework

A coursework assessment marked by the teacher and moderated by the Ministries in the candidate's home country or Cambridge. Detailed instructions for teacher assessment are available from the Ministries of Education or Cambridge.

The coursework consists of at least four practical exercises carried out over the course and a practical investigation, which could be up to three practical exercises.

When planning practical work, teachers should make sure they do not contravene any school, education authority or government regulations.

Total marks: 90 (Practical skills 60, Investigative skills 30)

Weighting: 30% (Practical skills 20%, Investigative skills 10%)

Information for teachers

This booklet relates to examinations taken in the year printed on the cover. It is the normal practice of Cambridge 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 Cambridge Customer Services.

Nomenclature

The proposals in *'Signs, Symbols and Systematics (The Association for Science Education Companion to 16–19 Science, 2000)'* and the recommendations on terms, units and symbols in *'Biological Nomenclature (2000)'* 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 sulfate, sulfite, nitrate, nitrite, sulfurous 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, 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.

Availability

This syllabus is examined in the November examination series.

This syllabus is not available to private candidates.

Detailed timetables are available from **www.cie.org.uk/examsofficers**

Combining this with other syllabuses

Candidates can combine this syllabus in an examination series with any other Cambridge syllabus, except:

- syllabuses with the same title at the same level

Please note that Cambridge IGCSE, Cambridge International Level 1/Level 2 Certificate and Cambridge O Level syllabuses are at the same level.

5. Syllabus aims and assessment objectives

It is expected that the subject matter will be treated practically as far as is possible. Some of the practical work will be in the form of demonstrations and visits to places of agricultural interest, but candidates will also be expected to have carried out individual and group practical work in agriculture, at least on a small scale, such as in a school garden.

5.1 Syllabus aims

The syllabus aims to:

1 promote an appreciation of agriculture as an applied science
2 stimulate an interest in, and create an awareness of, existing problems and opportunities in agricultural and rural development
3 stimulate positive attitudes by showing that efficient farming can be both a profitable and a rewarding occupation
4 demonstrate the value of agriculture to the family and community, so as to show how improved agriculture can contribute to the worldwide campaign for freedom from hunger
5 encourage the teaching, in a practical manner, of basic principles and skills in agriculture and of efficient farm business management
6 ensure that schools take an active part in rural development by integration of agricultural activities into the school curriculum
7 encourage the development of a school farm, ensuring that students actively participate in the farming events throughout the course, including at weekends and during school holidays
8 develop initiative, problem-solving abilities, scientific methods and self-education so as to encourage resourcefulness and self-reliance
9 provide a basis, together with the basic sciences and mathematics, for more advanced studies in agriculture

5.2 Assessment objectives

There are three assessment objectives that describe the knowledge, skills and abilities that candidates are expected to demonstrate at the end of the course. They reflect those aspects of the aims that will be assessed.

AO1 Knowledge with understanding

Candidates should be able to demonstrate agricultural knowledge and understanding in relation to the correct use of:

1 facts, concepts, principles, patterns, models and theories
2 terms, symbols, quantities and units
3 the techniques, procedures and principles of safe agricultural practice

The subject content defines the factual knowledge that candidates may be required to recall and explain. Questions testing these objectives will often begin with one of the following words: *define*, *state*, *name*, *describe*, *explain* or *outline*. (See the glossary of terms at the back of this booklet.)

AO2 Handling information and solving problems

Candidates should be able – using oral, 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 use information to identify patterns, report trends and draw inferences
4 present reasoned explanations for phenomena, patterns and relationships
5 make predictions and propose hypotheses
6 solve problems, including some of a quantitative nature

These assessment objectives cannot be precisely specified in the subject content because questions testing such skills may be based on information that 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, reasoned or deductive manner to a novel situation. Questions testing these objectives will often begin with one of the following words: *discuss*, *predict*, *suggest*, *calculate* or *determine*. (See the glossary of terms at the back of this booklet.)

AO3 Practical skills and investigations

Candidates should be able to:

1 use and organise techniques, apparatus and material
2 observe, measure and record
3 interpret and evaluate experimental observations and data
4 plan and carry out investigations (and, where appropriate, make predictions and propose hypotheses).

5.3 Relationship between assessment objectives and components

The approximate weightings allocated to each of the assessment objectives are summarised in the tables below.

Assessment objective	Approximate weighting
AO1: Knowledge with understanding	30%
AO2: Handling information and problem solving	40%
AO3: Experimental skills and investigations	30%

Teachers should take note that there is a greater weighting of 70% for skills (including handling information, problem solving, practical, experimental and investigative skills) than for knowledge and understanding. Teachers' schemes of work and the sequence of learning activities should reflect this balance, so that the aims of the syllabus may be met, and the candidates fully prepared for the assessment.

Assessment objective	Paper 1 (marks)	Paper 2 (marks)
AO1: Knowledge with understanding	43	0
AO2: Handling information and problem solving	57	0
AO3: Experimental skills and investigations	0	90

5.4 Grade descriptions

Criteria for the standard of achievement likely to have been shown by candidates awarded Grades A, C, and F are shown below. The standard of achievement required for the award of Grade C, include the criteria for Grade F. Similarly, the standard of achievement required for the award of Grade A includes the criteria for Grade C.

A **Grade A** candidate should be able 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 that 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 should be able 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 should be able 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 minor manipulation of data is needed
- recognise which of two given hypotheses explains a set of facts or data.

It is expected that candidates will demonstrate a background knowledge of, and/or an increased depth of knowledge, in the physical, chemical and mathematical concepts and processes listed in sections 6.1 and 6.2.

6. Syllabus content

1 General agriculture

Content

1.1 General principles of land use

1.2 Principles of agricultural economics

Learning outcomes

Candidates should be able to:

(a) describe different forms of land use, including different agricultural systems and farming practices (rotations, mixed farming and monoculture), forestry and aquaculture

(b) describe and explain the ways in which the uses of land in different areas may be limited by topographical, climatic and other environmental factors

(c) understand that population growth leads to a need for efficient use of land and farm planning

(d) describe organic production, hydroponics and genetically modified (GM) crops and be able to discuss arguments for and against the use of GM crops and organic production

(e) explain the principles of supply and demand, diminishing returns, opportunities and choices facing the farmer, decision-making based on understanding of economic factors.

2 Soil

Content

2.1 Soil formation

2.2 Soil types, composition, texture and temperature

2.3 Soil fertility

2.4 Soil erosion and soil conservation

2.5 Drainage and irrigation

2.6 Water cycle

Learning outcomes

Candidates should be able to:

(a) explain soil formation from parent material by physical, chemical and biological agents of weathering

(b) describe soil profile in terms of topsoil, subsoil and underlying materials

(c) describe soil texture in terms of different sizes of soil particles, sand, silt and clay

(d) understand soil structure, including the importance of forming and maintaining a good crumb structure, the effects of humus and maintenance of organic matter in the soil, oxidation of organic matter and the loss of soil structure causing capping and soil pans

(e) describe different soil types (sandy soils, loam soils and clay soils) and their properties, including water-holding capacity and drainage

(f) outline soil constituents in terms of mineral matter, organic matter, air, water (free or gravitational water, capillary and hygroscopic water) and living organisms (bacteria, nematodes, fungi and earthworms)

(g) understand the influence of soil temperature on the rate of plant growth, the danger of excessive heat to young seedlings and the danger of frost to some crops, and the methods of reducing the effect of extreme temperatures by mulching of seed beds and shading of transplanted seedlings

(h) explain the importance of the following major nutrients to soil fertility and describe the signs and effects of their deficiency in plants: major nutrients – compounds of nitrogen, phosphorus, potassium, calcium, magnesium and sulfur

(i) carry out practical soil sampling and tests for soil pH

(j) describe the nitrogen cycle and its importance to soil fertility

(k) explain the importance of legumes and the use of organic fertilisers (manure and compost) in maintaining good soil structure and fertility

(l) describe the use of inorganic fertilisers (limited to **one** example each of a fertiliser containing predominantly phosphorus and predominantly potassium and **one** example of a compound fertiliser) in maintaining soil fertility

(m) explain how fertilising practices and liming can affect soil pH

(n) describe types of soil erosion, their causes, agents, prevention and control

(o) describe drainage as movement of gravitational water down through the soil and understand the drainage of waterlogged land by means of ditches and the loss of plant nutrients due to leaching

(p) understand the effects of poor drainage on soil organisms and root respiration

(q) explain the need for irrigation and describe methods of irrigation with the effects on crop yield and quality (details of irrigation programmes for individual crops and of equipment specification are **not** required)

(r) describe and understand the significance of the water cycle and ground water resources.

3 Principles of plant growth

Content

3.1 Movement of materials through plants

3.2 Reproduction in plants

3.3 Germination

Learning outcomes

Candidates should be able to:

(a) describe the distribution and function of root tissues and the structure and function of root hairs

(b) explain the absorption of plant requirements from the soil, including the principles of diffusion, osmosis, the passage of water and dissolved mineral salts through vascular tissues

(c) explain how the structure of a leaf is related to function (cellular detail is **not** required)

(d) outline gas exchange by diffusion through the stomata

(e) describe photosynthesis in terms of carbon dioxide, water, light and chlorophyll leading to the synthesis of carbohydrates and the production of oxygen

(f) describe the distribution and function of tissues in a stem (dicotyledon only)

(g) define the term *translocation* as the movement of synthesised food to storage organs and explain the principles of modification of different parts of plants to form food storage organs and the types of food materials stored

(h) explain transpiration in terms of the transpiration stream, loss of water by evaporation and diffusion of water vapour through stomata

(i) describe the effects of temperature, humidity, wind and light intensity on the rate of transpiration

(j) define the term *sexual reproduction*

(k) describe the structure and functions of the flowers of a maize plant and of a bean plant

(l) define the term *pollination*

(m) describe the process of fertilisation in a **named** plant

(n) describe how seeds and fruits are dispersed and explain the importance of dispersal in relation to weed control

(o) describe asexual reproduction from stem tubers (e.g. Irish potato and yam) and from stem cuttings (e.g. sweet potato, cassava and sugar cane)

(p) describe seed structure and the germination of maize and bean (or other legume) and understand the conditions required for germination.

4 Crop production

Content

4.1 Land preparation

4.2 Cultivation of cash crops

Learning outcomes

Candidates should be able to:

(a) describe land preparation by stumping and clearing and soil preparation by primary and secondary cultivations by hand or machine (e.g. ploughing or digging, harrowing or raking)

(b) name the main types of crop found locally (legumes, roots and tubers, edible fruits and cereals) and their products

(c) describe in detail the cultivation of **one** crop of local importance in relation to:

- soil and climatic requirements
- soil preparation
- sowing or planting time and method
- choice of suitable cultivars
- seed rate and spacing
- rates of application of fertiliser and manure
- prevention and control of common pests, weeds and diseases
- recognition of crop maturity
- harvesting, yield and storage
- record keeping (including a diary of events and production).

5 Crop protection

Content

5.1 Weed control

5.2 Pest control

5.3 Disease control

5.4 The use of farm chemicals

Learning outcomes

Candidates should be able to:

(a) identify one **named** local weed species of a crop and describe its harmful effects and the mode of spread

(b) explain methods of weed control including cultural, mechanical and chemical methods

(c) describe the life cycle, effect and method of spread of **one** pest from **each** of the following:

- biting and chewing pests (e.g. grasshoppers, locusts, termites, leaf miners and beetles)
- piercing and sucking pests (e.g. aphids, Bagrada bugs, mealy bugs and scale insects)
- boring pests (e.g. weevils, stalk borer and American bollworm *(Helicoverpa armigera)*)

(d) name and describe the mode of action of chemical controls for pests including contact pesticides and systemic pesticides and understand the appropriate use of these pesticides in controlling pests in the groups listed above

(e) describe biological and biotechnical methods of controlling pests

(f) describe methods of cultural pest control including rotation and catch cropping

(g) describe the mode of infection, harmful effects, prevention and control of **one named** plant disease from each of the following groups:

- bacterial diseases, fungal diseases and viral diseases

(h) explain the importance and methods of safe handling of farm chemicals, including the use of specifically designed protective clothing, correct dilution and mixing, precautions before, during and after application and avoidance of pollution when cleaning spraying equipment

(i) explain the importance of safe storage of farm chemicals to include chemicals that are toxic, (e.g. herbicides, insecticides and flammable e.g. fuels).

6 Livestock anatomy and physiology

Content

6.1 Digestion in ruminants and non-ruminants

Note

The differences between ruminant and non-ruminant digestion should be discussed generally but can be illustrated using relevant examples from local agriculture. Examples of ruminants include sheep, cows and goats. Examples of non-ruminants include pigs and poultry.

6.2 Sexual reproduction in mammals

Learning outcomes

Candidates should be able to:

(a) describe the structure and function of the digestive system of a ruminant and a non-ruminant

(b) describe the processes of digestion and absorption in the alimentary canals of a ruminant and a non-ruminant (reference to specific enzymes is **not** required)

(c) describe the reproductive systems (male and female) of a **named** mammalian farm animal

(d) describe the processes of fertilisation and birth in a **named** mammalian farm animal

(e) define the terms *weaning* and *lactation* and understand the importance of colostrum.

7 Livestock production and health

Content

7.1 Livestock housing

7.2 Livestock nutrition

7.3 Livestock health

7.4 Study of **one** ruminant and **one** non-ruminant animal with particular reference to (a) to (k) below

Learning outcomes

Candidates should be able to:

(a) describe suitable housing and living conditions for livestock

(b) describe the care and rearing of young stock

(c) describe the nutritional requirements (including food materials, their nutritional content and signs of deficiency) and feeding practices (including the importance of a balanced ration suited to the age and the stage of development of the livestock)

(d) outline the meaning of the terms *maintenance ration* and *production ration*

(e) explain the importance of an adequate, clean water supply

(f) demonstrate stockmanship, including care in the handling of animals, record keeping, including a diary of events and production records

(g) recognise the signs of health and of ill-health in livestock

(h) explain the ways in which infectious and contagious diseases are spread

(i) explain the problems caused by parasites

(j) explain what is meant by the terms *notifiable/scheduled diseases*

(k) explain the importance of livestock hygiene and the isolation of sick animals.

8 Pasture management

Content

8.1 Extensive pasture management

8.2 Intensive pasture management

Learning outcomes

Candidates should be able to:

(a) describe the vegetation of grazing lands, including grasses and legumes for grazing and bush for browsing

(b) describe how improved pastures can be established

(c) explain what is meant by the terms *rotational grazing*, *paddock* and *zero grazing*, *unenclosed* and *enclosed grazing systems* and *intensive* and *extensive grazing*

(d) describe extensive management methods, including the importance of stocking rates, carrying capacity and the dangers of overstocking, bush control and the use and misuse of fire

(e) explain how pasture utilisation can be improved by fencing and rotational grazing.

9 Livestock and crop breeding

Content

9.1 Monohybrid inheritance

9.2 Selective breeding in animals and plants

Learning outcomes

Candidates should be able to:

(a) define the terms *chromosome*, *gene*, *allele*, *homozygous*, *heterozygous*, *dominant* and *recessive*

(b) calculate and predict the results of simple genetic crosses involving 1:1 and 3:1 ratios

(c) explain the meaning of the terms *genotype* and *phenotype* and assess their importance in animal and plant breeding

(d) describe how breeding can improve yield, disease resistance, hardiness and appearance in livestock and in crops

(e) understand the role of artificial selection in the production of improved varieties of animals and plants of economic importance

(f) understand the benefits of artificial insemination

(g) understand the differences between selective crop breeding and genetically modified (GM) crops.

10 Farm structures and tools

Content

10.1 Fencing

10.2 Farm buildings

10.3 Farm water supplies

10.4 Farm tools

10.5 Farm machinery

Learning outcomes

Candidates should be able to:

(a) describe the treatment of fencing posts, methods of fence construction, types of fence suitable for different purposes, the use of hedges and windbreaks

(b) outline the properties and uses of wood, concrete blocks, metal, stone, brick, earth and thatch in the construction of farm buildings

(c) list suitable sources of water for human consumption, for livestock and for irrigation

(d) outline methods of water treatment by settling and filtration

(e) outline suitable methods of construction of storage dams to resist water pressure, which increases with depth

(f) describe the use of storage tanks, the distribution of water through pipe systems and simple plumbing, sufficient for maintaining a plastic pipe system, including pipe-joining and fitting of tap washers

(g) describe the use and maintenance of saw, hammer, screwdriver, file, spanner, sprayers and hand tools for cultivation

(h) explain the advantages and disadvantages of farm mechanisation

(i) describe the use and maintenance of mould-board plough, cultivator, harrow, planter and ridger (either ox- or donkey- or tractor-drawn).

7. Coursework

7.1 Introduction

Paper 2 is a teacher-assessed continuous assessment of the candidate's practical work.
The agriculture teacher, who is responsible for allocating marks, is required to submit the complete schedule of all marks for the purposes of moderation.
The number of marks available for the assessment of practical work during the course is 90 marks.
There are four practical exercises which test practical skills. Together these are worth 60 marks.
There is one practical investigation which tests investigatory skills. This is worth 30 marks.

Recording candidates' marks

Candidates' marks for the Paper 2: Practical Coursework must be recorded on the Individual Candidate Record Card produced by Cambridge. These forms, and the instructions for completing them, may be downloaded from **www.cie.org.uk/samples**. The database will ask you for the syllabus code (i.e. 0600) and your Centre number, after which it will take you to the correct forms. Follow the instructions when completing each form.

Practical work assesses skills and abilities essential to the study of agriculture that are not suitably measured by theory examinations. All candidates must complete practical exercises and an investigation.

It is the responsibility of the teacher to ensure that the work planned is safe and legally permitted by local legislation. It is recommended that a simple risk assessment be carried out by the teacher for each of the practical tasks and investigations to ensure that the health and safety of the candidates is not put at risk by the planned activities.

The internally moderated marks for all candidates must be recorded on the Coursework Assessment Summary Form. This form, and the instructions for completing it, may be downloaded from **www.cie.org.uk/samples**. The database will ask you for the syllabus code (i.e. 0600) and your Centre number, after which it will take you to the correct form. Follow the instructions when completing the form.

Internal moderation of coursework (where there is more than one teacher assessing)

Internal moderation is not required when there is only one group of candidates assessed by a single teacher. In this case it is the teacher's marks that are submitted. 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.

External moderation of coursework (required for all Centres)

Individual Candidate Record Cards and Coursework Assessment Summary Forms, with internally moderated marks for all candidates, or teacher's marks where there is only one teacher assessing the coursework, must be received by Cambridge. The deadlines and methods for submitting internally assessed marks are in the *Cambridge Administrative Guide* available on our website.

If there are ten or fewer candidates, all the coursework that contributed to the final mark for **all** the candidates must be sent to Cambridge. Where there are more than ten candidates, Cambridge will select the candidates whose Coursework is required. Cambridge will communicate the list of candidates to the Centre, and the Centre should despatch the work of these candidates to Cambridge immediately. A further

sample may also be required, so all records and supporting written work should be retained until after publication of results.

Further information about external moderation may be found in the *Cambridge Handbook* and the *Cambridge Administrative Guide*.

Re-submission of coursework and carrying forward internally assessed marks

Information about re-submission of coursework samples and about carrying forward internally assessed marks can be found in the *Cambridge Administrative Guide*.

7.2 Paper 2: Practical Coursework

The practical work carried out by candidates should be assessed by the agriculture teacher. This entails keeping a record for all the candidates, showing the operations carried out and the marks awarded.

Practical exercises

Much essential 'field work' in agriculture has no written component but, clearly, credit should be given for practical ability. At least four discrete practical exercises involving Assessment Objective AO3 (see section 3.2) should be assessed over the course. Each practical exercise should be assessed according to the criteria stated in section 7.2.3.

Ideally these exercises should be set on the different sections of the syllabus. A maximum of three of these exercises may be set as part of the longer practical investigation exercise. See section 7.2.5. Teachers may wish to combine up to three of the practical exercises with the practical investigation in this way. Other teachers may prefer the simplicity of keeping the two parts of the assessment separate.

The four or more individual practical exercises involving Assessment Objective AO3 should be spread out through the course in a way that suits the teacher and the course structure. The dates on the evidence should make clear when the work has been done so that confirmation is provided that the work has been done at different points in the course. Spreading out the assessments could be done, for example, by ensuring that at least one discrete practical exercise is assessed in each of four terms of study. At least one discrete practical exercise involving Assessment Objective AO3 should be assessed in **each** of four terms of study.

Practical investigation

This should address the parts of Assessment Objective AO3 where candidates produce a hypothesis, plan and carry out an investigation. The data collected is recorded, analysed and conclusions made. A written report is required and the limitations of the investigation noted. This is assessed according to the criteria stated in section 7.2.10. The practical work done during this investigation can be organised in such a way as to constitute practical exercises which can be assessed as such. Up to a maximum of three discrete practical exercises may be assessed during the carrying out of the investigation at the discretion of the teacher.

7.2.1 Examples of tasks suitable for the practical exercises

Imaginative teachers and candidates will find that almost any agricultural task or activity can be used as a basis for the assessment of practical skills through the practical exercises. Such tasks may be carried out in almost any agricultural context, from school or college farms, through allotments and backyard chicken or bee-keeping to extensive forestry or cattle ranching.

It is essential that the candidates have sufficient opportunity to acquire and practice the skills to be assessed before the assessment so that they can confidently show what they can do. This is particularly true where animals are involved so that candidates have been properly trained in dealing with the animals, both for their own safety and also to ensure the humane treatment of the animals concerned. The purpose of this assessment is to give a positive reward for the skills that have been acquired by candidates, so it is very important to ensure that this purpose is met by making sure that candidates have been properly prepared for the intended assessment.

Tasks associated with crop production

Any plant or non-plant crop is suitable. The tasks may involve manual tasks (e.g. digging with a spade or adze) or mechanised or animal-powered tasks (e.g. ploughing) or a combination of these.

The following are examples of tasks that will prove suitable, but clearly this is not exhaustive.

- digging with a spade or adze to produce a rough tilth
- ploughing with a hand-drawn, animal-drawn or tractor-drawn plough
- preparation of a seed bed using hoes, rakes or mechanical cultivators or tractor-drawn cultivators and harrows
- seed sowing (by hand, drills left open for checking depth and spacings; using a hand or tractor-drawn drill, settings of drill left for checking)
- fertilising (calculation of quantities, placement, top dressing)
- transplanting and shading
- mulching
- weeding by hand, using a hoe or flame gun
- pruning
- crop protection (spraying, pest and disease control)
- harvesting and storage of crops

Tasks associated with livestock / poultry production

The animals involved may be conventional livestock, poultry or any other agricultural animal production (e.g. bees, farmed fish or silkworm larvae). The tasks may be manual (e.g. removing soiled bedding and replacement with clean material) or mechanised (e.g. herding using a quad-bike, milking using a mechanical milking parlour) or a combination of these.

The following are examples of tasks that will prove suitable. Again, this is not a list of all the possibilities (and the bracketed sections beginning 'including …' are not comprehensive lists of all the activities that might make up the task, and the task selected might not include all of the listed activities).

- herding (including keeping the herd together; avoiding predators; ensuring access to food and clean water)
- tending animals in any enclosure (e.g. field, chicken run or house) (including ensuring access to food and water; dealing with waste; providing clean bedding; measures to minimise the risk of disease)
- enclosure and house maintenance (including fence construction or maintenance; hedge planting or maintenance; construction, routine maintenance, repair, cleaning or disinfection of housing, pens and nest boxes)
- dealing with disease (including measures to avoid disease, identification of diseased animals, isolation, appropriate treatment where possible [e.g. application of oil to poultry infected with scaly leg mite], disinfection of housing; deciding when to ask for advice [e.g. from an experienced farmer or veterinarian])

- husbandry (including selection of animals suitable for breeding, care for breeding animals, preparations for nesting, birth or hatching, supervision of birthing or hatching, care of new-born or newly hatched animals, deciding when to ask for advice)
- obtaining the product (including milking; collection, grading, cleaning and preparation of eggs for consumption or sale; humane preparations for taking stock to market)

7.2.2 Evidence of performance of practical exercises

The practical exercises will involve candidates in tasks and activities in which they demonstrate skills which will be assessed and will generate evidence of the demonstration of the skill for moderation.

Assessment of the practical exercises by the teacher needs to take place at the time of the performance of the skill by the candidate in order to ensure that the assessment is authentic. The teacher may well use tick-sheets, notes or other teacher-dated records to document the assessment, for later transfer onto the mark sheets. However these tick-sheets and teacher-dated records do not provide evidence of the candidate's performance that is suitable for moderation since such evidence should show the candidate performing the task or activity.

The evidence for moderation of the practical exercises can take many forms. In each case what is being sought is authentic evidence that shows that the candidate has carried out the various chosen practical tasks or activities. The evidence should show that the candidate has skills in such practical agricultural work, and also when the work was carried out.

The preferred forms of evidence are those generated by the candidate and those showing the candidate carrying out the work and are most conveniently presented on a USB flash stick, CD or DVD disk. The evidence for the entire sample of candidates for moderation may fit on a single stick or disk. This is acceptable as long as it is very clear which evidence belongs to which candidate, e.g. by putting the evidence for different candidates into different folders, labelled with the candidate number and name.

Authentic records generated during candidate activities must include the date when the practical activity was carried out and may include:

- Photographs of the candidate doing the task or activity. The images must clearly show the individual candidate carrying out the skill being assessed. These images may be presented in any convenient form (e.g. JPEG, GIF or BMP) or in a document or presentation with written or audio annotations referring to the skills, by the candidate, as well as their thoughts about their own performance of those skills (critical reflections).
- Short videos of the candidate carrying out the task or activity (not longer than 1 minute per activity). No editing or titles are required but candidates should add annotations and critical reflections as an audio or written commentary. Any common format is suitable (e.g. AVI or MPEG).
- Original diaries or notes recording the candidates carrying out of the tasks and activities. These must not be edited or written up neatly. They should be the authentic records kept by the candidate of the skills, and critical reflections, at the time of doing the task or activity. These should be scanned or clearly photographed for inclusion on the USB flash stick, CD or DVD disk.

7.2.3 Criteria for the assessment of practical exercises

Each practical exercise should be marked using the following criteria:

1. Responsibility	the ability to assume responsibility for the task in hand, and to work from given instructions without detailed supervision and help
2. Initiative	the ability to cope with problems arising in connection with the task, to see what needs to be done and to take effective action
3. Technique	the ability to tackle a practical task in a methodical, systematic way, and to handle tools skilfully and to good effect
4. Perseverance	the ability to see a task through to a successful conclusion with determination and sustained effort
5. Quality	the ability to attend to detail, so that the work is well finished and is well presented

7.2.4 Guide for marking against the practical exercises criteria

1. Responsibility	**Marks**
• Follows written or verbal instructions without the need for help • Carries out appropriate safety procedures • Assumes responsibility easily and leads in group work	3
• Follows written or verbal instructions with a little help • Is aware of the need for safety procedures but has difficulty recognising them without guidance • Shows responsibility for the work	2
• Follows written or verbal instructions with considerable help • Shows little regard for safety procedures, even when told • Shows some responsibility for the work	0–1
2. Initiative	**Marks**
• Offers solutions or explanations to unexpected problems • Recognises, and is able to anticipate, problems • Solves problems without help • Comments on imperfections of experimental methods or results	3
• Offers solutions or explanations to unexpected problems after seeking advice • Solves problems with help • Recognises faults in experimental methods, given some pointers	2

• Is uncertain how to proceed and requires considerable help • Recognises only the most obvious errors in experimental methods after considerable guidance	0–1
3. Technique	**Marks**
• Approaches tasks methodically and systematically • Handles tools/apparatus skilfully and confidently • Carries out practical procedures with dexterity	3
• Handles tools/apparatus effectively • Carries out practical procedures adequately	2
• Handles tools/apparatus clumsily • Carries out practical procedures with difficulty	0–1
4. Perseverance	**Marks**
• Completes all the required practical tasks and associated written work • Has a positive attitude and is well motivated	3
• Completes the required practical tasks and attendant written work with a little encouragement • Carries out repetitive procedures willingly	2
• Does not complete the required practical tasks and attendant written work • Is somewhat disinterested/impatient when carrying out work and is disinclined to repeat procedures	0–1
5. Quality	**Marks**
• Performs practical work thoroughly, pays attention to detail and produces a very good final result • Produces accurate, clear and neatly presented written work	3
• Performs practical work thoroughly for the most part and produces a satisfactory to good result • Produces mostly accurate and clearly presented written work	2
• Performs practical work in a rushed and superficial way and shows little concern for the finished product • Produces inaccurate and poorly presented written work	0–1

7.2.5 Practical investigation

This should address the parts of Assessment Objective AO3 where candidates produce a hypothesis, plan and carry out an investigation. The data collected is recorded, analysed and conclusions made. A written report is required and the limitations of the investigation noted. This is assessed according to the criteria stated in section 7.2.10. The practical work done during this investigation can be organised in such a way as to constitute practical exercises which can be assessed as such.

The candidates will carry out an investigation and write a report, not exceeding 1000 words. The teacher evaluates and marks the report and awards an overall mark out of 30.

7.2.6 The type of work required to test investigative skills

The main aim of the investigation is that it should be done by the individual candidate, in connection with some particular study problem. It should not be confused with the writing up of classwork exercises.

Agriculture offers a wide scope for such projects, and it should not be difficult to find suitable topics, bearing in mind the following principles:

(a) The work must be investigatory. Candidates must find the information for themselves by direct observation and measurement.

(b) Though the programme of study must be carried out by the candidate, it is the teacher's responsibility to guide the candidate, or even to select problems that suit the candidate's investigatory abilities. The teacher may also suggest methods of investigation that are likely to be effective. Candidates are not research workers but, when given appropriate guidance, they can learn how to carry out investigations for themselves.

(c) The nature of the problem to be investigated should be stated and discussed by the candidate in the introduction.

(d) Time allocated to investigation work should be approximately 5 periods of 40 minutes, including homework. This should be enough to achieve a good standard. Candidates should be discouraged from spending so much time on their projects that their normal classwork suffers.

(e) Candidates will not necessarily solve all the problems they tackle, but they should make a worthwhile attempt to do so. When problems fail to yield positive results, candidates should be encouraged to discuss their actual findings and comment on the implications. Good investigation work by candidates often leads them to understand the difficulties and subtleties of the problem, and this can be very educational. For some candidates, negative results can be depressing, and teachers must use their judgement when guiding them, so that they do not become discouraged.

7.2.7 Examples of acceptable investigations

Investigations can be based on a variety of topics. The following examples are intended as a guide, but teachers may wish to help their candidates to devise investigations of their own along similar lines.

Field experiments

- comparison of sowing depths, to discover effects; minimum, optimum and maximum depths
- thinning of root crops; no thinning, thinning to various spacings, effects upon total yield and size of roots produced
- plant population in relation to yield; spacing of plant stations and rows, comparison to find optimum spacings
- spraying versus not spraying; effects on infestation with disease or pest organisms, effects on yield, cost-effectiveness
- top-dressing versus not top-dressing; various treatments and effects, comparison of costs and yields
- fertiliser trials; organic versus inorganic, effects of differing application rates upon yields, diminishing returns
- rationing of livestock feed versus ad-lib feeding; effects on production, cost-effectiveness
- effects of different levels of nutrition on young stock (e.g. broiler chickens); measurement of live weight gain under different rationing regimes, effects on health, cost-effectiveness

In the case of field trials, it is often useful to have a group of candidates involved, in order to make possible replication of treatments on plots in different parts of the garden or field. This improves the statistical accuracy of the trial. However, each candidate's contribution must be assessed and **individual reports must be written**.

When different treatments are tried, the effect upon yield of produce is often a factor to be measured. The cost-effectiveness of alternative treatments should also be worked out, to see which one is the most profitable.

Attention should be paid to the presentation of results in a clear and concise form, i.e. tabulation or graphical representation. Reasons should always be given for treatments carried out, methods tried, or conclusions reached.

An example of how the practical exercises may be integrated within the practical investigation

A candidate has decided to carry out an investigation into the effect of nitrate fertiliser on the yield of cabbages. Having proposed a hypothesis with the scientific reasons behind it and planned a suitable investigation, the practical work is carried out. The first practical assessment could involve the preparation of the soil seed bed. The second assessment could involve the planting and spacing of cabbages and the application of nitrate fertiliser. The third assessment could involve harvesting and measuring the cabbage yield. The recording of the data, subsequent analysis and limitations are then written up as part of the practical investigation.

7.2.8 The degree of guidance by the teacher

This calls for skill on the part of the teacher. Ideally, the candidate should be free to choose a topic for the investigation and to decide on the methods to be used. In practice, the candidate will need help, because of inexperience. The teacher should never leave the candidate in doubt for long about what to do next, so that the candidate does not lose interest in or enthusiasm for the investigation.

7.2.9 The layout of the investigation report

Title: The report should have a clear title. This should appear on the first page, together with the name of the candidate and the name of the school.

Contents: A list of contents should be included, showing clearly the main sections of the report and the numbers of pages where they appear. Lists of tables, graphs and photographs can also be included, if appropriate.

Introduction: This should state the objective(s) of the investigation, the questions to be asked or a hypothesis, and describe briefly the plans for carrying it out. Sources of material, such as reference books or people interviewed, should be acknowledged. Details of the time (with dates) and the place where the investigation was carried out should be given.

Methodology: A description of the investigation. Relevant details of the methods used to plan, sample, measure, collect and analyse data.

Presentation of data findings: Data collected should be presented in this section as tables, charts, graphs or histograms. They must always be labelled with a brief description of the data.

Findings and conclusions: The conclusions of the investigation should be summarised in a few paragraphs. The findings should be compared to the original plan set out in the introduction. Limitations of the data should be noted and suggestions made for improvements. Help received from other people should be acknowledged.

7.2.10 Criteria for the assessment of the practical investigation

The practical investigation should be marked using the following criteria:

Criteria	Marks available
1. The selection of relevant questions (hypothesis) for the investigation	5
2. The planning of the investigation and the principles on which it is based	5
3. The handling of evidence	5
4. The ability to make deductions from the evidence or the data acquired	5
5. The ability to recognise limitations of the investigation	5
6. Description of practical, presentation, layout and originality (candidate's own work)	5

7.2.11 Guide for marking against the investigation report criteria

1. The selection of relevant questions (hypothesis) for the investigation	Marks
Relevant questions (hypothesis) selected without guidance, appropriate and clearly stated	5
Relevant questions (hypothesis) selected without guidance, appropriate but poorly expressed	4
Relevant questions (hypothesis) selected with guidance, appropriate and clearly stated	3
Relevant questions (hypothesis) selected with guidance, appropriate but poorly expressed	2
Relevant questions (hypothesis) selected with considerable guidance	1
Relevant questions (hypothesis) provided for the candidate	0
2. The planning of the investigation and the principles on which it is based	**Marks**
Investigation well planned, without guidance, showing evidence that the relevant principles are understood	5
	4
Investigation adequately planned, with some guidance, relevant principles understood	3
	2
Investigation plan sketchy, plan produced with considerable guidance or no evidence that principles are understood	1
Investigation plan provided for the student	0
3. The handling of evidence	**Marks**
Results presented neatly and clearly in a table, appropriate method of analysis chosen, graphs and/or histograms accurate and correctly presented (i.e. correct scale, axis, labelling etc.)	5
	4
Results presented neatly and clearly in a table, inappropriate method of analysis chosen, graphs and/or histograms inaccurate and incorrectly presented	3
	2
Results not presented in a table, inappropriate method of analysis chosen, graphs and/or histograms inaccurate and poorly presented	1
	0

4. The ability to make deductions from the evidence or the data acquired	Marks
Comprehensive deductions based on the evidence, conclusions given with reasons	5
Several deductions based on the evidence, conclusions given with reasons	4
Few deductions based on the evidence, one conclusion given	3
Few deductions based on the evidence, no conclusions given	2
One deduction, no elaboration	1
Tasks carried out with considerable help, inaccurate observations and records	0
5. The ability to recognise limitations of the investigation	**Marks**
All major limitations identified, assessed and improvements suggested	5
	4
Several limitations identified, assessment superficial, no improvements suggested	3
	2
One or two limitations identified but no assessments or improvements given	1
	0
6. Description of investigation, presentation, layout and originality (candidate's own work)	**Marks**
Clear, full description of the aims and nature of the topic; work neat and well presented; layout as required by the syllabus; candidate's own work	5
	4
Description of the aims and nature of the investigation given; lacking in either neat presentation or layout not as required by the syllabus; candidate's own work	3
	2
Outline only of the aims and nature of the investigation; poorly presented; layout not as required by the syllabus; candidate's own work	1
	0

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

8. Appendix

8.1 Physical and chemical concepts and processes

For the purpose of assessment, candidates will be expected to demonstrate:

1. an understanding of temperature, pressure, evaporation and relative humidity
2. an understanding of the terms *element*, *mixture*, *compound*, *atom*, *molecule* and *ion*
3. an understanding of the terms *acid*, *base* and *pH value*
4. an understanding of energy transfer/conversion.

8.2 Mathematical requirements

Calculators may be used in all parts of the assessment.

Candidates should be able to:

1. add, subtract, multiply and divide
2. understand averages, decimals, fractions, percentages and ratios
3. understand the relationship between surface area and volume
4. use direct and inverse proportion
5. draw charts and graphs, including histograms, from given data
6. interpret charts and graphs
7. select suitable scales and axes for graphs.

8.3 Terminology, units, symbols and presentation of data for agriculture

This section follows the practice laid down in the following documents:

- Association for Science Education booklet
  Signs, Symbols and Systematics: The ASE Companion to 16–19 Science (2000)
- Institute of Biology
  Biological Nomenclature, Standard terms and expressions used in the teaching of Biology (2000)

Candidates should be made aware of the information given in this section during teaching and practical work, as it will be used in examination papers.

8.3.1 Units

The International System of units will be used (SI units). Units will be indicated in the singular not in the plural, e.g. 28 kg.

(a) SI units commonly used in agriculture

N.B. Care should be taken in the use of *mass* and *weight*. In many agricultural contexts, the term *mass* is correct, e.g. dry mass, biomass.

Quantity	Name of unit	Symbol for unit
length	kilometre metre centimetre millimetre micrometre	km m cm mm μm
mass	tonne (1000 kg) kilogram gram milligram microgram	t kg g mg μg
time	year day hour minute second	y d h min s
amount of substance	mole	mol

(b) Derived SI units

Quantity	Name of unit	Symbol for unit
energy	kilojoule joule (calorie is obsolete)	kJ J

(c) Recommended units for area, volume and density

Quantity	Name of unit	Symbol for unit
area	hectare = 10^4 m^2 square metre square decimetre square centimetre square millimetre	ha m^2 dm^2 cm^2 mm^2
volume	cubic kilometre cubic metre cubic decimetre (preferred to litre) litre cubic centimetre cubic millimetre	km^3 m^3 dm^3 dm^3 (not l) cm^3 mm^3
density	kilogram per cubic metre or gram per cubic centimetre or	kg m^{-3} g cm^{-3}

(d) Use of solidus

The solidus (/) will **not** be used for a quotient, e.g. m/s for metres per second.

8.3.2 Presentation of data

The solidus (/) is to be used for separating the quantity and the unit in tables, graphs and charts, e.g. time/s for time in seconds.

(a) Tables

- Each column of a table will be headed with the physical quantity and the appropriate SI unit, e.g. time/min.
- There are three acceptable methods of stating units, e.g. metres per sec *or* m per s *or* m s^{-1}.
- The column headings of the table can then be directly transferred to the axes of a constructed graph.

(b) Graphs

- The independent variable will be plotted on the *x*-axis (horizontal axis) and the dependent variable plotted on the *y*-axis (vertical axis).
- Each axis will be labelled with the physical quantity and the appropriate SI unit, e.g. time/min.
- The graph is the whole diagrammatic presentation. It may have one or several curves plotted on it.
- Curves and lines joining points on the graph should be referred to as 'curves'.
- Points on the curve should be clearly marked as crosses (x) or encircled dots (⊙). If a further curve is included, vertical crosses (+) may be used to mark the points.

(c) Pie charts

These should be drawn with the sectors in rank order, largest first, beginning at 'noon' and proceeding clockwise.

(d) Bar charts

These are drawn when one of the variables is not numerical, e.g. number of eggs of different colours. They should be made up of narrow blocks of equal width that do **not** touch.

(e) Column graphs

These are drawn when plotting frequency graphs from discrete data, e.g. frequency of occurrence of nests with different numbers of eggs. They should be made up of narrow blocks of equal width that do **not** touch.

(f) Histograms

These are drawn when plotting frequency graphs with continuous data, e.g. frequency of occurrence of stems of different lengths or chicks of different masses. The blocks should be drawn in order of increasing or decreasing magnitude and they **should** be touching.

8.4 Glossary of command terms used in science papers

During the moderation of a question paper, care is taken to 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 the wording of questions to ensure that it is as concise and 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 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 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. (a) *Explain* may imply reasoning or some reference to theory, depending on the context. It is another way of asking candidates to give reasons for something. The candidate needs to leave the examiner in no doubt **why** something happens.

   (b) *Give a reason/Give reasons* is another way of asking candidates to explain **why** something happens.
6. (a) *Describe*, the data or information given in a graph, table or diagram, requires the candidate to state the key points that can be seen in the stimulus material. Where possible, reference should be made to numbers drawn from the stimulus material.

   (b) *Describe*, a process, requires the candidate to give a step-by-step written statement of what happens during the process.

   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 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. the 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.

In all questions, the number of marks allocated are shown on the examination paper and should be used as a guide by candidates to how much detail to give. In describing a process, the mark allocation should guide the candidate about how many steps to include. In explaining why something happens, it guides the candidate to how many reasons to give, or how much detail to give for each reason.

9. Other information

Equality and inclusion

Cambridge International Examinations has taken great care in the preparation of this syllabus and assessment materials to avoid bias of any kind. To comply with the UK Equality Act (2010), Cambridge has designed this qualification with the aim of avoiding direct and indirect discrimination.

The standard assessment arrangements may present unnecessary barriers for candidates with disabilities or learning difficulties. Arrangements can be put in place for these candidates to enable them to access the assessments and receive recognition of their attainment. Access arrangements will not be agreed if they give candidates an unfair advantage over others or if they compromise the standards being assessed.

Candidates who are unable to access the assessment of any component may be eligible to receive an award based on the parts of the assessment they have taken.

Information on access arrangements is found in the *Cambridge Handbook* which can be downloaded from the website **www.cie.org.uk/examsofficer**

Language

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

Grading and reporting

Cambridge IGCSE results are shown by one of the grades A*, A, B, C, D, E, F or G indicating the standard achieved, A* being the highest and G the lowest. 'Ungraded' indicates that the candidate's performance fell short of the standard required for grade G. 'Ungraded' will be reported on the statement of results but not on the certificate. The letters Q (result pending), X (no results) and Y (to be issued) may also appear on the statement of results but not on the certificate.

Entry codes

To maintain the security of our examinations, we produce question papers for different areas of the world, known as 'administrative zones'. Where the component entry code has two digits, the first digit is the component number given in the syllabus. The second digit is the location code, specific to an administrative zone. Information about entry codes can be found in the *Cambridge Guide to Making Entries*.

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