BOTSWANA
EXAMINATIONS
COUNCIL

BOTSWANA SENIOR SECONDARY EDUCATION

ASSESSMENT SYLLABUS

AGRICULTUAL SCIENCE

[CODE: 1517]

2024 - 2029

FOREWORD

The Botswana Examinations Council (BEC) is pleased to authorise the publication of the Outcome Based Assessment (OBA) syllabus for Agricultural Science in the senior secondary education programme. The assessment syllabus forms part of the Botswana General Certificate of Secondary Education (BGCSE) suite of syllabi available to candidates who have followed the senior secondary programme. The BGCSE is designed for a wide range of learner ability in line with the aspirations of the Revised National Policy on Education of 1994, and its standards are based on Cambridge GCSE and IGCSE.

Our mission as Botswana Examinations Council is “provision of a credible and responsive assessment and examination system”. In the quest for responsiveness, the BEC has aligned the assessment to Outcome Based Education (OBE) that recognises the need to impart 21st century skills on learners. As such, School-Based Assessment (SBA) forms a component of the final assessment. Furthermore, periodic reviews are promoted for the assessment syllabi to reflect the aims of the national curriculum and international best practice. Customer feedback forms an integral part of such reviews.

This syllabus document is the outcome of a great deal of professional consultation and collaboration, and I wish to extend my thanks to all those who contributed towards its development. On behalf of the Botswana Examinations Council, I wish to record my appreciation for the part played by Cambridge as part of the Accreditation Agreement between them and the Council.

ACKNOWLEDGEMENT

The Botswana Examinations Council wishes to acknowledge the diligent contribution of all the stakeholders who played a pivotal role in the development the Agricultural Science Assessment syllabus for the Botswana Senior Secondary Education (BSSE). The stakeholders gave a lot of priority to this national assignment over and above regular work assignments and this document was produced within the stipulated time frame. A task such as this one requires mental focus, commitment, dedication, a high level of accountability and responsibility, as such all of them were equal to this task and are much appreciated.

The Syllabus Development Task Team (SDTT) comprised of the following:

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The members of the Syllabus Advisory Committee (SAC) comprised of the following:

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1.0 INTRODUCTION

As part of the Botswana Senior Secondary Education (BSSE) Programme, the Agricultural Science Assessment Syllabus is designed to outline how candidates who have completed a two-year course based on the academic Pathway (Science) of the Senior Secondary School Agricultural Science Teaching Syllabus are to be assessed.

The syllabus aims to assess positive achievement at all levels of ability. Candidates will be assessed in ways that encourage them to demonstrate what they know, understand and can do. Provider Based Assessment (PBA) will contribute to the final grade of assessment.

The syllabus will be assessed through one written paper, a practical examination and an aggregated provider-based assessment, the details of which are outlined in the Scheme of Assessment. This Agricultural Science Assessment Syllabus should be read in conjunction with:

(a) the Botswana Senior Secondary School Agricultural Science Teaching Syllabus

(b) the specimen question papers and mark schemes

Prior Learning

The Agricultural Science is for learners at Botswana Senior Secondary level (NCQF level 4). To access this syllabus, a learner must have successfully completed Junior Secondary level or equivalent with credit in Agriculture and /or Integrated Science at NCQF level 2. Any learner who has some formal training in Agriculture or able to display crop and livestock production skills may be considered for enrolment, only upon successful completion of the test. Agriculture Science will preferably be offered to students who have previously studied Agriculture.

Progression

Upon completion of BSSE Agriculture Science, learners may progress to tertiary or vocational institutions to study Agriculture related programmes. The Botswana General Certificate of Senior Secondary Education also enables learners to progress directly into employment in areas of crop or livestock production. Career where Agriculture Science is important may include but not limited to Veterinarian, Food Scientist, Agricultural Economist, Agronomist, Agricultural Engineer, Animal Nutritionist, Environmental Scientist, Plant Scientist, Agricultural Scientist, Forester, Aqua-culturist, Animal Scientist, Geneticist, Landscape Designer and Agribusiness.

2.0 TEACHER SUPPORT

A number of support structures are available for teachers handling the Agricultural Science syllabus.

2.1 Support Documents

To ensure uniformity of standards across the centres, the Botswana Examinations Council will provide the education providers with documents and materials that will guide them on how to conduct valid and reliable assessments. These will include guidelines for Outcome Based Assessments, practical test manuals, specimen papers with corresponding mark schemes, annual Principal Moderator and Principal Examiners' reports. The same documents will also be available on the BEC Website.

2.2 Training

BEC will offer periodic training to personnel conducting Provider Based Assessment to equip them with requisite knowledge and skills to deliver credible, valid and reliable assessments. This will include training on item writing.

2.3 Resources

Resources required for the implementation and assessment of this learning programme are included in the appendix.

3.0 SYLLABUS AIMS

According to the Agricultural Science Teaching Syllabus for the academic pathway of the BSSE programme, candidates pursuing this course should with due consideration to safety, health, the environment and quality, be able to:

1. acquire knowledge and skills that are directly linked with a nation's productivity and competitiveness.
2. strike a balance between theoretical knowledge and practical application to everyday situations related to Agriculture.
3. display skills by working with different media, materials, tools, implements and machinery to produce Agricultural Products.
4. Apply skills to investigate cause and effect and the interrelatedness of phenomena in agriculture.

4.0 ASSESSMENT OBJECTIVES

Candidates will be assessed on the following:

ASSESSMENT OBJECTIVES (AOs)

Candidates will be assessed on the following:

1	Knowledge and understanding	[40%]
2	Application skills	[30%]
3	Investigation skills	[30%]

AO1: **Knowledge and understanding**

Candidates should be able to:

Demonstrate knowledge and understanding in agricultural science in relation to correct:

1.Reference to facts, laws, patterns, models, theories, concepts and principles used in agricultural science.

2.Techniques, procedures and principles used in agricultural science practices.

3. Use of terms, symbols, quantities and units of measurement used in agricultural science.

This assessment objective defines the factual knowledge the candidate may be required to recall and explain. Questions testing the assessment objective may begin with one of the following command words: define, state, name, identify, classify, differentiate, describe, explain, outline or discuss, etc.

AO2: APPLICATION SKILLS

Candidates should be able to:

1.Follow instructions.

2.Choose and use suitable techniques, equipment and materials safely and correctly.

3.Handle and use tools, implements, machinery, materials and stock correctly.

4.Record observations, measurements and estimates.

5.Use information to identify patterns, report trends, draw inferences and make predictions.

6.Translate information from one form to another.

7.Present reasoned explanations for phenomena, patterns and relationships.

This assessment objective 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 this objective will often begin with one of the following command words: discuss, predict, suggest, carry out, demonstrate, calculate or determine, etc.

AO3: INVESTIGATION SKILLS

Candidates should be able to:

1. Identify a problem, propose hypothesis, plan and carry out an investigation.

2. Interpret and evaluate observations and experimental data.

3. Draw conclusions, make recommendations and report results.

4. Solve problems of a quantitative and qualitative nature.

This objective can be assessed by observing a candidate carrying out a specified practical oriented task. A set criterion is used to determine the extent to which the candidate has mastered a given task. Questions testing this objective will often begin with one of the following command words: design, perform, investigate, conduct, predict, create and determine, etc.

5.0 SCHEME OF ASSESSMENT

5.1 The Components

Paper 1	[1 hour 30 mins]	[60 marks]	[40%]

A short answer structured questions paper targeting assessment objectives 1 (AO1) and assessment objectives 2 (AO2). The questions will test skills in assessment objectives 1 (AO1) and assessment objectives 2 (AO2).
The paper consists of 8 questions, each representing a module of the teaching syllabus.

Paper 2	[1 hour 45 mins]	[60 marks]	[40 %]

A practical examination paper targeting assessment objective 2 (AO2) and assessment objective 3 (AO3). Question 1 will come from the section soils, Question 2 on the section of crops while question 3 will come from a section of animals. Each question will carry a total mark of 20.
Details on how to prepare for administering the paper will be provided in the form of instructions to centres accompanying the question paper.

Paper 3	[5 terms]	[40 marks]	[20 %]

Provider Based Assessment targeting assessment objective 1 (AO1), assessment objective 2 (AO2) and assessment objective 3(AO3). The component will consist of the Research Project assessment score attained as specified in the Assessment Guide for centres. The assessment will run the full length of the syllabus instruction.

The research project skills for each candidate will be assessed based on the outlined criteria attached in the appendix section of the assessment guide for centres. The candidate shall demonstrate research skills over a period of time and shall:

i. Submit a written research proposal
i. conduct research project and
i. submit a scientific research project report write-up.

The written research proposal will be assessed by the provider and also be submitted for external moderation. It will be marked out of a total of 13 marks. Each candidate will present their proposal to a panel of subject teachers who will award an agreed score to the candidate. Centres will be expected to submit a portfolio of work towards the progression of the research project. The research project report write-up on the other hand will be marked out of 27 marks. The research project write up will also be marked by a team of subject teachers, then will be subjected to external moderation to quality assure the marks that are submitted to BEC

5.2 Relationship Between Assessment Objectives and Components

Assessment Objective	Marks and weightings						Total weighting (%)
	Paper 1		Paper 2		Paper 3		
	marks	%wt	marks	%wt	marks	%wt	
AO 1: Knowledge and understanding	42±2	28%			11±2	5.5%	**33.5**
AO 2: Application skills	18 ±2	12%	24±2	16%	11±2	5.5%	**33.5**
AO 3: Investigation skills	**0**		36 ±2	24%	18±2	9%	**33**
Total Marks	**60**		**60**		**40**		
Total Weighting (%)		**40**		**40**		**20**	**100**

5.3 Grade Descriptors

Grade A

A candidate should be able to:

- Demonstrate with ease a clear knowledge and understanding of all scientific facts, principles, theories, concepts, procedures, trends, and practices as used in agriculture.
- Apply a wide range of scientific facts, principles, theories, procedures, and practices accurately to solve problems of qualitative or quantitative nature using correct symbols and units and specifying correct level of precision.
- Display an extensive awareness of problems existent in agriculture, investigate and recommend modern and environmentally safe solutions that are aligned with smart agriculture practices.
- Identify a wide range of opportunities existent in agriculture and relate with ease how the opportunities can be used to improve the quality and value of life of an individual.
- Evaluate soil properties and animal nutrition systematically and accurately to determine suitability and make appropriate recommendations to ensure the use of modern agricultural approaches and improved production.
- Exhibit an extensive creativity, innovation, critical thinking, problem solving and decision-making skills when developing or using technologies for sustainable agriculture production.
- Handle a wide range of tools, implements, machinery, materials, and stock appropriately and observing all safety, health and environmental concerns when carrying out agricultural activities.
- Investigate accurately and systematically on a clearly stated agricultural problem, precisely interpret and evaluate observations and experimental data, and draw logical conclusions, make relevant recommendations.

Grade C

A candidate should be able to:

- Demonstrate a clear knowledge and understanding of most scientific facts, principles, theories, concepts, procedures, trends, and practices as used in agriculture.
- Apply a limited range of scientific facts, principles, theories, procedures, and practices accurately to solve problems of qualitative or quantitative nature using correct symbols and units and specifying correct level of precision.
- Display awareness of problems existent in agriculture, investigate and recommend modern and environmentally safe solutions that are aligned with smart agriculture practices.
- Identify a limited range of opportunities existent in agriculture and relate how the opportunities can be used to improve the quality and value of life of an individual.
- Evaluate soil properties and animal nutrition accurately to determine suitability and make appropriate recommendations to ensure the use of modern agricultural approaches and improved production
- Exhibit limited creativity, innovation, critical thinking, problem solving and decision-making skills when developing or using technologies for sustainable agriculture production.
- Handle a limited range of tools, implements, machinery, materials, and stock appropriately and observing most safety, health and environmental concerns when carrying out agricultural activities.
- Investigate accurately a clearly stated agricultural problem, interpret and evaluate observations and experimental data, and draw conclusions and make recommendations.

Grade E

A candidate should be able to:

- Demonstrate limited knowledge and understanding of some scientific facts, principles, theories, concepts, procedures, trends, and practices as used in agriculture.
- Apply a limited range of scientific facts, principles, theories, procedures, and practices to solve problems of qualitative or quantitative nature using correct symbols and units and specifying correct level of precision with some inconsistencies.
- Display limited awareness of problems existent in agriculture, investigate and recommend modern and environmental solutions that are aligned with smart agriculture practices.
- Identify some opportunities existent in agriculture with limited relationship on how the opportunities can be used to improve the quality and value of life of an individual.
- Evaluate soil properties and animal nutrition to determine suitability and make some recommendations to ensure the use of modern agricultural approaches and improved production
- Exhibit limited creativity, some problem solving and decision-making skills when developing or using technologies for sustainable agriculture production.
- Handle a limited range of tools, implements, machinery, materials, and stock observing some safety, health and environmental concerns when carrying out agricultural activities.
- Investigate a stated agricultural problem with some ambiguity, state observations and present experimental data with limited conclusions and make some recommendations.

Grade G

A candidate should be able to:

- Demonstrate basic knowledge and understanding of limited scientific facts, principles, theories, concepts, procedures, trends, and practices as used in agriculture.
- Apply limited range of scientific facts, principles, theories, procedures, and practices to solve problems of qualitative or quantitative nature using incorrect symbols and units with low level of precision.
- Display limited awareness of problems existent in agriculture with no recommendations to modern and environmentally safe solutions that are aligned with smart agriculture principles.
- Identify very few opportunities existent in agriculture and demonstrate little effort in making use of the opportunities to improve the quality and value of life of an individual.
- Exhibit very limited creativity, some problem solving and decision-making skills when developing or using technologies for sustainable agriculture production
- Handle very limited range of tools, implements, machinery, materials, and stock observing some safety, health, environmental concerns when carrying out agricultural activities.
- Investigate a stated agricultural problem with ambiguity, state observations and present experimental data with irrelevant or no conclusions and recommendations.

5.4 Availability of the Syllabus

This syllabus is available to both school candidates and private candidates.

5.5 Combining the Syllabus with Other Syllabuses

Candidates may not combine this syllabus in an examination series with the following Botswana Senior Secondary Education assessment syllabus(es):

- Field Crop Production
- Horticulture
- Animal Production

6.0 CONTENT

The Teaching Syllabus covers nine modules:

Module 1	
AGSSL 1	EXPLORE PRINCIPLES OF SUSTAINABLE AGRICULTURE
AGSSL 1.1: Demonstrate knowledge and understanding of principles of land use planning. AGSSL 1.2: Demonstrate knowledge and understanding of principles of agricultural economics and extension. AGSSL 1.3: Demonstrate knowledge and understanding of organic farming, hydroponics and smart agriculture.	
Module 2	
AGSSL 2	MANAGE SOIL AND SOIL WATER SYSTEMS
AGSSL 2.1: Demonstrate understanding of soil formation and its fertility. AGSSL 2.2: Demonstrate understanding of soil conservation. AGSSL 2.3: Demonstrate understanding of irrigation.	
Module 3	
AGSSL 3	EXPLORE PRINCIPLES OF PLANT GROWTH
AGSSL 3.1: Demonstrate understanding of plant anatomy and physiology. AGSSL 3.2: Demonstrate knowledge and skills in plant growth. AGSSL 3.3: Demonstrate knowledge and skills in plant reproduction	
Module 4	
AGSSL 4	PROTECT CROPS FROM PESTS AND DISEASES.
AGSSL 4.1: Demonstrate knowledge and skills in controlling crop pests. AGSSL 4.2: Demonstrate knowledge and skills in controlling weeds. AGSSL 4.3: Demonstrate knowledge and skills in controlling crop diseases. AGSSL 4.4: Demonstrate knowledge and skills in the safe use of chemicals in the farm.	
Module 5	
AGSSL 5	EXPLORE ANATOMY AND PHYSIOLOGY OF ANIMALS
AGSSL 5.1: Demonstrate understanding of anatomy and physiology of animal cell AGSSL 5.2 Demonstrate understanding of anatomy and physiology of animals	
Module 6	
AGSSL 6	PROTECT ANIMALS FROM DISEASES AND PARASITES
AGSSL 6.1: Demonstrate knowledge and skills in protecting animals from parasites and diseases. AGSSL 6.2: Demonstrate knowledge and skills in animal nutrition.	
Module 7	

PHYSL 7	BREED LIVESTOCK AND PLANTS
AGSSL 7.1: Demonstrate understanding of genetics and inheritance. AGSSL 7.2: Demonstrate understanding of breeding methods. AGSSL 7.3: Demonstrate understanding of breeding livestock and plants.	
Module 8	
AGSSL 8	USE FARM MACHINERY AND STRUCTURES
AGSSL 8.1: Determine the use of various farm equipment. AGSSL 8.2: Demonstrate understanding of the use of various farm Structures. AGSSL 8.3: Maintain Farm Equipment.	
Module 9	
AGSSL 9	CARRY OUT INVESTIGATIVE RESEARCH PROJECT ON EITHER ANIMALS OR CROPS
AGSSL 9.1: Investigate challenges affecting either crops or animal production. AGSSL 9.2: Demonstrate skills in writing a research project report on either crops or animal production.	

The details of the Performance Criteria and the Learning outcomes are covered in the Agricultural Science teaching syllabus of Botswana Senior Secondary School Learning Programme.

7.0 PROVIDER BASED ASSESSMENT

Provider based assessment in Agricultural Science entails a continuous assessment of the candidate's work throughout the execution of the learning programme. This will establish the extent of mastery of the Learning Outcomes (LO's) by the candidates. The education provider shall assess the candidate and keep evidence of assessment for every performance criterion as stipulated in the teaching syllabus. The Botswana Examination Council shall select the scores from the different provider-based assessments to be included in the final assessment of the candidate as specified in the Assessment *Guide for Centres* and will remain subject to review from time to time. A portfolio of assessment evidence shall be kept in the centre for every candidate for authentication of the scores awarded to each candidate.

7.1 Composition of provider-based assessment

According to the Agricultural Science Teaching Syllabus, provider-based assessment is expected to be achieved through the following:

- Practical Tasks
- Projects
- marked tests
- marked assignments
- marked quizzes

The contribution of provider-based assessment is 20% of the total weight of the final assessment of the candidate. The percentage contribution of the provider-based assessment will remain subject to review based on the reliability and validity of the scores provided by the centres. For summative assessment purpose the Botswana Examinations Council shall sample Research Project and subject it to external moderation.

7.2 Moderation of provider-based assessment

In order to validate the provider-based assessment scores from the centres, moderation of scores will be done. Prior to assessment of the candidates, centres are required to moderate their assessments internally by standardizing each assessment. The internally moderated scores will then be subjected to external moderation.

7.2.1 Internal moderation

The Senior Teacher for the subject shall be responsible for the coordination of the standardization of assessments done within the centre. The rest of the teachers in the centre will be required to assess the candidates to a common standard as agreed in the standardisation meetings. The internal standardization records shall be kept by the Senior Teacher for submission to the External Moderator.

7.2.2 External moderation

The Botswana Examinations Council shall provide the centres with an external moderation schedule in advance of the moderation exercise. Details of documents required for moderation are specified in the *Assessment Guide for Centres*.

8.0 OTHER INFORMATION

8.1 Equality and Inclusion

The Botswana Examinations Council has taken care in the preparation of this assessment syllabus and accompanying assessment materials to avoid bias of any kind. To comply with the accreditation standards this assessment was designed with the aim of avoiding direct and indirect discrimination.

The standard assessment arrangements may present unnecessary barriers for candidates with special learning needs. Access arrangements will be put in place to enable such candidates to be assessed and to be given a fair recognition of their attainment. Access arrangements that give a candidate an unfair advantage over the others or that compromise the standards being assessed will not be permitted.

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

Modifications made to assessments will be in line with the Special Education Needs guidelines of BEC. It is recommended when registering the candidates for entry into the syllabus, centres should specify the special learning requirements for such candidates.

8.2 Grading and Reporting

Botswana Senior Secondary Education (BSSE) reports on a grading scale ranging from A* to G. A* being the highest and G being the lowest. Ungraded (U) indicates that the candidate's performance fell short of the standard required for a grade G. Ungraded will be reported on the statement of results but not on the certificate. The letters Y (results pending / yet to be issued), and X (no results) may appear on the statement of results but not on the certificate.

9.0 APPENDICES

A Definition of command words

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 description of their meanings. Candidates should appreciate that the meaning of a term must depend in part on its context.

1 **Define:** (the term(s)) is intended literally, only a formal statement or equivalent paraphrase being required.

2 **What do you understand by / what is meant by the (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 intended mark value.

3 **State:** implies a concise answer with little or no supporting argument e.g., numerical answer that can 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 are 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 **because** something happens.

(b) **Give a reason / give reasons**: is another way of asking candidates to explain **why** something happens.

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 particular experiments. In the former instance, the term usually implies that the answer should include reference to (visual) observations associated with the phenomena.

In other contexts, describe should be interpreted more generally i.e., the candidate has greater discretion about the nature and organisation of the material to be included in the answer.

[Describe and explain may be coupled, as 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 the essentials.

9 **Predict**: implies that the candidate is not expected to produce the required response by recall but by making a logical connection with other pieces of information. Such information may be wholly given in the question or may depend on the answers extracted in an early 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 law principle, or the necessary reason is to be included in the question.

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 conditions describing an unknown or to imply that the 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 numerical answers are 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 ruler, or mass, using a balance.

15 **Determine**: often implies that the quantity concerned can be directly obtained from a suitable measuring instrument e.g. length, using a ruler, or mass, using a balance.

16 **Estimate:** implies a reasoned order or magnitude statement or calculation of the quantity concerned making such simplifying assumption 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 needs only to 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.

It is expected that candidates will demonstrate background knowledge of and or an increased depth of knowledge, in the following physical, chemical and mathematical concepts and processes.

In all questions, the number of marks allocated are shown on the examination paper and should be used as a guide by candidates to know 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.

B Mathematical Skills

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.

C Presentation of Data

These terms will be used by the Principal Examiners during the setting of papers. Candidates should be made aware of the terminology during teaching and practical work. This section follows the practice laid down in the following documents:

Association for Science Education Booklet, SI Units, Symbols and Abbreviations (1981)

Institute of Biology, Biological Nomenclature: Recommendations on Terms, Units and Symbols (1989)

2 Units

The international system of units will be used (SI units). The units will be indicated in the singular not in the plural, e.g., 47 kg.

(a) SI units commonly used in Agriculture are listed below

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

(b) Derived SI Units are listed below

Quantity	Name of units	Symbol for unit
energy	kilojoule	*kJ*
	joule	*J*

(c) Recommended units for area, volume and density are listed below

Quantity	Name of units	Symbol for unit
area	hectare	*ha*
	square metre	m^2
	square centimetre	cm^2
	square decimetre	dm^2
	Square millimetre	mm^2
volume	cubic metre	m^3
	litre	*l*
	cubic centimetre	cm^3
	cubic decimetre	dm^3
	cubic millimetre	mm^3
density	kilogram per cubic metre	$kg\,m^{-3}$
	gram per cubic centimetre	$g\,cm^{-3}$

(d) Use of solidus

Negative indices- symbol combined in a quotient – will be written as, for example, either m s^{-1}or metres per second

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

The solidus (/) is used in tables and graphs to separate a physical quantity from its appropriate unit e.g., time / s, not time measured in seconds (see section 3)

3 Presentation of data

(a) Tables

(i) Each column of a table will be headed with the physical quantity and appropriate SI units e.g., time / s, rather than time (s).

There are three acceptable methods of stating units e.g., metre per sec or m per s or m s^{-1}

(ii) The column headings of the table can then be directly transferred to the axes of a constructed graph.

(b) Graphs

(i) The independent variable will be plotted on the *x* (horizontal axis) and the dependent variable plotted on the *y* (vertical axis).

(ii) The graph is the whole diagrammatic presentation. It may have one or several curves plotted on it.

(iii) Curves and lines joining points on the graph should be referred to as ‘curves’.

(iv) Points on the curve should be clearly marked as crosses (x) 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. Pie charts should preferably contain no more than six sectors.

(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 which 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 which 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 magnitude and should be touching.

D Resources required for the syllabus

No.	Description	Quantity	Comment
1	**Curriculum Resources** Agriculture Science reference textbooks Charts Videos Models Access to internet		Will be determined by the number of students
1	**Agriculture Laboratory** Furnished with: Fume cupboards Ovens Fridge Gas taps Running water and Sink Workingbenches Teachers' demonstration table Lockable cabinets for chemical storage	4	The number of labs will depend on enrolment and numbers opting for the syllabus

	First aid kit Safety charts Fire extinguisher Window Blinds Glassware (Beakers, measuring cylinders, test tubes Petri dishes, watch glass) Glassware Holders Lab stools Magnifying glasses Microscopes Forceps Probes Scalpel Dissecting Tray Incubators Stirrers Hot plates Balancing scale Test kits (soil, starch, fat and moisture) pH Meters		
2	**Land** 4m^2 of land / learner Net shading space Farm chemical storage Tool Shed (Secure) Water ponds/Reservoir	-	Will depend on student numbers at least enough for whole class
3	**Garden tools** Spade Shovel Digging Fork Hand fork trowel Hose pipe		Will depend on student numbers at least enough for whole class

	Steel Rake Leaf rake Axe Pick Pick axe Wheelbarrow Slasher Hedge Shear Saw Prunning saw Secateur Hoe Corn Knife Straight Hedge Shear Lawn mower Plant pots Seed trays		
4	**Pest control equipment** Knapsac Sprayer Hand sprayer Face mask Hand gloves Respirator Overall / Lab coats Rubber boots		Will depend on student numbers at least enough for whole class
5	**Livestock handling tools and equipment**. Syringes Needles Deworming gun / drenching gun Burdizzo Dehorning iron Branding iron Hoof trimmer Eartag applicator		Will depend on student numbers at least enough for whole class

	Rubber ring elastrator Ear notcher Dip Tank Spray race		
6	**Farm Implements and Machinery** Subsoiler Ripper Mouldboard plough Disc Plough Cultivator Harrow Milking Machine Feed mixer Hammer mill Bailer Chain saw Tractor Combined Harvester Silage chopper	– 	Can be accessed through field visits
7	**ICT Equipment** Internet access Computers Printers Projectors Screens Smart Boards CDs USB		Will depend on student numbers at least enough for whole class
8	**Learning Resource** Relevant textbooks Charts / models of Anatomy and physiology of plants and animals, Pests, weeds, diseases etc		Will depend on student numbers at least enough for whole class

9	**Consumables** These include: Organic and Inorganic fertilizers Growing media Seeds Pesticides Herbicides Plant bags Animal feed stuff		Will depend on topic under discussion
10	**Transportation**		To enable students to observe operations that can not be performed in a school setting