CARIBBEAN EXAMINATIONS COUNCIL

CAPE® Biology

SYLLABUS
2008–2019

Macmillan Education
4 Crinan Street, London, N1 9XW
A division of Macmillan Publishers Limited
Companies and representatives throughout the world

www.macmillan-caribbean.com

ISBN 978-1-380-03083-2

www.cxc.org
www.cxc-store.com

First published 2018

Designed by Macmillan Publishers Limited
Cover design by Macmillan Publishers Limited and Red Giraffe

CAPE® Biology Free Resources

LIST OF CONTENTS

Biology

Biology is the scientific study of living organisms. The study of this subject leads to an understanding and appreciation of the concepts of life at all levels and hence to a greater respect and reverence for life. The interconnected web of life and the unique role of the human species are integral to the dynamic value of the biosphere. The CAPE Biology Syllabus prepares students to acquire knowledge about how to protect, sustain, conserve and improve the variety of life in the ecosphere. It also provides a foundation for persons wishing to pursue careers in biological, environmental, agricultural, medical, paramedical and applied science.

Unit 1: Biomolecules, Reproduction and Development

- Module 1 Cell and Molecular Biology
- Module 2 Genetics, Variation and Natural Selection
- Module 3 Reproductive Biology

Unit 2: Bioenergetics, Biosystems and Applications

- Module 1 Bioenergetics
- Module 2 Biosystems Maintenance
- Module 3 Applications of Biology

CARIBBEAN EXAMINATIONS COUNCIL

Caribbean Advanced Proficiency Examination
CAPE®

BIOLOGY SYLLABUS

Effective for examinations from May/June 2008

Published by the Caribbean Examinations Council

Correspondence related to the syllabus should be addressed to:

The Pro-Registrar
Caribbean Examinations Council
Caenwood Centre
37 Arnold Road, Kingston 5, Jamaica, W.I.

Telephone: (876) 630-5200
Facsimile Number: (876) 967-4972
E-mail address: cxcwzo@cxc.org
Website: www.cxc.org

Contents

This document CXC A10/U2/07 replaces CXC A10/U2/01 issued in 2001.

Please note that the syllabus was revised and amendments are indicated by italics.

First issued 1999
Revised 2001
Revised 2007

Please check the website www.cxc.org for updates on CXC's syllabuses.

Introduction

The Caribbean Advanced Proficiency Examination (CAPE) is designed to provide certification of the academic, vocational and technical achievement of students in the Caribbean who, having completed a minimum of five years of secondary education, wish to further their studies. The examinations address the skills and knowledge acquired by students under a flexible and articulated system where subjects are organised in 1-Unit or 2-Unit courses with each Unit containing three Modules. Subjects examined under CAPE may be studied concurrently or singly.

The Caribbean Examinations Council offers three types of certification. The first is the award of a certificate showing each CAPE Unit completed. The second is the CAPE diploma, awarded to candidates who have satisfactorily completed at least six Units, including Caribbean Studies. The third is the CAPE Associate Degree, awarded for the satisfactory completion of a prescribed cluster of seven CAPE Units including Caribbean Studies and Communication Studies. For the CAPE diploma and the CAPE Associate Degree, candidates must complete the cluster of required Units within a maximum period of five years.

Recognised educational institutions presenting candidates for CAPE Associate Degree in one of the nine categories must, on registering these candidates at the start of the qualifying year, have them confirm in the required form, the Associate Degree they wish to be awarded. Candidates will not be awarded any possible alternatives for which they did not apply.

Biology Syllabus

◆RATIONALE

Science plays a major role in the evolution of knowledge. It empowers us to use creative and independent approaches to problem solving. It arouses our natural curiosity and enables us to meet diverse and ever expanding challenges. It enhances our ability to inquire, seek answers, research and interpret data. These skills lead to the construction of theories and laws that help us to explain natural phenomena and exercise control over our environment. Science is, thus, an integral component of a balanced education.

The most important natural resource in the Caribbean is its people. If the Caribbean is to play an important role in the new global village and survive economically, a sustained development of the scientific and technological resources of its people is essential.

The diverse forms of life, investigated and recorded by human society, have led to the development of a discipline known as Biology. The study of this subject leads to an understanding and appreciation of the concept of life at all levels and, hence, to a greater respect and reverence for life. The interconnected web of life and the unique role of the human species is integral to the dynamic nature of the biosphere. Students of Biology should recognise the enormous responsibility they must undertake to ensure the continuity of life in all its forms. It is incumbent on them to use this knowledge to protect, sustain, conserve and improve the variety of life in the ecosphere. Additionally, the study of Biology prepares students for careers in biological, agricultural, environmental, medical, paramedical and applied science.

This CAPE syllabus is, therefore, designed to provide a coherent course of study which addresses, in addition to a specific knowledge base, the development of related skills and attitudes. The syllabus takes into account the requirements for tertiary education at regional and international institutions. The syllabus is structured in such a way as to ensure that students become aware of their moral, social, and ethical responsibilities, as well as, the benefits intrinsic to the practical application of scientific knowledge to careers in the scientific field.

◆AIMS

The syllabus aims to enable students to:

1. acquire a body of knowledge and develop an understanding of biological concepts and principles;

2. understand how new information results in reformulation or rejection of earlier models and concepts;

3. recognise the scope of Biology from the molecular level to that of entire ecosystems;

4. develop an ability to communicate biological information in a variety of acceptable ways;

5. acquire an understanding of the scientific method and be able to apply it to solving problems, both in academic and non-academic settings;

6. appreciate the impact of biological knowledge on society and its relevance to ethical, economic, environmental and technological issues;

7. acquire training in the practical skills and thought processes associated with the study of science;

8. develop the ability to apply biological knowledge and skills to relevant Caribbean situations and issues.

◆SKILLS AND ABILITIES TO BE ASSESSED

The skills students are expected to develop on completion of this syllabus, have been grouped under three main headings:

(i) Knowledge and Comprehension;

(ii) Use of Knowledge;

(iii) Experimental Skills.

Knowledge and Comprehension (KC)

Knowledge	The ability to identify, remember and grasp the meaning of basic facts, concepts and principles.
Comprehension	The ability to: - select appropriate ideas, match, compare and cite examples of facts, concepts and principles in familiar situations; - explain familiar phenomena in terms of theories, models, laws and principles.

Use of Knowledge (UK)

Application	The ability to: - use facts, concepts, principles and procedures in unfamiliar situations; - transform data accurately and appropriately; - use common characteristics as a basis for classification; - use formulae accurately for computations.

Use of Knowledge (UK) (cont'd)

Analysis and Interpretation	The ability to: - identify and recognise the component parts of a whole and interpret the relationships between those parts; - identify causal factors and show how they interact with each other; - infer, predict and draw conclusions; - make necessary and accurate calculations and recognise the limitations and assumptions of data.
Synthesis	The ability to: - combine component parts to form a new meaningful whole; - make predictions and solve problems.
Evaluation	The ability to make reasoned judgements and recommendations based on the value of ideas and information and their implications.

Experimental Skills (XS)

Observation, Recording and Reporting	The ability to: - select observations relevant to the particular activity; - make accurate observations and minimise experimental errors; - recognise, identify and interpret biological materials both microscopically and macroscopically; - record observations, measurements, methods and techniques with due regard for precision, accuracy and units; - record and report unexpected results; - select and use appropriate models of recording data or observations, for example, graphs, tables, diagrams and drawings; - present data in an appropriate manner, using the accepted convention of recording errors and uncertainties;

Experimental Skills (XS) (cont'd

- organise and present information, ideas, descriptions and arguments clearly and logically in a complete report, using spelling, punctuation and grammar with an acceptable degree of accuracy;

- report accurately and concisely using scientific terminology and conventions as necessary.

Manipulation and Measurement

The ability to:

- follow a detailed set or sequence of instructions;

- make measurements with due regard for precision and accuracy;

- handle chemicals and living organisms with care;

- cut, stain and mount sections and make temporary mounts;

- set up light microscope for optimum use both under low power and high power;

- use the stage micrometer and eyepiece graticule for accurate measuring;

- assemble and use simple apparatus and measuring instruments.

Drawing

The ability to:

- make clear, accurate line representations of specimens, with no shading or unnecessary details;

- produce drawings with clean continuous lines of even thickness;

- label drawings accurately and use label lines which do not cross each other or carry arrowheads or dots;

- annotate drawings appropriately and accurately;

- make drawings which are large enough to display specific details;

- calculate the magnification of the drawings.

Experimental Skills (XS) (cont'd)

Planning and Designing	The ability to:

- identify problems, make predictions, develop hypotheses and devise means of carrying out investigations to test the hypotheses;
- plan and execute experimental procedures and operations in an appropriate sequence;
- use experimental controls where appropriate;
- modify an original plan or sequence of operations as a result of difficulties encountered in carrying out experiments or obtaining unexpected results;
- take into account possible sources of errors and danger in the design of an experiment;
- select and use appropriate equipment and techniques.

Planning and Designing skills may be assessed by use of fieldwork.

◆PRE-REQUISITES OF THE SYLLABUS

Any person with a good grasp of the Caribbean Secondary Education Certificate (CSEC) Biology and Chemistry syllabuses, or the equivalent, should be able to pursue the course of study defined by this syllabus. However, successful participation in the course of study will also depend on the possession of good verbal and written communication skills.

◆STRUCTURE OF THE SYLLABUS

This syllabus is arranged into TWO Units, each made up of three Modules. Whilst each Module in each Unit is independent, together they form a coherent course of study which should prepare candidates for the world of work and studies at the tertiary level.

Unit 1: Biomolecules, Reproduction and Development

Unit 1 is expected to be covered in approximately 150 hours, and consists of three Modules. This Unit is structured as follows:

Module 1	-	*Cell and Molecular Biology*
Module 2	-	*Genetics, Variation and Natural Selection*
Module 3	-	*Reproductive Biology*

Unit 2: Bioenergetics, Biosystems and Applications

Unit 2 is expected to be covered in approximately 150 hours, and consists of three Modules. This Unit is structured as follows:

Module 1	-	*Bioenergetics*
Module 2	-	*Biosystems Maintenance*
Module 3	-	*Applications of Biology*

Each Unit forms a discrete package for certification.

The syllabus is arranged into two (2) Units, Unit 1 which will lay the foundation, and Unit 2 which expands on and applies the concepts formulated in Unit 1. It is, therefore, recommended that Unit 2 be taken after satisfactory completion of Unit 1 or a similar course. Each Unit will be certified separately.

For each Module there are general and specific objectives. The general and specific objectives indicate the scope of the content, including practical work, on which the examination will be based. However, unfamiliar situations may be presented as stimulus material in a question.

Explanatory notes are provided to the right of some specific objectives. These notes provide further guidance to teachers as to the level of detail required.

The single underlining of a specific objective and its explanatory notes, indicate those areas of the syllabus that are suitable for practical work. However, practical work should not necessarily be limited to these objectives.

It is recommended that of the approximately 50 hours suggested for each Module, a minimum of 20 hours be spent on laboratory-related activities, such as conducting experiments, making field trips and viewing audio-visual materials.

UNIT 1: BIOMOLECULES, REPRODUCTION AND DEVELOPMENT

MODULE 1: CELL AND MOLECULAR BIOLOGY

GENERAL OBJECTIVES

On completion of this Module, students should:

1. *understand* the chemical structure of water, carbohydrates, lipids and proteins and their roles in living organisms;

2. *understand* that cells are the basic units of living organisms, grouped into tissues and organs;

3. understand fluid mosaic model of membrane structure and the movement of substances into and out of cells;

4. *understand the mode of action of enzymes.*

SPECIFIC OBJECTIVES	EXPLANATORY NOTES
1. <u>Aspects of Biochemistry</u>	
Students should be able to:	
1.1 *discuss how* the structure and properties of water relate to the role that water plays as a medium of life;	*Water as a most suitable solvent in relation to its essential roles in transport: cellular and systemic levels.*
1.2 explain the relationship between the structure and function of glucose;	*Exact molecular ring structure in full.*
1.3 explain the relationship between the structure and function of sucrose;	*Exact molecular ring structure in full.*
1.4 *discuss how* the molecular structure of starch, glycogen and cellulose relate to their functions in living organisms;	*Molecular structure: types of bonds; chain and ring structure where appropriate; 3D nature; hydrolysis and condensation reactions; relate structure to properties.*
1.5 describe the molecular structure of a triglyceride and its role as a source of energy;	Without going into detail, the student should be made aware of the relationship between triglycerides and obesity.

SPECIFIC OBJECTIVES		EXPLANATORY NOTES
Aspects of Biochemistry (cont'd)		
1.6	describe the structure of phospholipids and their role in membrane structure and function;	*Relate structure to properties and hence to function.*
1.7	describe the generalised structure of an amino acid, and the formation and breakage of a peptide bond;	
1.8	*explain the meaning of the terms: primary, secondary, tertiary and quaternary structures of proteins;*	*Describe the types of bonding (hydrogen, ionic, disulphide) and hydrophobic interactions that hold the molecule in shape.*
1.9	*outline the molecular structure of haemoglobin, as an example of a globular protein, and of collagen, as an example of a fibrous protein;*	*Ensure that the relationships between their structures and functions are clearly established.*
1.10	*carry out tests for reducing and non-reducing sugars, starch, lipids and proteins;*	*Benedict's test, KI/I_2 test, emulsion test, Biuret test.*
1.11	*investigate and compare quantitatively reducing sugars and starch.*	
2.	**Cell Structure**	
Students should be able to:		
2.1	make drawings of typical animal and plant cells as seen under the light microscope;	*Clear drawings required (refer to page 4).* *Differences between electron and light microscope and between resolution and magnification.*
2.2	*describe and interpret drawings and electron micrographs of the structure of membrane systems and organelles of typical animal and plant cells;*	*Rough and smooth endoplasmic reticulum, Golgi body, mitochondria, ribosomes, lysosomes, chloroplasts, cell membrane, nuclear envelope, centrioles, nucleus and nucleolus.*

SPECIFIC OBJECTIVES		EXPLANATORY NOTES
Cell Structure (cont'd)		
2.3	*outline the functions of membrane systems and organelles;*	*As specified in the Explanatory Notes of Specific Objective 2.2.*
2.4	*compare the structure of typical animal and plant cells;*	*Stress similarities and differences.*
2.5	*describe the structure of a prokaryotic cell;*	
2.6	*compare the structure of prokaryotic cells with that of eukaryotic cells;*	*Outline the basis of the endosymbiotic development of eukaryotic cells.*
2.7	*explain the concepts of tissue and organ using as an example the dicotyledonous root;*	
2.8	*make plan drawings to show the distribution of tissues within an organ, such as the dicotyledonous root.*	*Use transverse section of a dicotyledonous root to illustrate tissues including parenchyma, xylem and phloem. The root is used as an organ.*
3. Membrane Structure and Function		
Students should be able to:		
3.1	*explain the fluid mosaic model of membrane structure;*	*Outline the roles of phospholipids, cholesterol, glycolipids, protein and glycoproteins. Diagrams are required.*
3.2	*explain the processes of diffusion, facilitated diffusion, osmosis, active transport, endocytosis and exocytosis;*	*Emphasise the distinction between diffusion and osmosis; and active and passive processes.* *Diagrams are required.*

SPECIFIC OBJECTIVES	EXPLANATORY NOTES
Membrane Structure and Function (cont'd)	
3.3 investigate the effects on plant cells of immersion into solutions of different water potentials.	No calculations will be set on water potential.
4. Enzymes	
Students should be able to:	
4.1 explain that enzymes are globular proteins that catalyse metabolic reactions;	*Definition of metabolism, anabolism, catabolism required.*
4.2 *explain the mode of action of enzymes in terms of an active site, enzyme and/or substrate complex, lowering of activation energy and enzyme specificity;*	*Properties of enzymes. Induced-fit hypothesis.*
4.3 *explain the effects of pH, temperature, enzyme concentration and substrate concentration on enzyme action;*	*Construction and interpretation of graphs.*
4.4 explain the effects of competitive and non-competitive inhibitors on enzyme activity;	*Use succinic dehydrogenase, nicotine and insecticides (pyrethroids) as examples of enzyme inhibitors.*
4.5 *investigate the effects of temperature and substrate concentration on enzyme-catalysed reactions, and explain these effects.*	

Suggested Teaching and Learning Activities

To facilitate students' attainment of the objectives of this Module, teachers are advised to engage students in the teaching and learning activities listed below.

1. *Conduct laboratory exercises to reinforce subject matter rather than as a separate activity.*

2. *Read and use current information in this particular area, since it is constantly changing.*

3. Use multimedia and 3-dimensional models to assist in conceptualising cell and/or molecular structure.

Scientific Journals, such as:

New Scientist

Scientific American

Biological Sciences Review

News Magazines, such as:

Time

Newsweek

Discover

RESOURCES

Bradfield, P., Dodds, J. et al — *AS Level Biology*, Essex: Pearson Education Limited, 2001.

Clegg, C. with Mackean, D. — *Advanced Biology: Principles and Applications*, London: John Murray Publishers, 2006.

Jones, A., Reed, R. and Weyers, J. — *Practical Skills in Biology*, 3rd Edition, New Jersey: Pearson Prentice Hall, Pearson Education Limited, 2003.

UNIT 1
MODULE 2: GENETICS, VARIATION AND NATURAL SELECTION

GENERAL OBJECTIVES

On completion of this Module, students should:

1. *understand the structure of nucleic acids and their roles in protein synthesis and nuclear division;*
2. *understand the behaviour of chromosomes, nucleus and cytoplasm in mitotic and meiotic cell division and their importance for stability and variation in a species;*
3. *understand the importance of mitosis and meiosis for stability and variation in a species;*
4. *understand the patterns of inheritance;*
5. *understand selected aspects of genetic engineering and its medical, agricultural, environmental, ethical and social implications;*
6. *understand the genetic basis of variation and its importance in natural selection.*

SPECIFIC OBJECTIVES	EXPLANATORY NOTES
1. *Structure and Roles of Nucleic Acids*	
Students should be able to:	
1.1 *illustrate the structure of RNA and DNA using simple labelled diagrams;*	*Draw a nucleotide using shapes; recognise (not draw) the structural formulae of nucleotides, ribose, deoxyribose, pyrimidines, purines; nature of hydrogen bonds.*
1.2 *explain the importance of hydrogen bonds and base pairing in DNA replication;*	*Recognise (include) the significance of 5' and 3'; semiconservative replication; genetic code; initiation, transcription, translation, termination.*
1.3 *explain the relationship between the sequence of nucleotides and the amino acid sequence in a polypeptide;*	
1.4 *describe the roles of DNA and RNA in protein synthesis;*	*Different types of RNA and their respective roles.*
1.5 *explain the relationship between the structure of DNA, protein structure and the phenotype of an organism;*	
1.6 *describe the relationship between DNA chromatin and chromosomes.*	

UNIT 1
MODULE 2: *GENETICS, VARIATION AND NATURAL SELECTION (CON'TD)*

SPECIFIC OBJECTIVES		EXPLANATORY NOTES
2.	**Mitotic and Meiotic Cell Division**	
Students should be able to:		
2.1	*describe with the aid of diagrams, the processes involved in mitotic cell division;*	*Include interphase.*
2.2	*make drawings from prepared slides, and/or a freshly prepared root tip squash to show the stages of mitosis;*	
2.3	*explain the importance of DNA replication for maintaining genetic stability;*	
2.4	*discuss the role and importance of mitosis in growth, repair and asexual reproduction;*	
2.5	*explain what is meant by homologous pairs of chromosomes, and the terms haploid and diploid;*	
2.6	*describe with the aid of diagrams, the processes involved in meiotic cell division;*	*Include crossing over, alignment of chromosomes at metaphase, random segregation at anaphase. Names of the intermediate stages of meiosis not required.*
2.7	*construct models to demonstrate chromosome behaviour in meiosis;*	*Pipe cleaners, plastic wire, embroidery thread. Bristol board may be used for modelling chromosome behaviour in meiosis – biodegradable materials not recommended.*
2.8	*describe how meiosis contributes to heritable variation.*	

SPECIFIC OBJECTIVES		EXPLANATORY NOTES
3.	*Patterns of Inheritance*	
Students should be able to:		
3.1	*explain the terms: gene, allele, dominant, recessive, codominant, homozygous and heterozygous;*	*Use examples.*
3.2	*use genetic diagrams to solve problems involving monohybrid and dihybrid crosses;*	*Include those involving sex linkages, codominance multiple alleles and dominant epistasis. Candidates should understand the ratios.*
3.3	*analyse the results of a genetic cross by applying the Chi-square test;*	*Formulae will be given. Set out data in tabular form.*
3.4	*determine whether the difference between the observed and expected ratio is significant using the results of the Chi-square test.*	*Include the concept of probability. Explain the use of 0.05 confidence limits and the null hypothesis.*
4.	*Aspects of Genetic Engineering*	
Students should be able to:		
4.1	*outline the principles of restriction enzyme use in removing sections of the genome;*	
4.2	*explain the steps involved in recombinant DNA technology;*	*Include isolation of genes; cloning of genes; vectors. Use examples including insulin production.*
4.3	*discuss the possible benefits and hazards of gene therapy;*	*Use examples including cystic fibrosis.*
4.4	*discuss the implications of the use of genetically modified organisms on humans and the environment.*	*Medical, agricultural, ethical and social implications.*

UNIT 1
MODULE 2: *GENETICS, VARIATION AND NATURAL SELECTION (CON'TD)*

SPECIFIC OBJECTIVES		EXPLANATORY NOTES
5.	**Variation and Natural Selection**	
Students should be able to:		
5.1	Explain why sexually produced organisms vary in characteristics;	
5.2	describe gene and chromosome mutations;	
5.3	*discuss the implications of changes in DNA nucleotide sequence for cell structure and function in sickle cell anaemia;*	
5.4	explain how mutation brings about genetic variation;	*Consider sickle-cell anaemia, Down Syndrome.*
5.5	explain why heritable variation is important to selection;	
5.6	*explain how environmental factors act as forces of natural selection;*	*Include examples, such as resistance to antibiotics, Biston betularia (peppered moth).*
5.7	explain how natural selection may be an agent of constancy or an agent of change;	*Directional, disruptive and stabilising selection; knowledge of appropriate graphs is required.*
5.8	*discuss* how natural selection brings about evolution;	*Darwin's theory, its observations and conclusions.*
5.9	*discuss the biological species concept;*	*Discuss the limitations of this concept, for example, in breeding.*
5.10	explain the process of speciation.	*Include isolating mechanisms – reproductive, geographic, behavioural and temporal, allopatric and sympatric speciation with reference to two named examples.*

UNIT 1
MODULE 2: GENETICS, VARIATION AND NATURAL SELECTION (CON'TD)

Suggested Teaching and Learning Activities

To facilitate students' attainment of the objectives of this Module, teachers are advised to engage students in the teaching and learning activities listed below.

1. Attempt several exercises in order to gain familiarity with the mathematical aspects of Biology and to appreciate levels of significance.

2. *Review literature on biodiversity and conservation.*

3. *Discuss how humans use artificial selection to create, for example, domesticated animals, different breeds of dogs, chickens that lay a lot of eggs, Barbados Blackbelly sheep, Jamaica Hope.*

RESOURCES

Gaston, K. and Spicer, J. — *Biodiversity – An Introduction*, 2nd Edition, United Kingdom: Blackwell Publishing, 2004.

National Geographic Magazine

Video and/or Television materials such as those found on the Discovery Channel

Darwin_ online.org.uk

Conservation International Website (http:// www.conservation.org)

PBS Evolution website http://www.pbs.org/wgbh/evolution works on Darwin

www.merlot.com

www.nap.edu/readingriom/books/evolution98 *teaching about evolution in the nature of science.*

UNIT 1
MODULE 3: REPRODUCTIVE BIOLOGY

GENERAL OBJECTIVES

On completion of this Module, students should:

1. *understand asexual reproduction and vegetative propagation;*

2. *understand sexual reproduction in the flowering plant;*

3. *understand sexual reproduction in humans.*

SPECIFIC OBJECTIVES	EXPLANATORY NOTES
1. <u>*Asexual Reproduction and Vegetative Propagation*</u>	
Students should be able to:	
1.1 *explain the term asexual reproduction;*	*Discuss binary fission, budding, asexual spore formation, fragmentation; one example of asexual reproduction in plants, for example, ginger, meristems, hormone stimulation, details of the processes involved in tissue culture and the production of cuttings.*
1.2 *discuss the advantages and disadvantages of asexual reproduction;*	
1.3 *explain the principles and the importance of vegetative propagation as exemplified by the use of cuttings and tissue culture;*	
1.4 *discuss the genetic consequences of asexual reproduction.*	
2. <u>*Sexual* **Reproduction in the Flowering Plant**</u>	
Students should be able to:	
2.1 describe the structure of the anther and the formation of pollen grains;	*Annotated* diagrams required.
2.2 describe the structure of the ovule and the formation of the embryo sac;	*Annotated* diagrams required.

UNIT 1
MODULE 3: REPRODUCTIVE BIOLOGY (cont'd)

SPECIFIC OBJECTIVES		EXPLANATORY NOTES
<u>*Sexual*</u> **<u>Reproduction in the Flowering Plant (cont'd)</u>**		
2.3	*<u>make drawings of the anther and embryo sac from prepared slides;</u>*	
2.4	*explain how cross-fertilisation is promoted;*	Non-synchronous maturation of stamens (*Protogyny)* and carpels *(protandry)*, separate sexes *(dioecy)*, insect pollination, self incompatibility *and sterility*.
2.5	*discuss the genetic consequences of sexual reproduction;*	*Include self fertilization and cross fertilization.*
2.6	*explain the sequence of events from pollination to fertilization;*	*Annotated diagrams required.*
2.7	*explain the significance of double fertilization in the embryo sac;*	
2.8	*discuss the development of the seed and the fruit from the embryo sac and its contents, the ovule and the avary.*	*Types of fruits not required.*
3.	*<u>Sexual Reproduction in Humans</u>*	
Students should be able to:		
3.1	describe the structure and function of the male and female reproductive systems;	*Annotated* diagrams required.
3.2	<u>make drawings from prepared slides of the mammalian ovary and testis</u>;	
3.3	explain gametogenesis;	*Explain the difference between the secondary oocyte and ovum.*
3.4	*compare the structure of the ovum and the sperm;*	

UNIT 1
MODULE 3: REPRODUCTIVE BIOLOGY (cont'd)

SPECIFIC OBJECTIVES		EXPLANATORY NOTES
Sexual Reproduction in Humans **(cont'd)**		
3.5	*discuss how the structure of the ovum and the sperm suit their functions;*	
3.6	explain how hormones regulate gametogenesis;	
3.7	discuss the importance of hormones in the control of the menstrual cycle;	Emphasise the principle of negative feedback mechanisms.
3.8	describe how and where fertilization and implantation normally occur;	
3.9	discuss how knowledge of human reproductive anatomy and physiology has been applied to the development of contraceptive methods;	
3.10	*explain the structure and functions of the placenta*;	
3.11	discuss the functions of the amnion;	
3.12	discuss the possible effects of maternal behaviour on foetal development.	Include the role of nutrition, alcohol abuse, use of legal and illicit drugs and cigarette smoking.

Suggested Teaching and Learning Activities

To facilitate students' attainment of the objectives of this Module, teachers are advised to engage students in the teaching and learning activities listed below.

1. Examine a range of floral structures in order to clarify varying pollination methods.

2. Invite resource personnel skilled in plant biotechnology and human reproduction.

3. Visits to appropriate *Family Planning Centres, Plant Propagation Stations and Tissue Culture Units.*

RESOURCES

Carrington, S.	*Wild Flowers of Barbados*, London and Basingstoke: Macmillan Press Limited, 1999.
Honeychurch, P.	*Caribbean Wild Plants and their Uses*, London and Basingstoke: Macmillan Caribbean, 1986.
Raven, P., Evert, R. and Eichhorn, S.	*Biology of Plants,* New York: W.H. Freeman and Company Publishers, 2002.
Taylor, D.	*Growth Development and Reproduction*, Cambridge: Cambridge University Press Advanced Sciences, 2001.

UNIT 2: BIOENERGETICS, BIOSYSTEMS AND APPLICATIONS

MODULE 1: BIOENERGETICS

GENERAL OBJECTIVES

On completion of this Module, students should:

1. *understand* the process of photosynthesis and its role in transforming light energy into chemical energy *in the form of Adenosine Triphosphate (ATP);*

2. *understand* the process of cellular respiration and its role in producing ATP;

3. *understand* energy flow and nutrient cycling in ecosystems and their role in maintaining the stability of these ecosystems;

4. *appreciate* the ecosystem as a dynamic system involving interaction of biotic and abiotic components;

5. *be aware of biodiversity and conservation.*

SPECIFIC OBJECTIVES	EXPLANATORY NOTES
1. *Photosynthesis and ATP Synthesis*	
Students should be able to:	
1.1 describe the structure of a dicotyledonous leaf, a palisade cell and a chloroplast *relating* these structures to their roles in the process of photosynthesis;	*Annotated* diagrams required.
1.2 make drawings from prepared slides of a transverse section of a dicotyledonous leaf, and a palisade cell;	
1.3 *explain the process of photophosphorylation;*	*Include ATP's functions as the universal energy "currency" in all living organisms.* *Include the role of pigments, and electron carriers in the process. The conversion of light energy into chemical energy of ATP, the reduction of NADP and the evolution of oxygen as a by-product should be noted. No biochemical detail is required.*

SPECIFIC OBJECTIVES		EXPLANATORY NOTES
Photosynthesis and ATP Synthesis **(cont'd)**		
1.4	outline the essential stages of the Calvin cycle involving the light independent fixation of carbon dioxide;	Knowledge of C_4 plants not required. Include the fixation of carbon dioxide by ribulose bisphosphate to yield phosphoglyceric acid (glycerate-3-P) and the subsequent conversion to triose phosphate and other carbohydrates. Emphasise the roles of ATP and NADP.
1.5	discuss the concept of limiting factors in photosynthesis;	
1.6	*investigate the effect of limiting factors on the rate of photosynthesis*;	*Light intensity and carbon dioxide concentration.*
1.7	discuss the extent to which knowledge of limiting factors can be used to improve plant productivity.	
2.	*Cellular Respiration and ATP Synthesis*	
Students should be able to:		
2.1	*outline* the stepwise breakdown of glucose in cellular respiration;	*Names of enzymes not required.*
2.2	*explain* the sequence of steps in glycolysis;	*Include the initial phosphorylation of glucose, lysis into two 3-carbon compounds and the subsequent production of pyruvate, a small yield of ATP and reduced NAD. Recognition of simplified structural formulae intermediate.*
2.3	*describe the structure of a mitochondrion, relating its structure to its function*;	Diagram required.
2.4	*state the fate of pyruvate in the cytosol when oxygen is available*;	*Pyruvate enters the matrix and is converted to acetyl CoA via oxidative decarboxylation.*

SPECIFIC OBJECTIVES	EXPLANATORY NOTES
Cellular Respiration and ATP Synthesis **(cont'd)**	
2.5 *outline the Krebs cycle;*	*Details of structures of intermediates not required.*
2.6 *explain the significance of the Krebs cycle in ATP formation;*	*Emphasise production of NADH and $FADH_2$; oxidation and decarboxylation.*
2.7 *explain the process of oxidative phosphorylation with reference to the electron transport chain;*	*Include the roles of hydrogen and electron carriers; the synthesis of ATP and the role of oxygen. No details of the carriers are required. A summary of ATP production should be known.*
2.8 *investigate the rate of oxygen uptake during respiration using a simple respirometer;*	*Germinating seeds may be used. A control is needed.*
2.9 *compare the fate of pyruvate in the absence of oxygen in animals and yeast.*	*Fermentation allows for the regeneration of NAD so that glycolysis can continue in the absence of oxygen. Include the concept of oxygen debt in mammals; and note that lactate can be converted back (oxidised) to pyruvate when oxygen is again available. Include commercial uses of yeast.*
3. Energy Flow and Nutrient Cycling	
Students should be able to:	
3.1 *distinguish among the terms ecosystem, habitat, ecological niche;*	*Use examples.*
3.2 discuss the way in which energy flows in an ecosystem;	*Food chains and food webs. Emphasise the advantages of the food web.*
3.3 discuss the efficiency of energy transfer between trophic levels;	
3.4 discuss the concept of biological pyramids;	Include the limitations of the pyramids of numbers, biomass and energy.

SPECIFIC OBJECTIVES	EXPLANATORY NOTES
Energy Flow and Nutrient Cycling (cont'd)	
3.5 *describe how nitrogen is cycled within an ecosystem;*	Include the role of microorganisms.
3.6 distinguish between energy flow and nutrient cycling within an ecosystem;	
3.7 explain how energy flow and nutrient cycling are important for ecosystems to remain self-sustaining units.	
4. *Ecological Systems, Biodiversity and Conservations*	
Students should be able to:	
4.1 *discuss how ecosystems function as dynamic systems;*	*Use a named example. Include interactions between biotic and abiotic factors.*
4.2 *explain the concept of biodiversity;*	*Discuss genetic diversity, species diversity and ecosystem diversity.*
4.3 *discuss the importance of the maintenance of biodiversity;*	*Intrinsic, direct and indirect values, including medicine, natural products, tourism.*
4.4 *discuss how species diversity is related to the stability of an ecosystem;*	
4.5 *explain how in situ and ex situ conservation methods are used to maintain biodiversity.*	*Protected areas and or reserves, seed banks, botanic gardens, zoos, sperm banks, embryo banks.*

Suggested Teaching and Learning Activities

To facilitate students' attainment of the objectives of this Module, teachers are advised to engage students in the teaching and learning activities listed below.

1. Review the general principles of oxidation, reduction and electron flow.

2. Use of charts and creation of concept maps rather than excessive biochemical details.

3. Use multimedia presentation and current information available in sources, such as Nature, National Geographic and Discovery to fully appreciate ecosystem dynamics.

4. *Refer to the Eden Project in the United Kingdom.*

5. *Organise fieldtrips or fieldwork to include the use of sampling techniques and measurement of abiotic factors.*

6. *Discuss human impact on biodiversity.*

RESOURCES

Reiss, M. and Chapman, J. *Ecology: Principles and Applications,* Cambridge: Cambridge University Press, 2003.

Websites

www.savethemanatee.org
www.ramsar.org/w.n.nariva
www.ramsar.org
www.wetlands.org

UNIT 2
MODULE 2: BIOSYSTEMS MAINTENANCE

GENERAL OBJECTIVES

On completion of this Module, students should:

1. *understand* the mechanism by which plants absorb minerals and water through the roots and transport them through the xylem;

2. *understand* translocation in the phloem;

3. *understand* the organization, structure and transport function of the mammalian circulatory system;

4. *understand* the concept of homeostasis and hormonal action;

5. *understand* the role of the kidneys as excretory and regulatory organs;

6. *understand the role of the nervous system in systems maintenance.*

SPECIFIC OBJECTIVES		EXPLANATORY NOTES
1.	*The Uptake and Transport of Water and Minerals*	
Students should be able to:		
1.1	*explain the uptake of ions by active transport in roots;*	Emphasise the role of the endodermis.
1.2	describe the entry of water into plant roots in terms of water potential;	
1.3	*relate the structure of xylem vessels to their function;*	Include transport and support roles.
1.4	make drawings from prepared slides of xylem vessels;	
1.5	*outline the ascent of water in plants;*	*Root pressure, capillarity, cohesion, adhesion and transpiration pull.* Include the role of stomata in transpiration.

SPECIFIC OBJECTIVES	EXPLANATORY NOTES
The Uptake and Transport of Water and Minerals (cont'd)	
1.6 investigate the impact of environmental factors *on the rate of transpiration*.	*Include light and air movements.*
2. Transport in the Phloem	
Students should be able to:	
2.1 *relate the structure of sieve tubes* and companion cells *to their function*;	
2.2 make drawings of sieve tubes and companion cells from prepared microscope slides;	
2.3 label pertinent features in an electron micrograph of a sieve tube and companion cell;	
2.4 *explain how phloem loading in the leaves occurs against a concentration gradient*;	
2.5 discuss mass (pressure) flow as a possible mechanism of translocation.	Experimental evidence for and against this hypothesis.
3. The Circulatory System of Mammals	
Students should be able to:	
3.1 describe the structure of arteries, veins and capillaries, *relating their structures to their functions;*	
3.2 make drawings of arteries and veins from prepared microscope slides;	

SPECIFIC OBJECTIVES		EXPLANATORY NOTES
The Circulatory System of Mammals (cont'd)		
3.3	*describe the structure of the heart*;	*Annotated diagram of the heart and associated major blood vessels.*
3.4	make drawings of *a longitudinal* section of the heart;	Use fresh or preserved specimens to emphasise the 3-D structure.
3.5	explain the cardiac cycle and its initiation;	
3.6	*discuss the internal factors that control heart action*;	
3.7	define the terms blood pressure and pulse;	
3.8	discuss factors affecting blood pressure;	
3.9	make drawings of erythrocytes and leucocytes from prepared slides;	
3.10	explain the role of haemoglobin in oxygen and carbon dioxide transport;	Flow charts not required.
3.11	*describe oxygen dissociation curves for adult haemoglobin*;	*Interpret data.*
3.12	explain the significance of the effect of carbon dioxide on oxygen dissociation curves (Bohr Effect).	

SPECIFIC OBJECTIVES		EXPLANATORY NOTES
4.	*Homeostasis and Hormonal Action*	
Students should be able to:		
4.1	discuss the *concept homeostasis*;	*Receptors, effectors, set point, feedback and homeostatic equilibrium. Emphasise the dynamics of feedback mechanisms.*
4.2	*outline the general principles of hormonal action in animals*;	*Include ductless glands in animals; target cells and receptors.*
4.3	*explain how insulin and glucagon regulate blood glucose concentration*;	
4.4	*explain the effect of the plant regular molecule, ethylene (ethene), on fruit ripening*;	*Mention the gaseous nature of ethylene and its effect on respiration. Types of fruits not required.*
4.5	*discuss the commercial use made of ethylene in supplying market-ready fruit.*	
5.	**The Kidney, Excretion and Osmoregulation**	
Students should be able to:		
5.1	explain the need to remove nitrogenous and other excretory products from the body;	*Review the formation of urea.*
5.2	describe the gross structure of the kidney and the detailed structure of the nephron and associated blood vessels;	*Annotated diagrams required.*
5.3	make drawings of sections of the kidney from prepared sides;	
5.4	explain the function of the kidney in terms of excretion and osmoregulation;	Include the role of ADH.
5.5	discuss the clinical significance of the presence of glucose and protein in the urine.	

SPECIFIC OBJECTIVES		EXPLANATORY NOTES
6.	**Nervous Co-ordination**	
Students should be able to:		
6.1	describe the structure of motor and sensory neurones;	*Annotated* diagrams required.
6.2	explain the role of nerve cell membranes in establishing and maintaining the resting potential;	
6.3	describe the *conduction* of an action potential along the nerve cell membrane;	Emphasise the value of myelinated neurons in increasing the speed of transmission.
6.4	*explain synaptic transmission*;	*Structure of cholinergic synapse. Annotated diagrams required.*
6.5	outline the role of synapses.	

Suggested Teaching and Learning Activities

To facilitate students' attainment of the objectives of this Module, teachers are advised to engage students in the teaching and learning activities listed below.

1. *Make slides of transverse and longitudinal sections of stems, roots and leaves from living tissue, selected by the students to investigate their microscopic structure.*

2. Use binocular microscopes to examine root hairs and stomata.

3. Set up experiments on transpiration in both cut stems and potted plants to show methods and results.

4. *If possible,* visit the hospital's cardiac unit to see how a pacemaker is fitted, a blood collection centre *and/or* a medical laboratory to observe blood testing.

5. Take blood pressure measurements, and investigate the effect of exercise, rest, excitement and temperature *on blood pressure.*

6. Use models of heart and kidneys to conceptualise 3-dimensional structure.

7. Make models of xylem, phloem, sections of Bowman's Capsules, nephrons, alveoli, arteries, veins and blood components, to scale.

8. Use multimedia, Discovery and Discovery Health television programs, access the local Education Unit's Audio Visual Resource Centre, and visit Websites using keywords and keep a record and or bookmarks of useful sites.

9. Allow or assist students to take photographs of microscope slides and make projector slides.

RESOURCES

Bradfield, P., Dodds, J. et al — *A2 Level Biology,* Essex: Pearson Education Limited, 2002.

Jones, A., Reed, R. and Weyers, J. — *Practical Skills in Biology*, 3rd Edition, New Jersey: Pearson Prentice Hall, Pearson Education Ltd., 2003.

Indge, B. — *Data and Data Handling for AS and A2 Biology,* London: Hodder and Murray Publishers, 2003.

Morgan, S. — *Practical Work for Biology,* London: Hodder and Stroughton, 2002.

Time, Newsweek, Nature, Discover
Insight Media Video & CD Rom Catalogue
(www.insight-media.com)
(email, cs@insight-media.com)

UNIT 2
MODULE 3: APPLICATIONS OF BIOLOGY

GENERAL OBJECTIVES

On completion of this Module, students should:

1. *understand the terms 'health' and 'disease'*;

2. *understand the principles of immunology*;

3. *be aware of the principles underlying social and preventative medicine*;

4. *understand drug abuse and its implications.*

SPECIFIC OBJECTIVES	EXPLANATORY NOTES
1. <u>Health and Disease</u>	
Students should be able to:	
1.1 discuss the meaning of the term 'health';	*Focus on the physical, mental and social aspects of health.*
1.2 *explain the categories of disease or illness*;	Include physical, mental, social, chronic, infectious, degenerate, inherited, self-inflicted, deficiency, with an example of each. *Diseases will fit into more than one category.*
1.3 *discuss reasons for the regional distribution of Acquired Immune Deficiency Syndrome (AIDS), diabetes and cancer;*	*AIDS: include the biology of the virus; length of incubation period; roles of lifestyle, ease of travel, cost of drugs and lack of education on the spread of the virus.* *Diabetes: include the effects of diet, obesity and prenatal malnutrition.* *Cancer: include roles of environmental hazards, food additives, viruses, genetic factors; implications of symptom awareness and failure to seek treatment in management of the disease.*

SPECIFIC OBJECTIVES	EXPLANATORY NOTES
Health and Disease (cont'd)	
1.4 *analyze data involving incidence and mortality rates of disease.*	*Explain the meanings of incidence and mortality rates; students should interpret and analyse data and draw conclusions and or make predictions.*
2. *Immunology*	
Students should be able to:	
2.1 *describe the mode of action of phagocytes;*	*Review phagocytosis; include role of mast cells and histamine production; complement; phagocytes as antigen-presenting cells.*
2.2 *define the term, "immune response";*	
2.3 *compare the origin and maturation of B- and T- lymphocytes;*	*Include the types of T-cells and their function (refer to HIV); B-cells and their function.*
2.4 *distinguish between the humoral and the cell-mediated immune responses;*	*Details required.*
2.5 *explain the role of memory cells in long-term immunity;*	*T- and B- memory cells.*
2.6 *relate the molecular structure of a typical antibody molecule to its function;*	*Labelled diagram of typical antibody showing its 'Y-shaped' structure; include the function of the various parts; specificity of antibody to antigen.*
2.7 *distinguish between active and passive immunity, natural and artificial immunity;*	*Include examples.*
2.8 *explain the role of vaccination in providing immunity;*	

SPECIFIC OBJECTIVES	EXPLANATORY NOTES
Immunology **(cont'd)**	
2.9 *state what is meant by a monoclonal antibody;*	
2.10 *describe the use of monoclonal antibodies in diagnosis and treatment.*	*The anticancer drug, MabThera; details required of the use of monoclonal antibodies in pregnancy testing.*
3. Social and Preventative Medicine	
Students should be able to:	
3.1 *discuss the causative relationship among diet, obesity and diabetes;*	*Review the concept of a balanced diet; Body Mass Index (BMI); Type 1 and Type 2 diabetes.*
3.2 *describe the effects of fats on the cardiovascular system;*	*Atherosclerosis, coronary heart disease, hypertension and stroke. Details of plaque formation.*
3.3 investigate the immediate effects of exercise on the body;	
3.4 *discuss the consequences of exercise on the body and the benefits of maintaining a physically fit body;*	*Include long-term and short-term consequences; relate benefits to the prevention of chronic diseases; refer to VO_2 max and cardiac efficiency.*
3.5 *describe the mechanisms of infection for AIDS and dengue fever and their causitive agents;*	*Include processes of infection; replication of the disease-causing organisms.*
3.6 *explain how AIDS and dengue fever are transmitted;*	*AIDS: mention lifestyle.* *Dengue fever: the vector is Aedes aegypti.*
3.7 assess the impacts of AIDS and dengue fever regionally;	*Include social and economic issues.*

SPECIFIC OBJECTIVES	EXPLANATORY NOTES
Social and Preventative Medicine (cont'd)	
3.8 *discuss the roles of social, economic and biological factors in the prevention and control of AIDS and dengue fever.*	
4. Substance Abuse	
Students should be able to:	
4.1 *discuss the meaning of the term, "drug abuse";*	Legal and illegal drugs.
4.2 *distinguish between psychological and physical dependence;*	
4.3 *describe the short-term and long-term consequences of alcohol consumption on the nervous system and the liver;*	*Short-term - fatty liver, hepatitis; long-term - cirrhosis, cancer, impaired nervous transmission, demyelination, dehydration of the brain cells.*
4.4 *discuss the social consequences of excessive alcohol use;*	*Drinking and driving, aggressive behaviour, intra-family violence, family breakdown and petty crime; Include a definition of 'a unit of alcohol'; Daily Alcohol Limits (DAL) – safe limits (that is, blood and breath limits)for driving.*
4.5 *describe the effects of the components of cigarette smoke on the respiratory and cardiovascular systems.*	*Passive smoking; effects of nicotine, tar and carbon monoxide on cilia, oxygen uptake, mucus secretion; development of hyperplasia, emphysema, chronic bronchitis, cancers including lung cancer; vasoconstriction, increase in number of erythrocytes, increase in blood viscosity, formation of blood clots.*

Suggested Teaching and Learning Activities

To facilitate students' attainment of the objectives of this Module, teachers are advised to engage students in the teaching and learning activities listed below.

1. Encourage students to read and use current information in this particular area, since it is constantly changing.

2. Visit centres of excellence, such as a field station, hospital or research institute from which students can gain practical experience in these areas.

3. View documentaries which deal with these issues.

4. Invite resource personnel.

5. Group presentations.

RESOURCE

Jones, M., Fosbery, R. and Taylor, D. *Biology 1,* Cambridge: Cambridge University Press, 2000.

◆OUTLINE OF ASSESSMENT

EXTERNAL ASSESSMENT (80%)

Paper 01 *(1 hour 30 minutes)*	*Forty-five multiple-choice items, 15 from each Module. Each item is worth 1 mark.*	*40%*
Paper 02 *(2 hours 30 minutes)*	*Section A - Three compulsory structured questions, one from each Module. Each question is worth 15 marks.* *Section B – Three compulsory essay questions one from each Module. Each question is worth 15 marks.*	*40%*

INTERNAL ASSESSMENT (20%)

The internal assessment will consist of selected practical laboratory exercises.

MODERATION OF INTERNAL ASSESSMENT

An Internal Assessment Record Sheet will be sent each year to schools submitting students for the examination.

All Internal Assessment Record Sheets and sample of assignments must be submitted to reach CXC by May 31 of the year of the examination. A sample of assignments will be requested by CXC for moderation purposes.

These assignments will be re-assessed by CXC Examiners who moderate the Internal Assessment. Teachers' marks may be adjusted as a result of moderation. The Examiners' comments will be sent to schools.

Copies of the students' assignment that are not submitted must be retained by the school until three months after publication by CXC of the examination results.

ASSESSMENT DETAILS

Each Unit of the syllabus is assessed as outlined below.

External Assessment by Written Papers (80% of Total Assessment)

1. There will be a combined question paper and answer booklet for Paper 01, and for Section A of Paper 02. A separate answer booklet will be provided for Section B of Paper 02.
2. S.I. Units will be used on all examination papers.
3. The use of silent non-programmable calculators will be allowed in the examination. Candidates are responsible for providing their own calculators.

Paper 01 (1 hour 30 minutes – 40% of Total Assessment)

1. **Composition of the Paper**

This paper will consist of forty-five multiple-choice items, fifteen from each Module. All questions are compulsory and knowledge of the entire Unit is expected. The paper will assess the candidate's knowledge across the breadth of the Unit.

The question will test KC and UK skills.

2. **Mark Allocation**

The paper will be worth 45 marks, with each question being allocated 1 mark.

3. **Question Type**

Questions may be presented using diagrams, data, graphs, prose or other stimulus material.

Paper 02 (2 hours 30 minutes - 40% of Total Assessment)

1. **Composition of Paper**

This paper will consist of two sections.

Questions on this paper test all three skills KC, UK and XS.

Section A will consist of three compulsory structured questions, one question from each Module.

Section B will consist of three compulsory essay questions, one from each Module. Knowledge of the entire Unit is expected.

2. **Mark Allocation**

The paper will be worth 90 marks.

Section A - each question	-	*15 marks*
Section B - each essay	-	*15 marks*
Total marks of Section A	-	*45 marks*
Total marks of Section B	-	*45 marks*

3. **Question Type**

Questions in Section A will be presented in a structured form. The questions will test KC and UK skills. Answers are to be written in a separate answer booklet.

Questions in Section B will be essays. The mark allocation for each section will be included. Answers for this section are to be written in a separate answer booklet. The questions will test KC, UK and XS skills.

Internal Assessment (20%)

Internal Assessment is an integral part of student assessment in the course covered by this syllabus. It is intended to assist students in acquiring certain knowledge, skills and attitudes that are associated with the subject.

During the course of study for the subject, students obtain marks for the competence they develop and demonstrate in undertaking their Internal Assessment assignments. These marks contribute to the final marks and grades that are awarded to students for their performance in the examination.

Internal Assessment provides an opportunity to individualise a part of the curriculum to meet the needs of students. It facilitates feedback to the student at various stages of the experience. This helps to build the self-confidence of students as they proceed with their studies. Internal Assessment also facilitates the development of the critical skills and abilities emphasised by this CAPE subject and enhances the validity of the examination on which candidate performance is reported. Internal Assessment, therefore, makes a significant and unique contribution to both the development of relevant skills and the testing and rewarding of students for the development of those skills.

The Caribbean Examinations Council seeks to ensure that the Internal Assessment scores that contribute to the overall scores of candidates are valid and reliable estimates of accomplishment. The guidelines provided in this syllabus are intended to assist in doing so.

Award of Marks

The following are the skills that will be assessed:

a. Analysis and Interpretation
b. Manipulation and Measurement
c. Observation, Recording and Reporting
d. Planning and Designing
e. Drawing

In each Unit, a total of 12 marks are to be allocated for each skill as indicated in the Table below.

Table
Internal Assessment Skills

Skill	Unit 1	Unit 2
*Observation, Recording and Reporting	12 marks	12 marks
Manipulation and Measurement	12 marks	-
Analysis and Interpretation	12 marks	12 marks
Planning and Designing	-	12 marks
Drawing	12 marks	12 marks
TOTAL	**48 marks**	**48 marks**

***Five of the 12 marks for Observation, Recording and Reporting (ORR) are to be awarded for communicating information in a logical way using correct grammar as described in the definition of the Observation, Recording and Reporting skill on pages 3 and 4. Teachers are required to provide criteria which clearly indicate how they award marks.**

Each Module will carry a maximum of 16 marks.

Each candidate's total Internal Assessment mark for any Unit should be divided in three and allocated to each Module equally.

Fractional marks should not be awarded. Wherever the Unit mark is not divisible by three, then

(a) when the remainder is 1 mark, it should be allocated to Module 1
(b) when the remainder is 2, one of the marks should be allocated to Module 2 and the other mark to Module 3.

Appropriate practical exercises for assessing any skill may be selected from any Module in the relevant Unit. Specific Objectives identified by single underlining are suitable for practical exploration.

Specific Guidelines for Teachers

1. Each candidate is required to keep a laboratory workbook which is to be marked by the teacher. Teachers are also expected to assess candidates as they perform practical exercises in which Manipulation and Measurement skills are required.

2. A maximum of TWO skills may be assessed by any one experiment.

3. The mark awarded for each skill assessed by practical exercises should be the average of at LEAST TWO separate assessments. The maximum mark for any skill will be 12. In each Unit, total marks awarded at the end of each Module will be 0 to 16.

4. Specific Objectives lending themselves to practical work are highlighted by single underlining. However teachers need not confine their practical exercises to these objectives.

INTERNAL ASSESSMENT – GENERAL GUIDELINES FOR TEACHERS

1. For each Unit marks must be submitted to CXC on the Internal Assessment forms provided. The forms should be despatched through the Local Registrar for submission to CXC by May 31 of the Year of the examination.

2. The Internal Assessment Forms for each Unit should be completed in duplicate. The original should be submitted to CXC and the copy retained by the school.

3. CXC will require a sample of the laboratory books for external moderation. Additional laboratory books may be required. These laboratory books must be retained by the school for at least 3 months after publication of examination results.

4. Candidates who do not fulfil the requirements for the Internal Assessment will be considered absent from the whole examination.

5. Teachers are asked to note the following:

   (i) candidates' laboratory books should contain all practical work undertaken during the course of study. Those exercises which are selected for use for the Internal Assessment should be clearly identified. The skill(s) tested in these selected practical exercises, the marks assigned and the scale used must be placed next to the relevant exercises;

   (ii) teachers' criteria and breakdown of marks for assessing a skill must be clearly stated and submitted with the laboratory books;

   (iii) the standard of marking should be consistent;

   (iv) the relationship between the marks in the laboratory books and those submitted to CXC on the Internal Assessment Form should be clearly shown.

◆REGULATIONS FOR PRIVATE CANDIDATES

1. Candidates who are registered privately will be required to sit Papers 01, 02 and 03B. Detailed information on Papers 01 and 02 is given on page 38 of this syllabus.

2. **Paper 03B (Alternate to Internal Assessment) - 20%**

   This paper will be of 2 hours duration and will consist of THREE questions as follows:

   (i) a practical based question to be executed by the candidate;
   (ii) a question based on data analysis;
   (iii) a planning and design exercise.

This paper will constitute 20% of the overall assessment of the candidates' performance on the Unit.

◆REGULATIONS FOR RESIT CANDIDATES

Candidates, who have earned a moderated score of at least 50% of the total marks for the Internal Assessment component, may elect not to repeat this component, provided they re-write the examination no later than TWO years following their first attempt. These resit candidates must complete Papers 01 and 02 of the examination for the year in which they register.

Resit candidates must be entered through a school or other approved educational institution.

Candidates who have obtained less than 50% of the marks for the Internal Assessment component must repeat the component at any subsequent sitting or write Paper 03B.

◆ASSESSMENT GRID

The Assessment Grid for each Unit contains marks assigned to papers and to Modules and percentage contribution of each paper to total scores.

Papers	*Module 1*	*Module 2*	*Module 3*	*Total*	*(%)*
External Assessment *Paper 01* *(1 hour 30 minutes)* *Multiple Choice*	*15* *30 (weighted)*	*15* *30 (weighted)*	*15* *30 (weighted)*	*45* *90 (weighted)*	*(40)*
Paper 02 *(2 hours 30 minutes)* *Section A - Structured questions* *Section B - Essay questions*	 *15* *15*	 *15* *15*	 *15* *15*	 *45* *45*	*(40)*
Internal Assessment *Papers 03A or 03B*	*16*	*16*	*16*	*48*	*(20)*
TOTAL	*76*	*76*	*76*	*228*	*(100)*

RESOURCES

The following is a list of books and other printed material that might be used for CAPE Biology. The list is by no means exhaustive. Each student should have access to at least one text.

Texts

Clegg, C.J. and Mackean, D.J.	*Advanced Biology – Principles and Applications*, London: John Murray, 2000.

Supplementary Texts and Teachers' Guide

Anon	*Preliminary Biology Study Guide*, University of the West Indies, Barbados: Distance Education Centre, 1997.
Bradfield, P., Dodds, J., Dodds, et al.	*AS & A2 Level Biology,* Essex: *Pearson Educational, 2002.*
Cadogan, A. and Best, G.	*Environment and Ecology: Biology Advanced Studies*, Glasgow and London: Nelson Blackie, 1992.
Chapman, J. L. and Reiss, M.	*Ecology*, Cambridge: Cambridge University Press, 1992.
Huxley, A.	*Green Inheritance*, London: Gaia Books, 1992.
Fosbery, R., Jones, M. and Taylor, D.	*Advanced Biology, Volume 1 and 2, Cambridge: Cambridge University Press, 2002.*
Jones, M., Fosbery, R. et al	*AS Level and A Level Biology,* Cambridge: Cambridge University Press, 2003.
Kent, M.	*Advanced Biology,* Oxford: Oxford Press, 2000.
Margulis, L. and Schwartz, K.	*Five Kingdoms*, New York: W.H. Freeman and Co., 1998.
Odlum, E.P.	*Ecology*: A *Bridge Between Science and Society*, Sunderland, USA: Sinauer Associates, 1997.
Toole, G. and Toole, S.	*New Understanding of Biology for Advanced Level,* Cheltenham: Stanley Thornes Pub. Ltd., 1997.

Reference Books for Field Study

Plant Identification

Barlow, V. — *The Nature of the Islands*, Florida, Dunedin: Cruising Guide Publications, 1998.

Fournet, J. and Hammerton, J. — *Weeds of the Lesser Antilles* and or Mauvaises herbs des petites antilles, INRA, Paris/CARDI, 1994.

Nellis, D. — *Seashore Plants of South Florida and the Caribbean*, Sarasota: Pineapple Press, 1994.

Whittaker, M. — *Medicinal Plants of St. Kitts and Nevis Part 1*, Basseterre, St. Kitts: College of Further Education, 1992.

Animal Identification

Raffaele, H. et al — *A Guide to Birds of the West Indies*, New Jersey: Princeton University Press, 2003.

Stirling, P. — *Butterflies and Other Insects of the Eastern Caribbean*, London: Macmillan Caribbean, 1986.

Stokes, F. — *Divers and Snorkleler's Guide to the Fishes and the Sea Life of the Caribbean, Florida, Bahamas and Bermuda*, Philadelphia: Academy of Natural Sciences of Philadelphia, 1984.

Sultry, L. — *Seashell Treasures of the Caribbean*, London: Macmillan Caribbean, 1986.

Sutty, L. — *Fauna of the Caribbean - Last Survivors*, London: Macmillan Press, 1993.

GLOSSARY

KEY TO ABBREVIATIONS

KC - Knowledge and Comprehension
UK - Use of Knowledge
XS - Experimental Skills

WORD	DEFINITION	NOTES
Analyse	*Examine in detail*	UK
Annotate	Add a brief note to a label	Simple phrase or a few words only
Apply	Use knowledge and or principles to solve problems	Make references/conclusions; UK
Assess	Present reasons for the importance of particular structures, relationships or processes	Compare the advantages and disadvantages or the merits and demerits of a particular structure, relationship or process; UK
Calculate	Arrive at the solution to a numerical problem	Steps should be shown; units must be included
Cite	Provide a quotation or a reference to the subject	KC
Classify	Divide into groups according to observable characteristics	UK
Comment	State opinion or view with supporting reasons	UK
Compare	State similarities and differences	An example of a significance of each similarity and the difference stated may be required for comparisons which are other than structural

WORD	DEFINITION	NOTES
Construct	Use a specific format to make and or draw a graph, histogram, pie chart or other representations using data or material provided or drawn from practical investigations; build (for example, a model), draw scale diagram	Such representations should normally bear a title, appropriate headings and legend; UK
Deduce	Make a logical connection between two or more pieces of information; use data to arrive at a conclusion	UK
Define	State concisely the meaning of a word or term	This should include the defining equation and or formula where relevant; UK
Demonstrate	Show; direct attention to …	KC
Describe	Provide detailed factual information of the appearance or arrangement of a specific structure or sequence of a specific process	Description may be words, drawings or diagrams or an appropriate combination. Drawings or diagrams should be annotated to show appropriate detail where necessary; KC
Design	Include planning and presentation with appropriate practical detail	UK
Determine	Find the value present with appropriate practical detail	Where hypotheses are stated or when tests are to be conducted, possible outcomes should be clearly shown and/or the way in which data will be analyzed and presented; XS
Develop	Expand or elaborate an idea or argument with supporting reasons	KC/UK
Diagram	Simplified representation showing the relationship between components	KC/UK
Differentiate or Distinguish	State or explain briefly those differences between or among items which can be used to define the items or place them into separate categories	KC
Discuss	Present reasoned argument; consider points both for and against; explain the relative merits of a case	UK

WORD	DEFINITION	NOTES
Draw	Make a line representation from specimens or apparatus which shows an accurate relation between the parts	In case of drawings from the specimens, the magnification must always be stated; KC/UK
Estimate	Make an approximate quantitative judgement	
Evaluate	Weigh evidence and make judgements based on given criteria	The use of logical supporting reasons for a particular point is more important than view held; usually both sides of an argument should be considered ;UK
Explain	Give reasons based on recall; account for	KC
Find	Locate a feature or obtain as from a graph	UK
Formulate	Devise hypotheses	UK
Identify	Name specific components or features	KC
Illustrate	Demonstrate clearly using appropriate examples or diagrams	KC
Interpret	Explain the meaning of	UK
Label	Add names to identify structures or parts indicated by pointers	
List	Itemise without detail	KC
Measure	Take accurate quantitative readings using appropriate instruments	XS
Name	Give only the name of	No additional information is required; KC
Note	Record observation	XS
Observe	Pay attention to details which characterise a specimen, reaction or change taking place; to examine and note scientifically	Observation may involve all the senses and/or extensions of them but would normally exclude the sense of taste; XS
Outline	Give basic steps only	XS
Plan	Prepare to conduct an exercise	XS

WORD	DEFINITION	NOTES
Predict	Use information provided to arrive at a likely conclusion or suggest a possible outcome	UK
Record	Write an accurate description of the full range of observations made during a given procedure	This includes the values for any variable being investigated; where appropriate, record; data may be depicted in graphs, histograms or tables; XS
Relate	Show connections between; explain how one set of facts or data depends on others or are determined by them	UK
Sketch	Make a simple freehand diagram showing relevant proportions and any important details	
State	Provide factual information in concise terms outlining explanations	KC
Suggest	Offer an explanation deduced from information provided or previous knowledge. (... a hypothesis; provides a generalization which offers a likely explanation for a set of data or observations.)	No correct or incorrect solution is presumed but suggestions must be acceptable within the limits of scientific knowledge; UK
Test	To find out, following set procedures	XS
Use	Implies the need to recall and apply in order to come to a conclusion	UK

Western Zone Office
2007/06/25

FORM TP 2007-SPEC

TEST CODE **02107020**

CARIBBEAN EXAMINATIONS COUNCIL

ADVANCED PROFICIENCY EXAMINATION

BIOLOGY – SPECIMEN PAPER

UNIT 1 – PAPER 02

2 hours 30 minutes

READ THE FOLLOWING INSTRUCTIONS CAREFULLY.

1. This paper consists of SIX questions.

2. Section A consists of THREE questions. Candidates must attempt ALL questions in this section. Answers to this section MUST be written in this answer booklet.

3. Section B consists of THREE questions. Candidates must attempt ALL questions in this section. Answers to this section MUST be written in the answer booklet provided.

4. The use of silent non-programmable calculators is allowed.

SECTION A

Attempt ALL questions. You MUST write in this answer booklet.

1. The School Meals Department produces a popular dessert which the senior students take to the lab to analyse. They have access to distilled water, Bunsen burners, test tubes and the reagents listed in Table 1, Column 1. Table 1 is designed to show the tests, test results and deductions of the senior students.

(a) Complete Table 1 by describing the testing procedures the students use, and state the type of food molecule found (if any).

Table 1 - ANALYSIS OF DESSERT

Test Reagents	Testing Procedure	Test Results	Deduction
Benedict's solution		Clear blue solution	
Benedict's solution Dilute acid Sodium bicarbonate		 Brick red precipitate	
Iodine in potassium iodide solution		Light yellow – brown colour	
Ethanol		White emulsion	
Biuret solution		Pale purple colour	

[5 marks]

(b) Table 2 below is designed to show differences between prokaryotes and eukaryotes.

Complete Table 2 to detail the differences in size and structure between prokaryotes and eukaryotes.

Table 2

STRUCTURAL DIFFERENCES BETWEEN PROKARYOTES AND EUKARYOTES

Feature	Prokaryote cells	Eukaryote cells
Approximate size		
Nuclear structure		
Structure of DNA		
Energy generating structures		

[5 marks]

(c) The electron micrograph in Figure 1 below shows a membrane system in the cell.

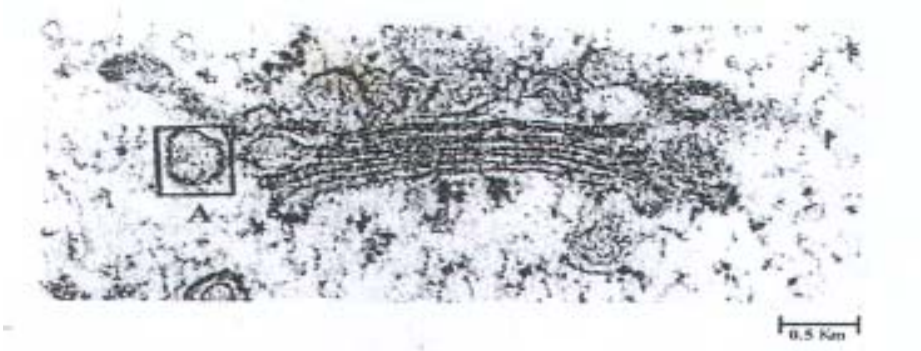


Figure 1. An electron micrograph of a membrane system

(i) Identify the membrane system shown in Figure 1.

_____

[1 mark]

GO ON TO THE NEXT PAGE

(ii) Distinguish between a tissue and an organ.

_____

_____

_____

[2 marks]

(d) (i) The amoeba, *Pelomyxa palustris*, hosts a permanent population of aerobic bacteria in its cytoplasm. A species of *Paramecium* hosts green unicellular algae in its cytoplasm. With reference to the endosymbiont theory, deduce which cellular organelles perform functions similar to those of aerobic bacteria and green algae, and insert your answer in the table below.

Organism	**Organelle**
Aerobic bacteria	_____
Green algae	_____

(ii) Name TWO organelles or structures, present in animal cells, that are NOT present in plant cells.

_____

[2 marks]

Total 15 marks

2. (a) The structures shown in Figure 2 below are 5 cm lengths of plasticine. One piece is white, and the other ink-coloured (blue or black).

Figure 2. Lengths of plasticine for chromosome models

Using the white and ink-coloured lengths of plasticine, you are asked to conceptualize models of the following chromosomes during the process of meiosis and to draw the models in the spaces provided below:

(i) ONE pair of homologous chromosomes aligning themselves.
Illustrate ONE cross-over between two of the chromatids.

To distinguish between the members of the pair of chromosomes, leave the white length of plasticine clear and the ink-coloured length of plasticine with hashed lines using your pen.

[2 marks]

(ii) Early anaphase of meiosis I, showing the exchanged chromatid material. (Shade appropriately).

[3 marks]

GO ON TO THE NEXT PAGE

(b) State TWO ways in which the process of meiosis increases rearrangement of the chromosomal material before it reaches the poles of the cell.

_____

_____

_____

_____

_____

[2 marks]

(c) Down's Syndrome is an example of a mutation.

(i) What type of mutation is involved in Down's Syndrome?

_____

[1 mark]

(ii) State how this mutation is caused.

_____

_____

_____

[1 mark]

(d) Sickle-cell anaemia is caused by a mutation in the haemoglobin gene. The normal alleles are AA, the lethal sickle-cell alleles are SS, and the heterozygote, which shows mild sickling, is AD. The sickle-cell allele has been established in the African population for thousands of years, alongside the disease malaria.

The maps of Africa in Figure 3 show the distribution of sickle-cell disease and malaria, prior to the 1950s, when mosquito eradication programs began.

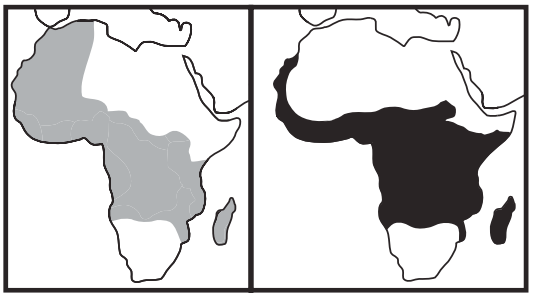


Figure 3. Distribution of sickle-cell disease and malaria in Africa

GO ON TO THE NEXT PAGE

Following the mosquito eradication programs in Africa, the incidence and distribution of malaria were reduced.

What effect would this reduction in the cases of malaria have on the incidence and distribution of sickle-cell disease, and why?

_____

_____

_____

_____

_____

_____

_____

[4 marks]

(e) Between 1650 and 1850, African populations were established in the Caribbean. Some of the territories had endemic malaria and some did not. The present-day frequencies of sickle-cell genes (SS, AS) and the normal gene (AA) have been calculated, and the results are expressed in Table 3.

Table 3

Malaria present in territory			**Malaria absent in territory**		
Territory	**Alleles**		**Territory**	**Alleles**	
	SS or AS	**AA**		**SS or AS**	**AA**
Honduras	164	541	St. Vincent	65	683
Suriname	35	137	Barbados	64	848

Use the figures in Table 3 to determine the ratio of sicklers (SS and AS) to normal (AA) in the malaria-present territories in comparison with the malaria-absent territories. How do they compare?

_____

_____

_____

_____

[2 marks]

Total 15 Marks

GO ON TO THE NEXT PAGE

3. (a) Consider the following hormones:

F - Follicle Stimulating Hormone
L - Leutenizing Hormone
O - Oestrogen
P - Progesterone (when not pregnant)

Write a circled symbol for EACH hormone on the graph in Figure 4 at the exact day where the hormone is at its maximum concentration during the menstrual cycle. (You may sketch in the graph lines to assist you if you wish.)

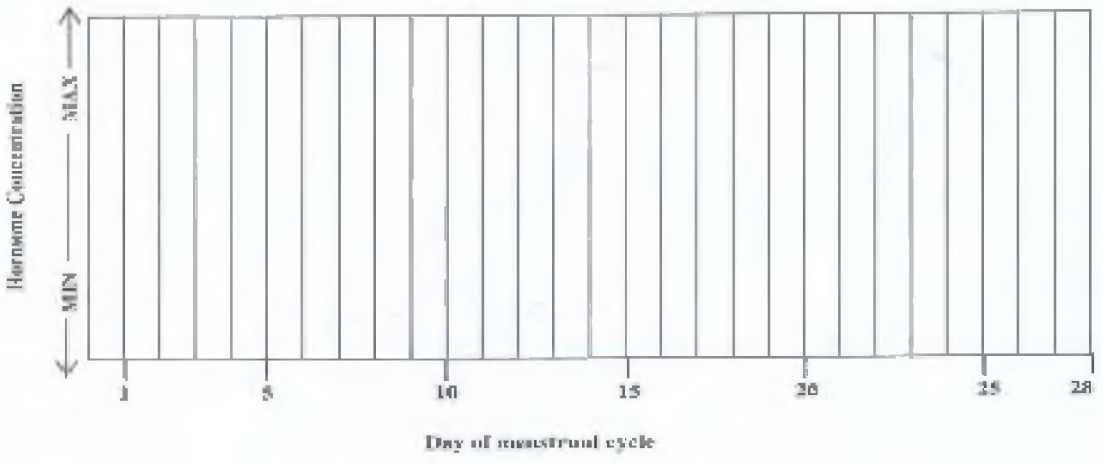


Figure 4. Hormone at its maximum concentration

[3 marks]

(b) Figure 5 is a microscopic section of a human ovary.

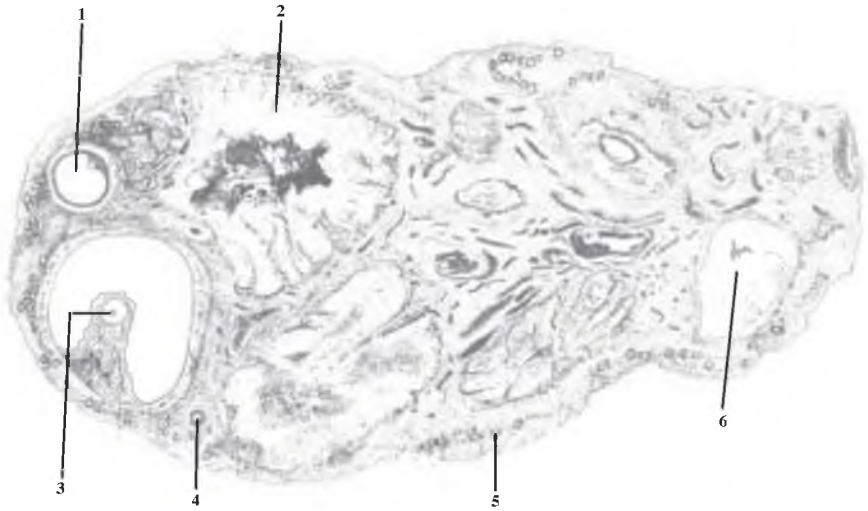


Figure 5. Section of a human ovary

Histology Colour Atlas of Microscopic Anatomy, 3rd Edition. Sobotta/Hammerson Urban and Schwartzenberg Inc.

(i) In the space provided below, at a magnification of 0.5, draw a plan diagram of the ovary in Figure 5 to show the distribution of the major tissues.

[3 marks]

(ii) Identify the following structures in Figure 5.

1: _____

2: _____

3: _____

5: _____

[2 marks]

(c) Figure 6 shows a foetus in its eighth week of pregnancy.

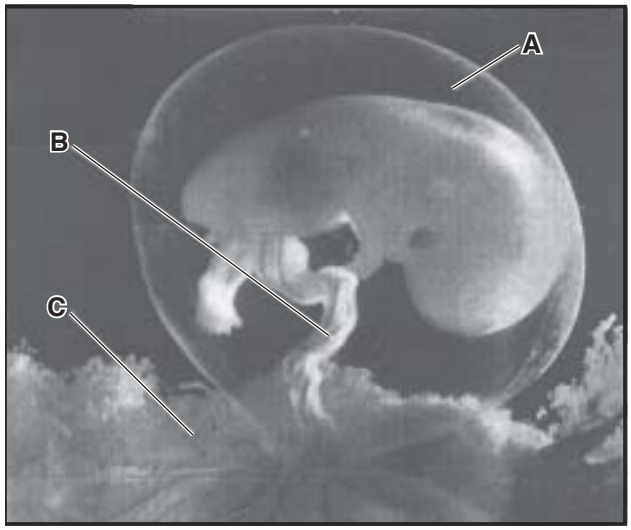


Figure 6. Foetus in the eighth week of pregnancy

Biology of Life on Earth.
J. Audesirk, G. Audesirk, Prentice Hall

(i) Name the cavity, labelled A in Figure 6, in which the foetus is developing and state its function.

_____

_____

_____

_____

[3 marks]

(ii) Name the structure, labelled B in Figure 6, and describe its function.

_____

_____

_____

_____

_____

[3 marks]

(d) Explain why the placenta is NOT an effective barrier against substances that can harm the foetus.

_____

_____

_____

[1 mark]

Total 15 marks

SECTION B

Attempt ALL questions. You MUST write in the answer booklet provided.

4. (a) Describe the fluid mosaic model of a cell surface.

[6 marks]

(b) Discuss how the structure and properties of water make it a suitable medicine for life. Include in your answer a drawing of the structure of the water molecule.

[9 marks]

Total 15 marks

5. (a) Explain how the sequence of nucleotides in the DNA molecule is related to the sequence of nucleotides in the RNA molecule.

[6 marks]

(b) How are the following influenced by the organism's DNA?

(i) The precise and accurate folding of globular proteins

[5 marks]

(ii) The erroneous formation of haemoglobins in sickle-cell anaemia

[4 marks]

Total 15 marks

GO ON TO THE NEXT PAGE

6. (a) Describe the way in which pollen grains are formed within the anther.

[6 marks]

(b) Compare the development of the zygote with that of the fertilised endosperm cell, in a fertilised carpel, in relation to

(i) the future differentiation of tissue

(ii) the location of food storage.

[4 marks]

(c) Bananas and sweet potatoes reproduce by asexual methods. Tomatoes and peppers reproduce sexually. Discuss the advantages and disadvantages of EACH type of reproduction in these plants.

[5 marks]

Total 15 marks

END OF TEST

FORM TP 2007-SPEC

TEST CODE **02107032**

CARIBBEAN EXAMINATIONS COUNCIL

ADVANCED PROFICIENCY EXAMINATION

BIOLOGY – SPECIMEN PAPER

UNIT 1 – PAPER 032

ALTERNATIVE TO SBA

2 hours

Candidates are advised to use the first 15 minutes for reading through this paper carefully.

READ THE FOLLOWING INSTRUCTIONS CAREFULLY.

1. This paper consists of THREE questions. Attempt ALL questions.

2. The use of silent non-programmable calculators is allowed.

1. You are to carry out a simple investigation into the effect of different concentrations of a solution on the tissue of the cucumber fruit. Read the instructions that follow carefully before beginning.

You are provided with the following concentrations of sucrose solution:

0.1 M, 0.2 M, 0.3 M, 0.4 M and 0.5 M

Remove ten, 2 cm deep sections that are 5 cm long from the cucumber provided, as shown in Figure 1 (i) and (ii) below.

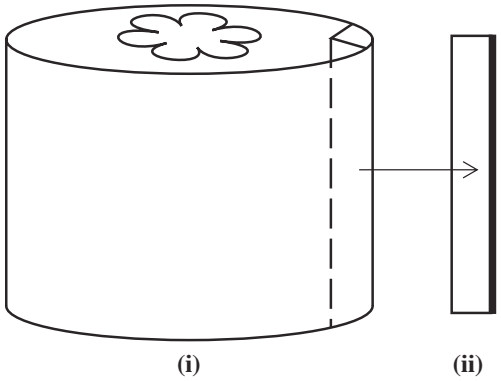


Figure 1 - Sections cut from a cucumber

The strip should have a tough covering of cuticularized epidermis, while the inner part is composed of cortical parenchyma cells.

As soon as the strip is cut out of the cucumber, it bends backwards as shown in Figure 2.

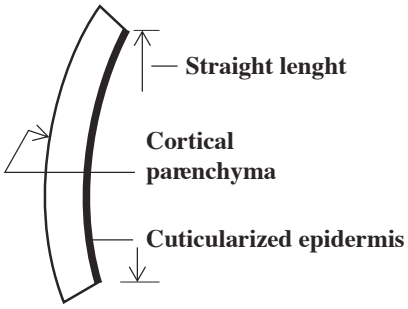


Figure 2

Measure the straight length of the epidermal strips and record the results.

Place two (2) strips in each of the five (5) petri dishes and treat as follows:

Petri Dish	Treatment
A	cover with sucrose solution 0.1 M
B	cover with sucrose solution 0.2 M
C	cover with sucrose solution 0.3 M
D	cover with sucrose solution 0.4 M
E	cover with sucrose solution 0.5 M

The cucumber strips should be completely submerged in the solutions.

Cover the petri dishes and leave for 30 minutes.

CONTINUE WITH THE REST OF THE EXAMINATION IN THE MEANTIME

After the 30 minutes have elapsed, measure the straight lengths of the strips in Solution 1 and find the average length. Repeat for the other solutions.

(a) Construct a table to show your results which will include the following: sucrose concentrations, initial length of strips, final length of strips and average length of strips in each concentration.

[8 marks]

(b) Which sucrose solution has a water potential CLOSEST to that of the cucmber?

_____

[1 mark]

GO ON TO THE NEXT PAGE

(c) Make simple line drawings of the strips in sucrose solutions of concentrations:

(i) 0.1 M

[2 marks]

(ii) 0.5 M

[2 marks]

(d) (i) State PRECISELY what happens to the cortical cells in the 0.1 M sucrose solution.

_____

_____

_____

_____

_____

_____

_____

[2 marks]

(ii) State PRECISELY what happens to the cortical cells in the 0.4 M sucrose solution.

_____

_____

_____

_____

_____

_____

_____

[2 marks]

(e) Give ONE reason why the strip shown in Figure 1 (ii) on page 2 curves backwards immediately after it is released.

_____

_____

_____

_____

[1 mark]

Total 18 marks

2. (a) The rates of enzyme-catalysed reactions can be influenced by the pH at which they occur. Table 1 shows the relative reaction rates for salivary amylase and arginase at different pH values.

(i) On the graph grid provided, plot a graph of the relative rates for BOTH salivary amylase and arginase.

[6 marks]

TABLE 1: REACTION RATES FOR TWO ENZYMES

pH Values	Relative reaction rates	
	Salivary amylase (units)	Arginase (units)
4.5	2.2	0
5.0	5.0	0
5.5	8.0	0.2
6.0	13.0	1.0
6.5	17.0	4.0
7.0	18.0	7.0
7.5	16.0	9.0
8.0	11.0	11.8
8.5	6.0	13.5
9.0	2.0	16.0
9.5		18.0
10.0		17.8
10.5		15.0
11.0		14.0

(ii) Using the graph, determine the optimal pH for

a) arginase activity _____

[1 mark]

b) salivary amylase activity _____

[1 mark]

(iii) Compound X is a substance that has two parts, Part 1 and Part 2. Part 1 can be digested ONLY by arginase and Part 2 ONLY by salivary amylase. Both enzymes are required for the complete digestion of compound X.

Determine the optimal pH at which BOTH of these enzymes together digest compound X.

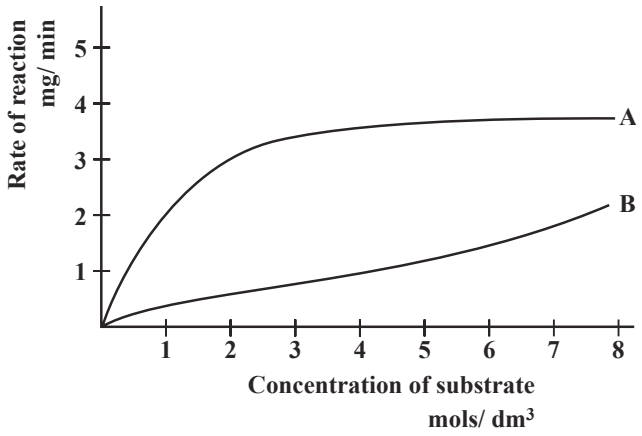
_____

[1 mark]

(iv) Explain the results seen for salivary amylase at pH 5 and 7.

[3 marks]

(b)



(i) Which graph line represents the enzyme-catalysed reaction?

_____

[1 mark]

(ii) Give a reason for your answer to 2(b)(i).

_____

_____

_____

_____

[3 marks]

(iii) At what concentration of substitute is the rate of reaction MAXIMAL?

_____

_____

[2 marks]

Total 18 marks

GO ON TO THE NEXT PAGE

3. A laboratory technician prepared two glucose solutions of different concentrations for a laboratory practical exercise the following day. The technician was called away and when he returned he realised he had not labelled the bottles.

Design a test that could help the technician determine which of the solutions prepared is the more concentrated, if a 1M solution of glucose from which the following dilution could be prepared: 0.75 M, 0.5 M, 0.25 M.

(a) List the apparatus that would be required.

_____

_____

_____

_____

[2 marks]

(b) List the reagents that would be needed.

_____

_____

_____

_____

[2 marks]

(c) List the steps that should be taken to make a coloured standard.

_____

_____

_____

_____

_____

_____

_____

_____

[3 marks]

GO ON TO THE NEXT PAGE

(d) Provide a table showing how the results for the coloured standard should be presented.

[2 marks]

(e) How would the coloured standard be used to determine which solution is more concentrated? List the steps.

_____

_____

_____

_____

_____

_____

_____

_____

[3 marks]

Total 12 marks

END OF TEST

FORM TP 2007-SPEC

TEST CODE **02238020**

CARIBBEAN EXAMINATIONS COUNCIL

ADVANCED PROFICIENCY EXAMINATION

BIOLOGY – SPECIMEN PAPER

UNIT 2 – PAPER 02

2 hours 30 minutes

READ THE FOLLOWING INSTRUCTIONS CAREFULLY.

1. This paper consists of SIX questions.

2. Section A consists of THREE questions. Candidates must attempt ALL questions in this section. Answers to this section MUST be written in this answer booklet.

3. Section B consists of THREE questions. Candidates must attempt ALL questions in this section. Answers to this section MUST be written in the answer booklet provided.

4. The use of silent non-programmable calculators is allowed.

SECTION A

Attempt ALL questions. Write your answer in this booklet.

1. (a) By means of named examples, distinguish between

(i) biome and biomass

_____

_____

_____

_____

_____

_____

[2 marks]

(ii) in situ and ex situ conservation methods.

_____

_____

_____

_____

_____

_____

[2 marks]

GO ON TO THE NEXT PAGE

(b) Give TWO reasons why it is more difficult to store frozen embryos than frozen sperm.

_____

_____

_____

_____

_____

_____

_____

_____

[2 marks]

(c) There are fewer than 250 white (albino) tigers on earth and they all live in zoos or on reserves. Captive breeding programs are used between the network of tiger sanctuaries.

(i) Give TWO reasons why white tiger populations in the wild have become so low.

_____

_____

_____

_____

_____

[2 marks]

(ii) Describe TWO objectives of the 'captive breeding programs' used between the network of tiger sanctuaries.

_____

_____

_____

_____

_____

GO ON TO THE NEXT PAGE

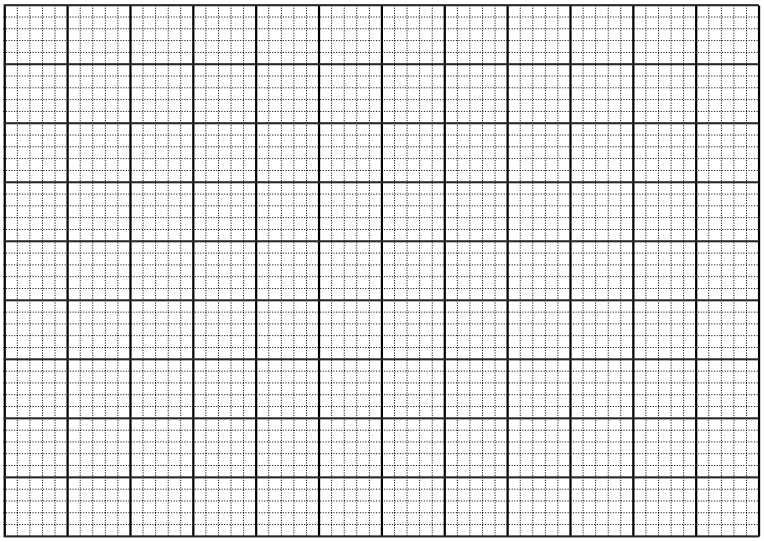
[2 marks]

(d) The data in Table 1 were collected from a river in the month of November.

Table 1

Species Type	Trophic Level	Dry wt. (g)
Aquatic angiosperm	Producer	175.5
Shrimp	Herbivore	15.6
Water beetles	Carnivore	3.4
Algae	Producer	150.5
Dragon fly nymphs	Carnivore	4.2
Caddis-fly larvae	Herbivore	9.8
Adult caddis-flies	Carnivore	6.4
Tadpoles	Herbivore	10.6

(i) Using the data in Table 1, construct a pyramid of biomass for the ecosystem.



[3 marks]

(ii) State TWO difficulties when constructing a pyramid of energy.

_____

_____

_____

[2 marks]

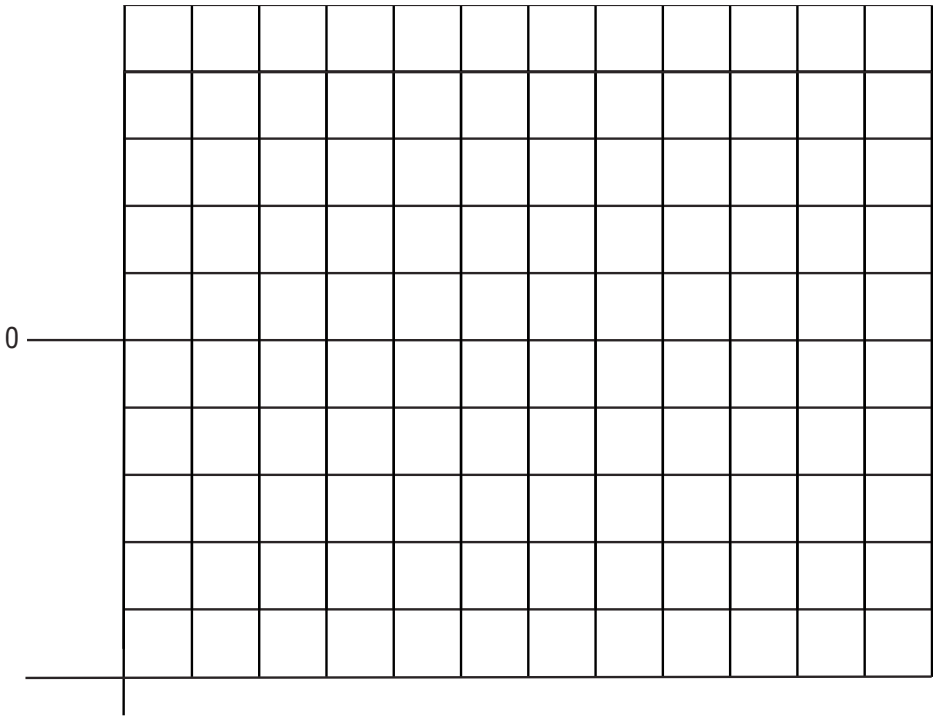
Total 15 marks

2. A group of students investigated the effect of sodium ions on the production of action potentials in the large neurons extracted from squids. Since the squid is a marine mollusc, they used a bathing solution of seawater. One neutron was placed in normal strength seawater (A), and the other in seawater diluted 50:50 with distilled water, (B). They simulated both neurons, and recorded the strength of the action potential in millivolts (mV). The results are set out in Table 2.

Table 2. MEMBRANE POTENTIALS IN TWO SOLUTIONS

Time Milliseconds	Membrane Potential mV	
	Normal Seawater A	Normal Seawater: distilled water, 50:50 B
0.0	–50	–50
0.2	–50	–50
0.4	+50	–30
0.6	+20	0
0.8	–60	+15
1.0	–70	–50
1.2	–60	–60
1.4	–50	–50

(a) (i) Use the grid provided to show these results graphically.



[5 marks]

GO ON TO THE NEXT PAGE

(ii) State TWO differences between the peaks in A and B.

1. _____

2. _____

[2 marks]

(iii) State ONE cause of the differences between the membrane potentials reached in A and B.

_____

_____

_____

[1 mark]

(b) Figure 1 shows a specialized type of cell.

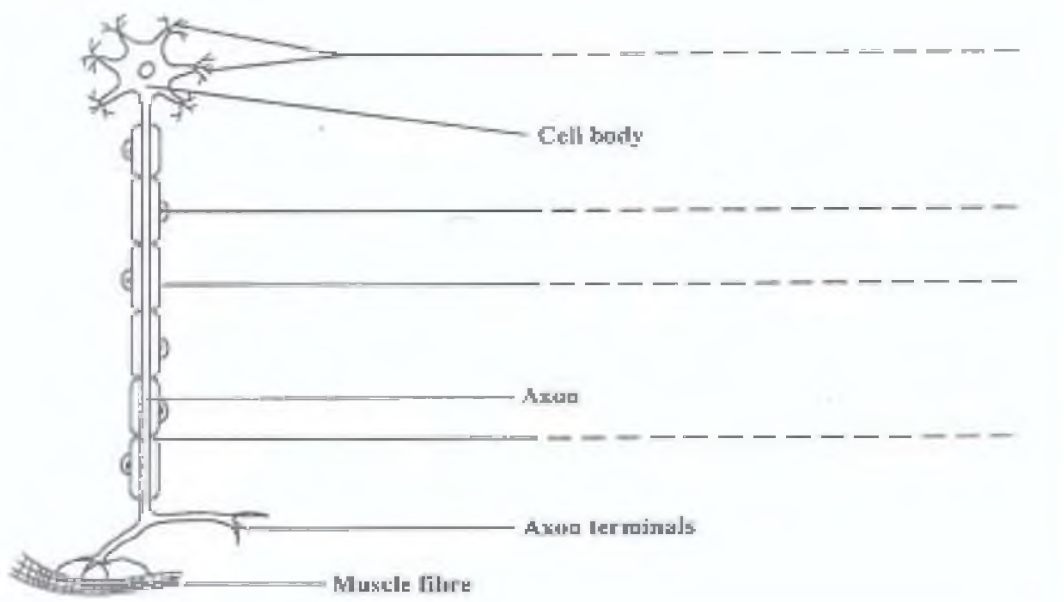


Figure 1. A nerve cell

(i) Identify the type of nerve cell shown in Figure 1.

_____

[1 mark]

(ii) On the diagram in Figure 1, complete the labelling of the nerve cell. **[1 mark]**

(c) List the major features of a chemical synapse.

_____

_____

_____

_____

[3 marks]

(d) Acetylcholine is always excitatory at synapses involving skeletal muscles. Curare blocks acetylcholine receptors.

Suggest, with an explanation, the effect that curare would have on muscular contraction.

_____

_____

_____

_____

[2 marks]

Total 15 marks

3. (a) State the name of the major carbohydrate stored in muscle tissue to provide a ready respiratory substate.

_____

[1 mark]

(b) Identify TWO products formed in the muscles during energetic exercise.

Product No. 1 _____

Product No. 2 _____

[2 marks]

(c) For the products identified in (b) above, state the effect of ONE of them on the heart rate.

_____

_____

[1 mark]

(d) Prolonged exercise of the muscles results in anaerobic respiration (fermentation).

(i) State precisely how this process affects the ATP output from EACH molecule of glucose respired.

_____

_____

_____

[1 mark]

(ii) Clarify the relationship between the presence of lactic acid in the muscle tissue and the oxygen debt.

_____

_____

_____

[1 mark]

GO ON TO THE NEXT PAGE

(iii) Light exercise creates little demand on the rate of breathing and heart output but as exertion and duration increase, both breathing movements and heart output intensify. When the body is exercising at its maximum capacity, oxygen consumption is at its highest. This state is called VO_2max. It is measured as the volume of oxygen in cubic centimetres, used per kilogram of body mass per minute.

$$VO_2\text{max} = O_2\ cm^3\ kg^{-1}\ minute^{-1}$$

A sports laboratory is equipped with a stopwatch, a weighing scale, appropriate tubing and a gas analyser, to measure oxygen consumption.

Explain the procedures you would use and the calculations you would make to find out the VO_2max of an athlete.

_____

_____

_____

_____

_____

_____

_____

_____

[4 marks]

(e) A 40-year-old subject signed up for a 24-month endurance training programme. The graph in Figure 2 summarizes the adaptive changes in the muscles.

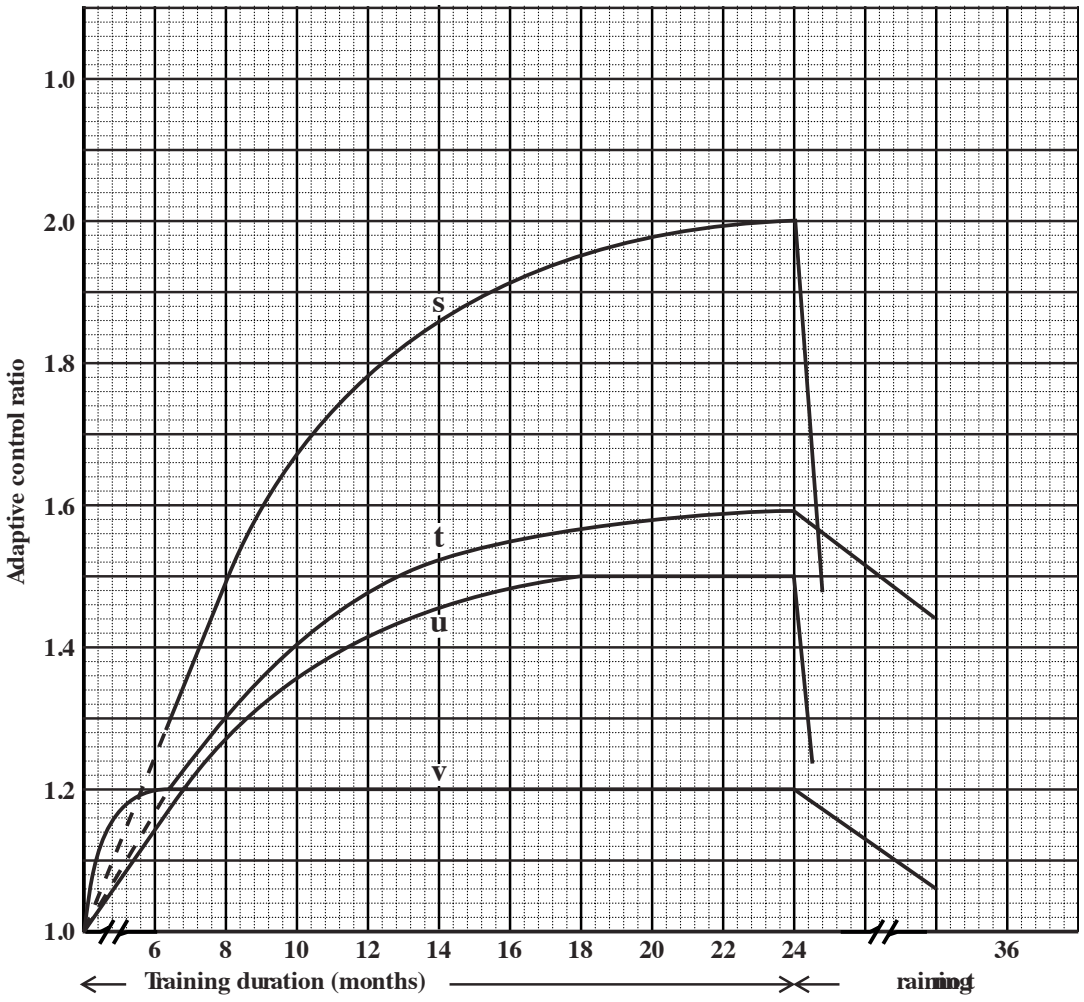


Figure 2. Adaptive changes in muscles

Adapted from Exercise Physiology: Energy, Nutrition and Human Performances, 5th Edition. W. D. Mc Ardle, F. I. Katch V. L. Katch. Lippincott Williams and Wilkins

With reference to the graph in Figure 2, answer questions (i) to (v).

(i) What is the percentage increase in VO_2max attained by the 40-year-old subject at the end of the 24-month period?

_____

[1 mark]

GO ON TO THE NEXT PAGE

(ii) Suggest why muscle fibres, which attain an increase in cross-sectional area in the first two months, do not achieve any further increase in diameter over the next 22 months.

_____

_____

_____

[1 mark]

(iii) If the muscle cells do not increase in size, suggest how muscles continue to cause an increase in VO_2max.

_____

_____

[1 mark]

(iv) At the end of 24 months, when training stops, why do curves 's' and 'u' decline abruptly, while curves 't' and 'v' decrease more slowly?

Reasons 's' and 'u' decline abruptly:_____

_____

_____

[1 mark]

Reasons 't' and 'v' decrease more slowly: _____

_____

_____

[1 mark]

Total 15 marks

SECTION B

Attempt ALL questions. Write your answers in the Answer Booklet provided.

4. (a) Clarify the **actions** and **purposes** of the oxidative and decarboxylative reactions which occur in the mitochondria during the following events:

(i) Entry and processing of pyruvic acid **[4 marks]**

(ii) Rotation of the Kreb's cycle **[5 marks]**

(b) By means of an annotated diagram, explain the process of oxidative phosphorylation, (the electron transport chain). Show the location of all hydrogen and electrons carriers, phosphate compounds and oxygen involved in the production of ATP. **[6 marks]**

Total 15 marks

5. (a) (i) Describe the forces and conditions which cause blood from the right atrium to enter and fill the right ventricle. **[6 marks]**

(ii) The right and left ventricles force blood out of the heart at pressures of approximately 4 kPa and 16 kPa respectively. Why is this necessary? **[4 marks]**

(b) Discuss how the **blood vessels** of the circulatory system are well adapted, structurally and functionally to:

(i) the return of blood **[2 marks]**

(ii) the interchange of substances with the tissues **[3 marks]**

Total 15 marks

6. (a) State the mode of action of plasma cells and phagocytes. **[2 marks]**

(b) Discuss the ways in which the maturation process of B and T lymphocytes prepare them for their specific roles. **[6 marks]**

(c) Chloe gets a positive pregnancy test on a kit that she has used at home. The box label says it contains monoclonal antibodies. Her husband doesn't know whether to trust it. Chloe, who has studied Biology, persuades him that it is based on sound technology and is accurate.

What convincing points could she make? **[3 marks]**

(d) Explain the difference between 'active artificial immunity' and 'passive artificial immunity'. **[4 marks]**

Total 15 marks

END OF TEST

FORM TP 2007-SPEC

TEST CODE **02207032**

CARIBBEAN EXAMINATIONS COUNCIL

ADVANCED PROFICIENCY EXAMINATION

BIOLOGY – SPECIMEN PAPER

UNIT 2 – PAPER 032

ALTERNATIVE TO SBA

2 hours

Candidates are advised to use the first 15 minutes for reading through this paper carefully.

READ THE FOLLOWING INSTRUCTIONS CAREFULLY.

1. This paper consists of THREE questions. Attempt ALL questions.

2. The use of silent non-programmable calculators is allowed.

1. (a) Make a labelled drawing of Specimen A.

[6 marks]

(b) (i) Investigation of stomatal density of Specimen B.

Procedure:

- Spread a thin layer of nail varnish over the lower surface of specimen B.
- Allow to dry.
- Peel off the thin replica with a fine forceps.
- Lay it on a slide and add a cover slip (it may be mounted in water if you choose).
- Count the number of stomata in a given field of view and repeat three times in different areas.

GO ON TO THE NEXT PAGE

- Obtain a mean value.

Count 1	Count 2	Count 3	$\bar{x}$

- Calculate the number of stomata per cm^2. Show your working.

Stomatal density _____

_____

[6 marks]

(ii) Would you expect stomatal density to be the same on the upper surface of Specimen B? Explain your answer

_____

_____

_____

_____

_____

[2 marks]

(c) Figure 1 shows a transverse section of a leaf.

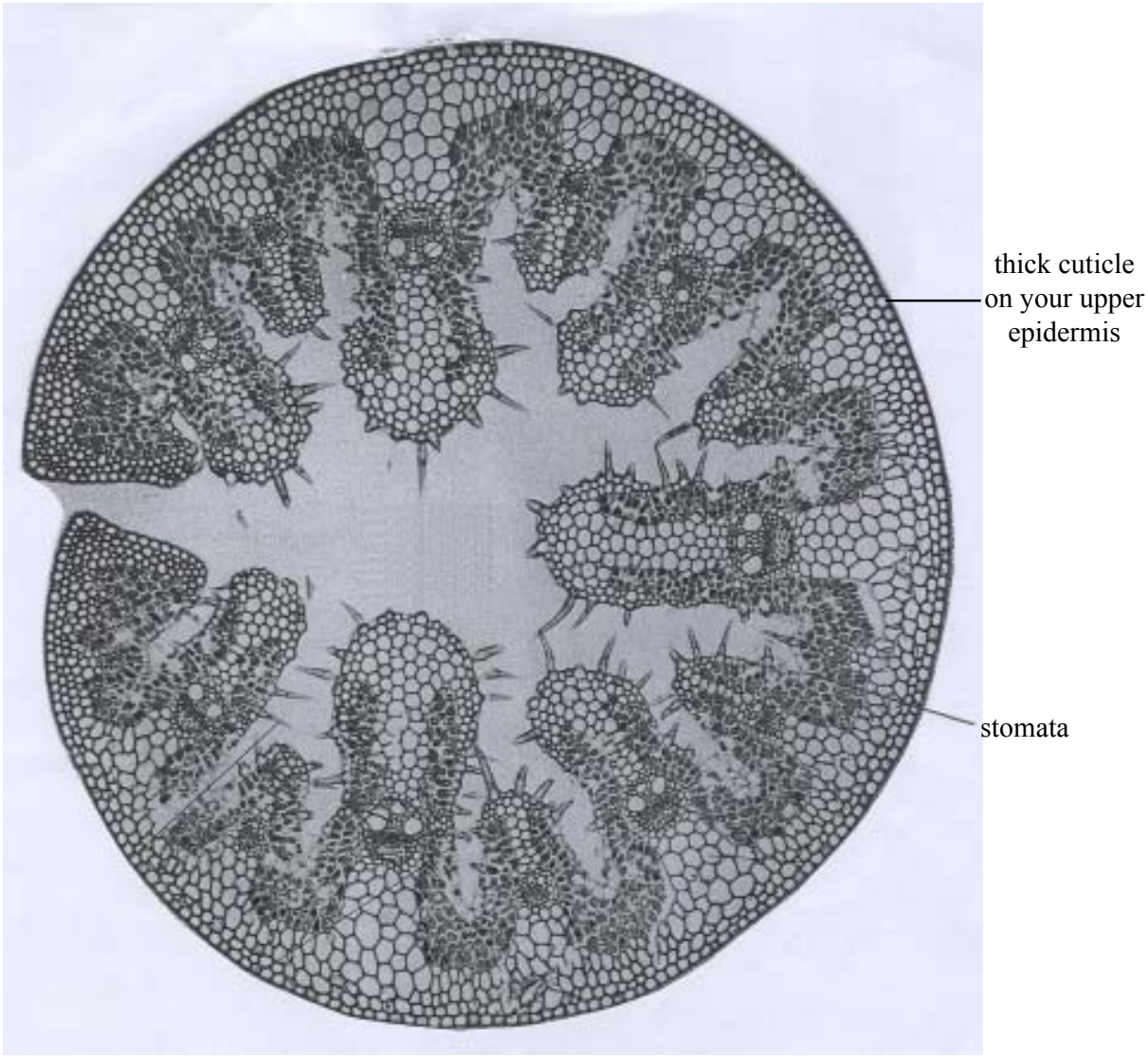


Figure 1. Transverse section of a leaf

List (state) with explanations, FOUR features of the leaf shown in Figure 1 that show how the plant is adapted to a dry environment.

1. _____

_____

2. _____

_____

3. _____

_____

4. _____

_____

[4 marks]

Total 18 marks

2. You are provided with the following apparatus and materials.

- Water bath
- Thermometer
- Elodea shoot
- Test tubes
- Sodium hydrogen carbonate solution
- Apparatus for measuring gas
- Meter rule
- 100W lamp

Use the apparatus above to plan and design an experiment to test the following observation:

Water plants evolve large volumes of gas when placed in a well illuminated area.

(a) Suggest a suitable hypothesis based on the observation given.

_____

_____

_____

_____

[2 marks]

(b) Write a suitable aim based on the hypothesis.

_____

_____

_____

[1 mark]

(c) Design an experimental procedure capable of testing the aim outlined in (b) on page 6.

[5 marks]

(d) (i) What results would be expected from the investigation.

_____

_____

_____

_____

[1 mark]

(ii) Design an appropriate table to show how the results could be presented.

[2 marks]

(e) What limitation could be expected from an experiment of this nature.

_____

_____

_____

_____

[1 mark]

Total 12 marks

3. Table 1 below, contains data on the typical birth-weight of babies over a period of 10 years. The mortality of babies, in relation to birth-weight is shown in Table 2.

TABLE 1. TYPICAL BIRTH-WEIGHT (AS A PERCENTAGE) OVER 10 YEARS

Birth-weight of babies (lbs)	% of babies
0 – 1 1 – 2 2 – 3 3 – 4	pre-drawn on histogram
4 – 5 5 – 6 6 – 7 7 – 8 8 – 9	2 9 18 14 5
9 – 10 10 – 11 11 – 12	pre-drawn on histogram

TABLE 2. PERCENTAGE MORTALITY OF BABIES IN RELATION TO BIRTH-WEIGHT

Birth-weight of babies (lbs)	% mortality
3	60
4	30
5	7
6	2.5
7	1.5
8	2
9	3
10	6
11	15

Use the data in Tables 1 and 2 above to answer questions (a) (i) and (ii).

(a) (i) On Figure 2, complete the **histogram** of the typical birth-weight of babies over a 10-year period. (**Note** that portions of this histogram have been pre-dawn).

(ii) Also on Figure 2, construct a **graph** of the percentage mortality of babies in relation to birth-weight. (Use a best-fit graph line). **[6 marks]**

GO ON TO THE NEXT PAGE

Figure 2 below is a graph grid that is to be used in answering questions (a) (i) and (ii).

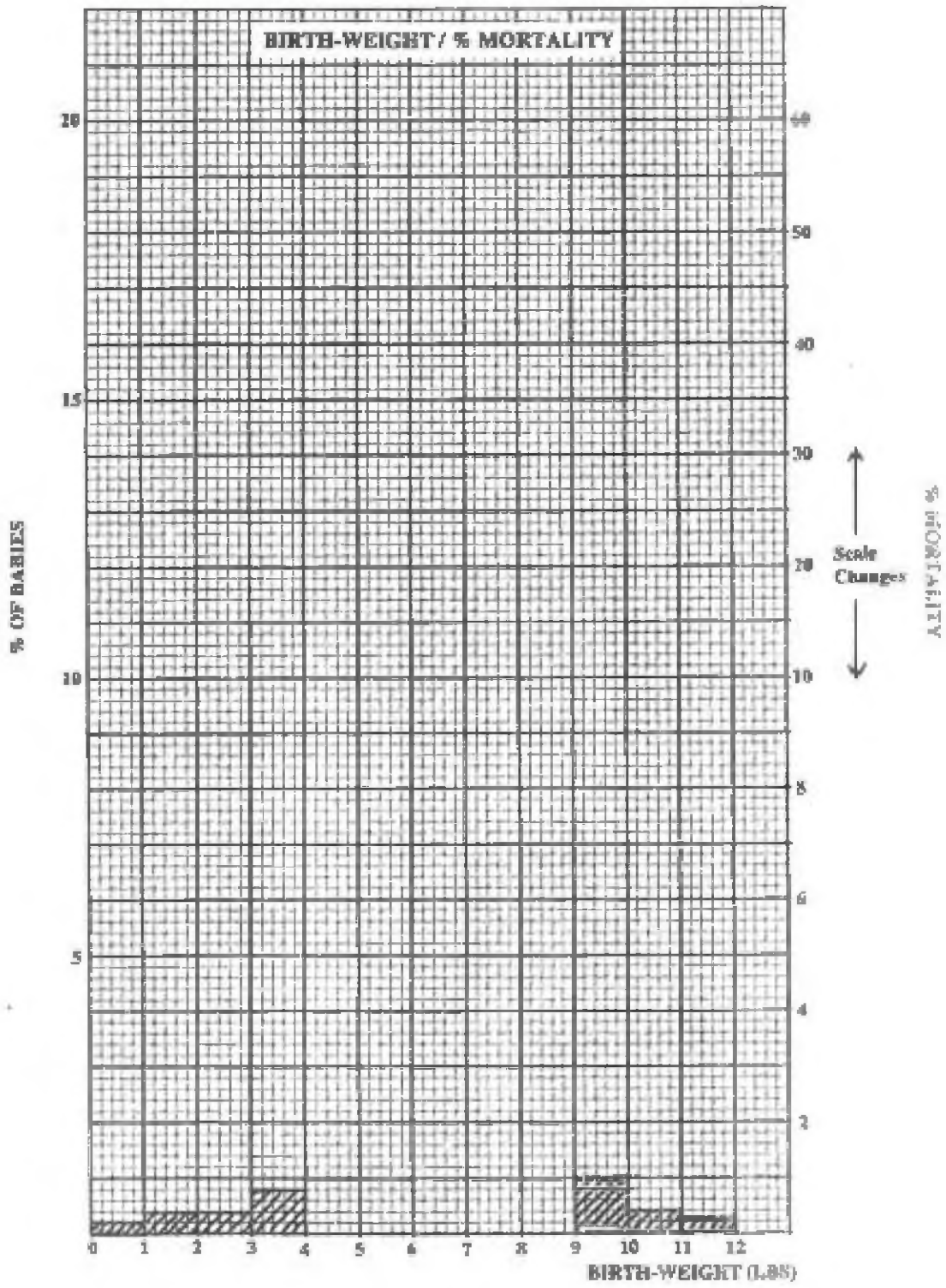


Figure 2

(b) Using quantative information from the graphs drawn on page 10, comment on the effect of birth-weight on percentage mortality.

_____

_____

_____

_____

_____

[3 marks]

(c) What effect would the observations you made in (b) have on the gene pool controlling the birth-weight of the foetus?

_____

_____

[1 mark]

(d) In terms of Natural Selection, what type of selection is operative in (c) above?

_____

[1 mark]

(e) Two special groups, the Masai and the Pygmies have different anthropomorphic measurements. The Masai people are typically over six feet in height, white, and tall. Pygmy people rarely exceed 4' 8" in height.

Draw TWO additional graphs on Figure 2 as follows:

(i) A graph line to represent the expected percentage mortality of babies in relation to birth-weight born in Masai.

(ii) A graph line to represent the expected percentage mortality of babies in relation to birth-weight born to Pygmies. **[2 marks]**

GO ON TO THE NEXT PAGE

(f) Pig litters range in size from about three to eighteen piglets per litter. The average number of piglets surviving in litters was determined three and six weeks after birth. Figure 3 gives the results of the investigation.

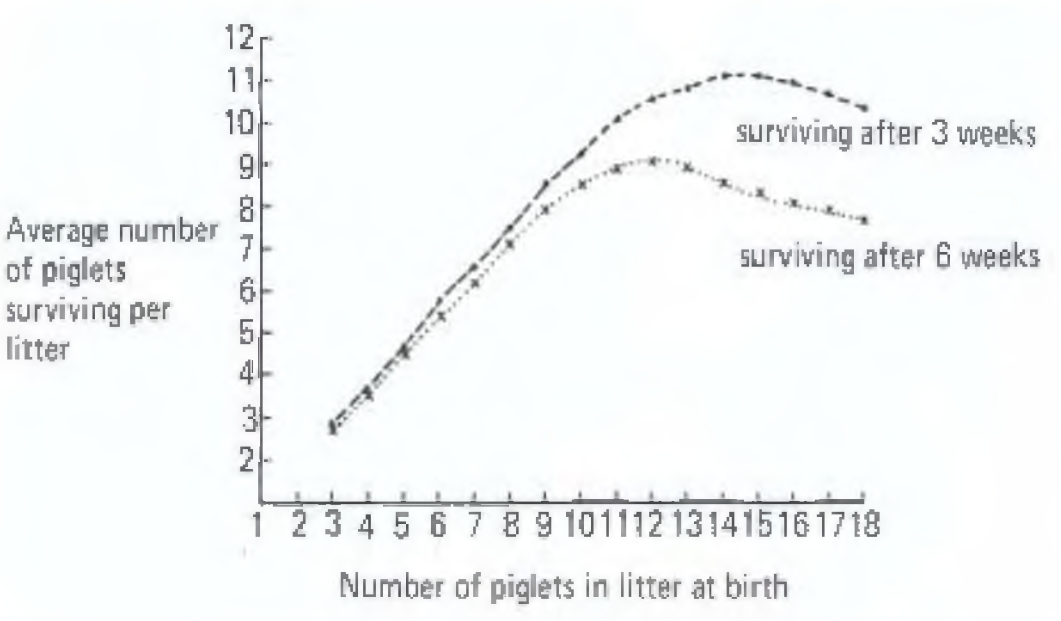


Figure 3. Litter size and piglet survival

Adapted from Problems in Animal Physiology. John Murray. 50, Albemarle St. London WIX 4BD, M.K. Sands, 1975.

(i) Complete the table below to show the difference in survival of piglets in the two litters.

TABLE 3. LITTER SIZE AND SURVIVAL IN PIGS

Number of Piglets in Litter at birth	Average number of Piglets surviving after 3 weeks	Average number of Piglets surviving after 6 weeks
3		
9		
15		

[3 marks]

(ii) Use the data from Figure 3 to suggest, with a reason, the optimum litter size for maximum survival.

_____

_____

_____

[1 mark]

(iii) How could you apply this information to a pig-breeding program to improve the piglet output.

_____

_____

_____

_____

[1 mark]

Total 18 marks

END OF TEST

C A R I B B E A N E X A M I N A T I O N S C O U N C I L

ADVANCED PROFICIENCY EXAMINATION

BIOLOGY - SPECIMEN PAPER

UNIT 2 – PAPER 02

MARK SCHEME

2008

CAPE BIOLOGY

UNIT 2 – PAPER 02

MARK SCHEME

Question 1.

KC	UK	XS

(a) (i) Biome

- A large, stable vegetative zone of the earth, e.g. grasslands, rainforests.
- A main life-zone, characterized by the dominant type of plant life growing there.

Biomass

- The weight of previously living matter obtained after heating off water until the tissues dry out, and there is no further weight reduction.

1 point from each section clearly explained - 1 mark each = 2 marks — **2**

(ii) Insitu

The study or preservation of a species in its natural surroundings, habitat or location, integrated with the normal food chains and environmental conditions.

Exsitu

The study of a species when removed from its natural habitat into a new location, simulated to resemble the natural one, for the purpose of research, captive breeding or education etc.

2 points well explained – 2 marks
1 point well explained – 1 mark — **2**

(b)
- Embryos are multicellular – more difficult than unicellular sperms.
- Embryos are larger than sperm.
- Embryos are spherical rather than oval, with a comparatively smaller surface area to volume ratio, and take longer to cool.
- Embryos have more cellular inclusions of different densities and freeze at different rates for different organelles.
- Embryo nuclei are more hydrated and their chromosomes are more dispersed and susceptible to freezing damage than those of sperm.

Any 2 - 1 mark each — **2**

KC	UK	XS

Question 1. (continued)

(c) (i) Why numbers are low

- Premature death reasons: being less well camouflaged, being killed, being hunted or captured or exotic pets or removed from breeding population by various methods – any suitable

CAPE BIOLOGY

UNIT 2 – PAPER 02

MARK SCHEME

			KC	UK	XS
		method is acceptable. • The albino gene itself: albinoism is relatively rare, albinoism is recessive and phenotypes therefore infrequent – and if removed, is even less frequent. N.B. 'Encroaching on habitat' is not specific enough – no accepted. **Any fact from each of the two lists of points – 2 marks** **Any fact from one of the sets of points – 1 mark**		**2**	
	(ii)	• To increase the numbers of white tigers. • To ensure variation is maintained. • To prevent close relatives from mating. • To breed preferred characters/qualities. • To permit invitro fertilization, etc. N.B. 'To return to habitat' – not accepted. Must be an activity while in captivity. **Any 2 of the above points – 2 marks** **Any 1 of the above points – 1 mark**		**2**	
(d)	(i)	• Pyramid, i.e. broader at bottom • 3 blocks used, for producers, herbivores, carnivores • prod 175.5+ 150.5 = 326.0; herb 15.6 + 9.8 + 10.6 = 36.0; car 3.4 + 4.2 + 6.4 = 14.0 **Accurate proportion seen** **Any 3 = 3 marks, any 2 = 2 marks, any 1 = 1 mark**			**3**

Question 1. (continued)

			KC	UK	XS
(d)	(ii)	• Difficult to measure energy of organism without killing it. • Energy lost will vary from organism to organism. • Amount of energy passing on is difficult to measure. **Any good point made by candidate** **Any 2 = 2 marks, any 1 = 1 mark**			**2**

CAPE BIOLOGY

UNIT 2 – PAPER 02

MARK SCHEME

4	**6**	**5**

Specific Objectives: 4.1, 4.5, 4.3, 4.2 – Module 1

KC	UK	XS

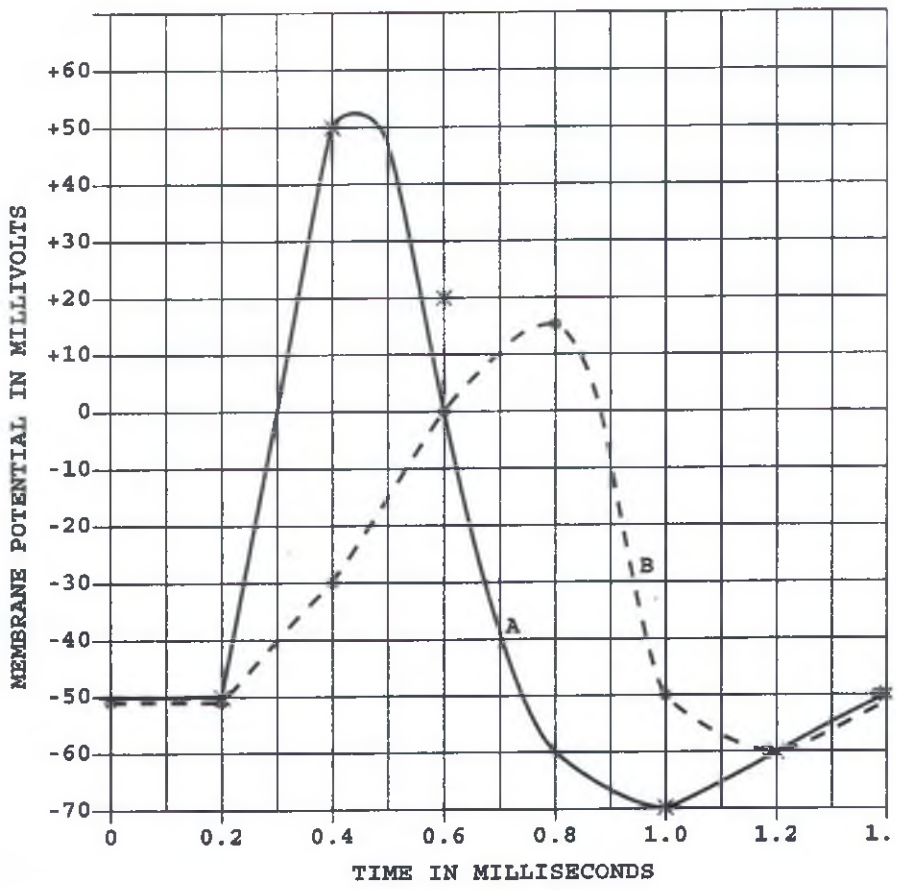
Question 2.

(a) (i)

CAPE BIOLOGY

UNIT 2 - PAPER 02

MARK SCHEME



- X axis data correct
- X axis correctly labelled
- Y axis correctly labelled
- Y axis data correct
- Graph A correct
- Graph B correct

5 points correct – 5 marks

(ii) 1 A peaks at +50 mV, B peaks at +15 millivolts

2 A peaks at 0.4 ms, B peaks at 0.8 ms

2 differences = 2 marks
1 difference = 1 mark

KC	UK	XS
	2	5

Question 2. (continued)

(a) (iii)
- The strength of the response is determined by the availability of sodium ions.
- There are more sodium ions in normal seawater than 50:50 sea/distilled water.

1 point = 1 mark

KC	UK	XS
	1	

CAPE BIOLOGY

UNIT 2 – PAPER 02

MARK SCHEME

(b) (i)	Motor neuron	1		
(ii)	Labels: Dendrites Schawnn cell / Schawnn cell nucleus Myelin sheath Node of Ranvier **3 labels correct = 1 mark**	1		
(c)	• Terminal button (synaptic knob) of presynaptic neuron. • Vesicles containing neurotransmitter. • Synaptic cleft. • Post synaptic membrane of nerve cell (or skeletal muscle). • Receptor molecules in post synaptic membrane. **4 points – 3 marks** **3 points – 2 marks** **1 – 2 points – 1 mark**	3		
(d)	• Muscular contraction would not occur. • Ach can no longer bind to the post synaptic. membrane and so transmission across the synapse will stop. **2 marks**	2		
		7	**3**	**5**

Specific Objectives: 6.1, 6.2, 6.3, 6.4 – Module 2

		KC	UK	XS
Question 3.				
(a)	Glycogen **Correct answer – 1 mark**	1		
(b)	• Carbon dioxide • Heat • Lactic acid **Any 2 correct - 2 marks**	2		
(c)	• Stimulates heartbeat frequency • Stimulates increased stroke volume • Increases cardiac output **Any 1 correct effect - 1 mark**	1		

CAPE BIOLOGY

UNIT 2 – PAPER 02

MARK SCHEME

			KC	UK	XS
(d)	(i)	The ATP output is reduced to form molecules for each glucose molecule respired. **Correct answer – 1 mark**	1		
	(ii)	The oxygen debt is the deficit in oxygen required to oxidize the accumulated lactic acid to pyrurate. **Correct answer – 1 mark**		1	
	(iii)	• Determine the weight, in kilograms of the athlete. • Exercise the athlete to maximum exertion. • Over a 60 second period measure the oxygen consumption in cm^3 (or any acceptable answer to achieve the O_2 consumption in 1 minute). • Divided the oxygen consumption in one minute by the kilograms to find the O_2 used per kilogram. • That gives the volume of O_2 in cm^3 per $kilogram^{-1}$ per $minute^{-1}$. **Any 4 points – 4 marks**			4

Question 3. (continued)

			KC	UK	XS
(e)	(i)	50% (1.0 to 1.5)			1
	(ii)	• Oxygen must be able to diffuse through the cytoplasm to the mitochondria, so the cell diameter is a limiting factor to further growth, after it achieves the maximum diameter which permits efficient O_2 diffusion (v CO_2 less). • They have reached their maximum size. **1 point clearly expressed – 1 mark**		1	
	(iii)	• The production of aerobic enzymes in the cell is increased, and drives respiration (s). • The increase in the capillary network provides more oxygen for respiration and ATP production (t). • More muscle cells are formed. • Myoglobin. **Either point correct – 1 mark**		1	
	(iv)	1. • s and u are dependent on biochemical events driven by enzymes and can be easily switched off and no longer produced. • Exercise has stopped, and feedback for enzyme synthesis ceases.		1	
		2. • t and v involve cell and tissue structure and only decline with reduced demand, as fewer			

cells are generated to replace them, as they are gradually reabsorbed or removed. **1 mark each**		**1**	
	5	**5**	**5**

Specific Objectives: 3.3, 3.4 – Module 3

	KC	UK

Question 4.

(a) (i)

- ACTION Pyruvate has CO_2 removed decarboxy-lation.
  PURPOSE To reduce it from a 3-carbon compound to a 2-carbon compound.
- ACTION Hydrogen is removed (from pyruvate) (collected by NAD/FAD).
  PURPOSE To be used to produce ATP by the ETC.
- ACTION Reduction to a 2-carbon compound Acetyl CoA.
  PURPOSE Facilitates incorporation of Acetyl CoA into Krebs cycle.

4 statements, 2 of which must be actions and 2 of which must be purposes = 4 marks — **4**

(ii)

- ACTION Acetyl CoA (the product of oxidation and decarboxylation), combines with a 4-carbon compound.
  PURPOSE Forms a 6-carbon compound which is a substantial molecule, permitting repeated oxidation and decarboxylation (i.e. builds up the number of C bonds and attached H_2OH).
- ACTION Decarboxylation of the 6-carbon compound removes CO_2.
  PURPOSE This facilitates oxidation of the group.
- ACTION Oxidation of the 6-carbon compound removes hydrogen.
  PURPOSE The hydrogen is used by the ETC to make ATP (collected by NAD).
- ACTION The resulting 5-carbon compound is decarboxylated.
  PURPOSE To reduce the compound to a 4-carbon compound, and facilitate removal of H.
- ACTION Oxidation of 5-carbon acid compound to 4-carbon.
  PURPOSE Provides H for ATP production.
- ACTION 4-carbon acid compound is able to combine with Acetyl CoA.
  PURPOSE This permits the cycle to continue.

5 statements, at least 2 of which must be actions — **5**

CAPE BIOLOGY

UNIT 2 – PAPER 02

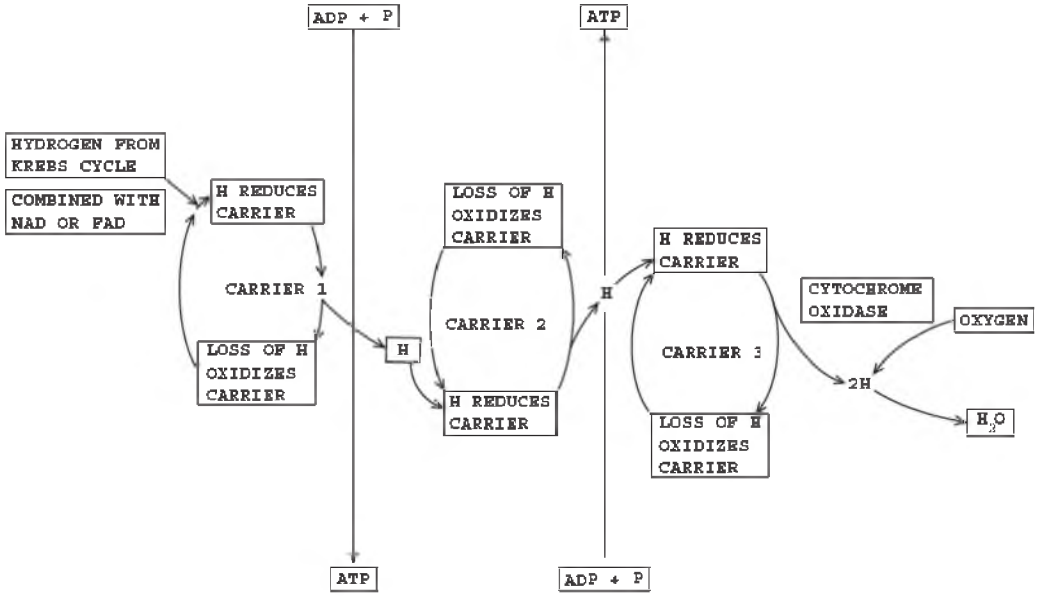
MARK SCHEME

and 2 of which must be purposes = 5 marks

KC	UK

Question 4. (continued)

(b) Electron transport chin / Respiratory chin
(Diagram should include these features)



- All arrow directions correct
- ATP + P → ATP shown clearly
- Hydrogen from Kreb cycle shown
- NAD or FAD shown
- Carriers (at least 2) labelled
- Reduced carrier shown
- Oxidised carrier shown
- 2 transfers of H are clear
- Oxygen is clearly shown
- Water is shown
- Cytochrome oxidase shown

6 points clearly annotated – 6 marks

6	
6	**9**

Specific Objectives: 2.4, 2.5, 2.6, 2.7 – Module 1

CAPE BIOLOGY

UNIT 2 – PAPER 02

MARK SCHEME

Question 5.

			KC	UK
(a)	(i)	• Blood from V. Cava fills the diastolic right atrium. • RV muscles relax as the heart starts to diastole. • Pressure is reduced in RV, creating tendency for blood to enter. • Cardiac muscle fibres naturally return to their pre-contraction state – walls of heart resume position and reduce the pressure to the RV. • Potential cavity ready to expand – i.e. RV has a lowered pressure – blood will flow in to region of low pressure. • As shape is resumed, chorda tendinae pull the tricuspid valve flaps apart/down – valve opens slightly and allows some blood from RA to trickle in. • Valve at entrance to RA (from Venae Cavae) closes so no blood can go back out via vena cava. • R fills with blood because atriums are at a higher pressure than that in the R ventricle. • Sino atrial node stimulates atrial wall and RA muscle cells in the wall contract. • RA contracts, forces blood through TCV (atrial systole). • Blood fills RV completely, pressing against the inside walls, and forcing under the TCV to close it. • Cannot escape as SLV are still closed at base of PA. **1 mark for each point to a maximum of 6 marks**		
	(ii)	**Right** Blood is at 4 kPa to the lungs because • Distance – close, no resistance • Alveoli fragile – prevents rupture • 1 capillary bed only **2 points – 2 marks**	6	
		Left Needs 16 kPa because • Distance 6' plus – overcome gravity and resistance • Circulation extensive – several sets of capillary beds • Atheromas, arteriole construction due to stress, temperature etc. – higher pressure needed **2 points – 2 marks**		2
				2

Question 5. (continued)

			KC	UK
(b)	(i)	Return of blood • Veins – lumen: diameter is greater (also less resistance). • Pressure low, 1 kPa: walls are thinner.		

CAPE BIOLOGY

UNIT 2 – PAPER 02

MARK SCHEME

• T media – some smooth muscle, few because non-pulsable elastic fibres. • Cannot construct (except when damaged – nerves). • T externa – collagen support layer. • Valves prevent back flow (MUST BE INCLUDED). • Venules collect blood from capillaries and lead to veins. **1 mark for each point to a maximum of 2 mark**		**2**
(ii) Interchange of substances with the tissues <u>Capillaries</u> • 1 cell thick – Squamous/pavement cells very permeable. • Lumen wide-relation to diameter (10 μm). • Link arteries to veins (arterioles/venules). • Form network from extensive penetration 80 000 km length. • Blood flow slow (1 mm per sec) – facilitates diffusion. • Narrowness of lumen enforces slow flow – i.e. diameter almost same as RBC (8 μm) for O_2 diffusion. • Tiny gaps in endothelium allow phagocytes etc. to enter tissues. **1 mark for each point to a maximum of 3 marks**		**3**
	6	**9**

Specific Objectives: 3.1, 3.5, 3.6, 3.7, 3.8 – Module 2

	KC	**UK**
<u>Question 6.</u>		
(a) (i) Phagocytes: • Are amoeboid cells produced in the bone marrow and they circulate in the blood. • They move rapidly to the site of an infection. • They can squeeze through capillary walls and directly invade the infection site. • The engulf antigens (large proteins/bacteria etc. < 250 nm). • They digest and kill the pathogens in a cellular vesicle. • They remove alien/foreign molecules which may cause harm to that organ, e.g. lung, liver. **Any 2 statements = 1 mark** **Any 1 statement – add to (ii)**	**1**	

CAPE BIOLOGY

UNIT 2 – PAPER 02

MARK SCHEME

(ii)	• Plasma cells – formed from B cells (by differentiation). • Secrete/synthesize antibodies (against specific antigens). • Each type of plasma cell produces a single type of antibody. • The antibody agglutinates/traps inactivates the antigen. • There are "effector" cells – carry out the "end reaction" of the immune response. • They increase in number rapidly during an infection, and decrease after the antigen is controlled. **Any 2 points – 1 mark** **Any 1 point – add to (i)**	**1**	

If candidate has 1 point only in both (i) and (ii), a mark may be given.

	KC	UK

Question 6. (continued)

(b)	• B cells originate in bone marrow from stem cells by mitosis. • Mature in bone marrow. • Genes are rearranges to give many (10 million) varying protein codes. • These variants code for different antibody surface receptors. • Each B cell is programmed to express during maturation just one type of surface receptor. • The range of B cells will therefore, between them, have an immense number of different receptors. • There will therefore be a B cell with receptor for any/every antigen. **5 points – 3 marks** **3 - 4 points – 2 marks** **1 - 2 points – 1 mark**		**3**
	T cells: • Form in bone marrow from stem cells by mitosis. • Migrate to thymus. • Differentiate genotype to form thousands of variants. • Variant genes code for specific surface receptors. • T cells have a wide range of individual surface receptors. • T cells have the body's own antigens presented to them by MHC. • If a T cell binds with and reacts with one of the body's own protein it is killed. • This prevents having T cells that attack the body's own cells,		

i.e. an auto immune attack in the body by its own.

5 points – 3 marks
3 - 4 points – 2 marks
1 - 2 points – 1 mark

	3

CAPE BIOLOGY

UNIT 2 – PAPER 02

MARK SCHEME

KC	UK

Question 6. (continued)

(c)
- When pregnancy occurs, a protein (called HCG) is produced.
- This can be detected in the urine.
- The monoclonal pregnancy test identifies HCG exactly, with no errors.
- The body has immune cells called B lymphocytes.
- There are thousands of varieties of them.
- Each variant B cell produces its own specific antibody. These antibodies respond to specific antigens. HCG (Pregnancy protein) is an antigen for which the body has a specific antibody-producing B cell.
- These B cells can be cloned in the lab to make millions of identical B cells. These B cells are "monoclones".
- They produce large amounts of a particular antibody. The antibody is called a "monoclonal antibody".
- The antibody (MAB) is manufactured in pharmaceutical companies in large quantities.
- The monoclonal antibody which matches HCG is used in the pregnancy test. When the test strip, coated with monoclonal is dipped in urine containing HCG.
- It reacts and the results can be seen. The antibody reacts only with pregnancy protein and no other protein. So it is very exact, specific and accurate.

5 – 6 points – 3 marks
3 - 4 points – 2 marks
1 - 2 points – 1 mark

3

KC	UK

Question 6. (continued)

(d)
- Examples: Polio, MMR, Tuberculosis, Small Pox.
- <u>Active Artificial Immunity</u> (AAI) uses weakened/killed attenuated antigens.
- They simulate the disease epitopes, but cannot cause the disease.
- The immune system responds and produces antibodies in the normal way.

• Then memory cells are made for a secondary reaction when needed, in future. • The AAI antigen may need to be re-introduced as a booster to maintain the response. • Antigens for Polio/MMR/BCG can be given in childhood; they confirm long term immunity by stimulating the body's own responses. • AAI is called 'vaccination/immunization'. • It can protect the whole population and make the disease rare, or eradicate it (small pox) • <u>Passive Artificial Immunity</u> (PAI) is very short lived. • It only lasts for a few days – 1 week. • Does not stimulate natural immune system. • Actual antibodies to the antigen are given. • These come from another person (or an animal). • It gives immediate protection in an emergency. • Or when a person is too ill to carry out an immune response. • Snake or spider toxins need immediate antitoxins/ antibodies. • Tetanus, from a wound – in soil is an active pathogen injected tetanus antitoxin counteracts the tetanus protein. • Antibodies which pass through the placenta, made by the mother, can protect the baby for a short time. This is also PAI. **For each part allot 2 marks as follows:** **2 points – 2 marks** **1 point – 1 mark**	**2+2**	
	6	**9**

Specific Objectives: 2.1, 2.3, 2.4, 2.7, 2.9, 2.10 – Module 3

C A R I B B E A N E X A M I N A T I O N S C O U N C I L

ADVANCED PROFICIENCY EXAMINATION

BIOLOGY - SPECIMEN PAPER

UNIT 2 – PAPER 03

MARK SCHEME

2008

CAPE BIOLOGY

UNIT 2 – PAPER 03

MARK SCHEME

Question 1.

			UK	XS
(a)	Specimen A: slide of lower epidermis of a leaf (whole mount)			
	•	Clear accurate line representation of specimen		
	•	Clean continuous lines of even thickness		
	•	Use of label lines that do not cross		
	•	Accurate labelling		
	•	Features correctly proportioned		
	•	Magnification given		
	•	Title given		
	Any point – 1 mark			**6**
(b)	(i)	Specimen B: dicotyledonous lead		
		• Mean correctly calculated		**2**
		• Calculation of stomatal density		**3**
		• Use of appropriate units		**1**
	(ii)	• No	**1**	
		• Dicotyledonous leaf	**1**	
(c)	•	Leaf rolled - to reduce transpiration rate		
	•	Stomata on lower epidermis not exposed to dry atmosphere		
	•	Presence of hairs trap H_2O – creating humid environment		
	•	Humid conditions in interior result in reduced transpiration.		
	•	Thick cuticle to reduce water loss across epidermis		
	Any point – 1 mark up to a maximum of 4 marks		**4**	
			6	**12**

Specific Objectives: 1.5, 1.6 – Module 2

Question 2.

			UK	XS
(a)	•	Mention of light being necessary for the process of photosynthesis, therefore in well illuminated areas, large amounts of oxygen will be released.		
	•	Increase in availability of light increases the rate of		

CAPE BIOLOGY

UNIT 2 – PAPER 03

MARK SCHEME

light dependent and hence light independent stages.

Statement relating directly to observation – 1 mark
Testable hypothesis – 1 mark **2**

(b) • To investigate the effect of light intensity on the rate of photosynthesis.

Suitable and related to hypothesis – 1 mark **1**

(c) • Suitable and logical sequence (can be enhanced with diagram).

• Controls included, i.e. parallel experiment set up with light source placed at one constant distance throughout experiment.

• Attempts to control conditions

- use of $NaHCO_3$ to ensure sufficient CO_2
- use of thermometer to check for changes in temperature. Replace water if change noted.

• Duration of investigation.

- length of time elapse before volume of gas is measured for each light intensity.

• Number of trials stated – to ensure reproductively of experiment.

Present tense MUST be used.

1 mark for each point correctly done
1 mark x 5 points – 5 marks **5**

	UK	XS

Question 2. (continued)

(d) (i) As distance from lamp decreases/increases THEN volume of gas SHOULD increase/decrease.

Future tense MUST be used – 1 mark
Future tense NOT used – 0 mark **1**

(ii) • Table must have title.

• 3 columns, distance from lamp, light intensity, volume of oxygen.

• Units must be shown, at least for lamp distance and volume of oxygen.

• Distances from lamp must be shown in increasing or decreasing order.

CAPE BIOLOGY

UNIT 2 – PAPER 03

MARK SCHEME

Example of table showing the effect of light intensity on rate of photosynthesis.

Distance of Lamp cm	Light Intensity	Volume of O_2 cm
80 40 20 10 5		

3 – 4 points – 2 marks
1 – 2 points – 1 mark

2

(e) • Amount of light in room, not given off from lamp can affect results when distance from lamp is great.

Limitation stated and explained - 1 mark

1

-	**12**

Specific Objectives: 1.6 – Module 1

UK	**XS**

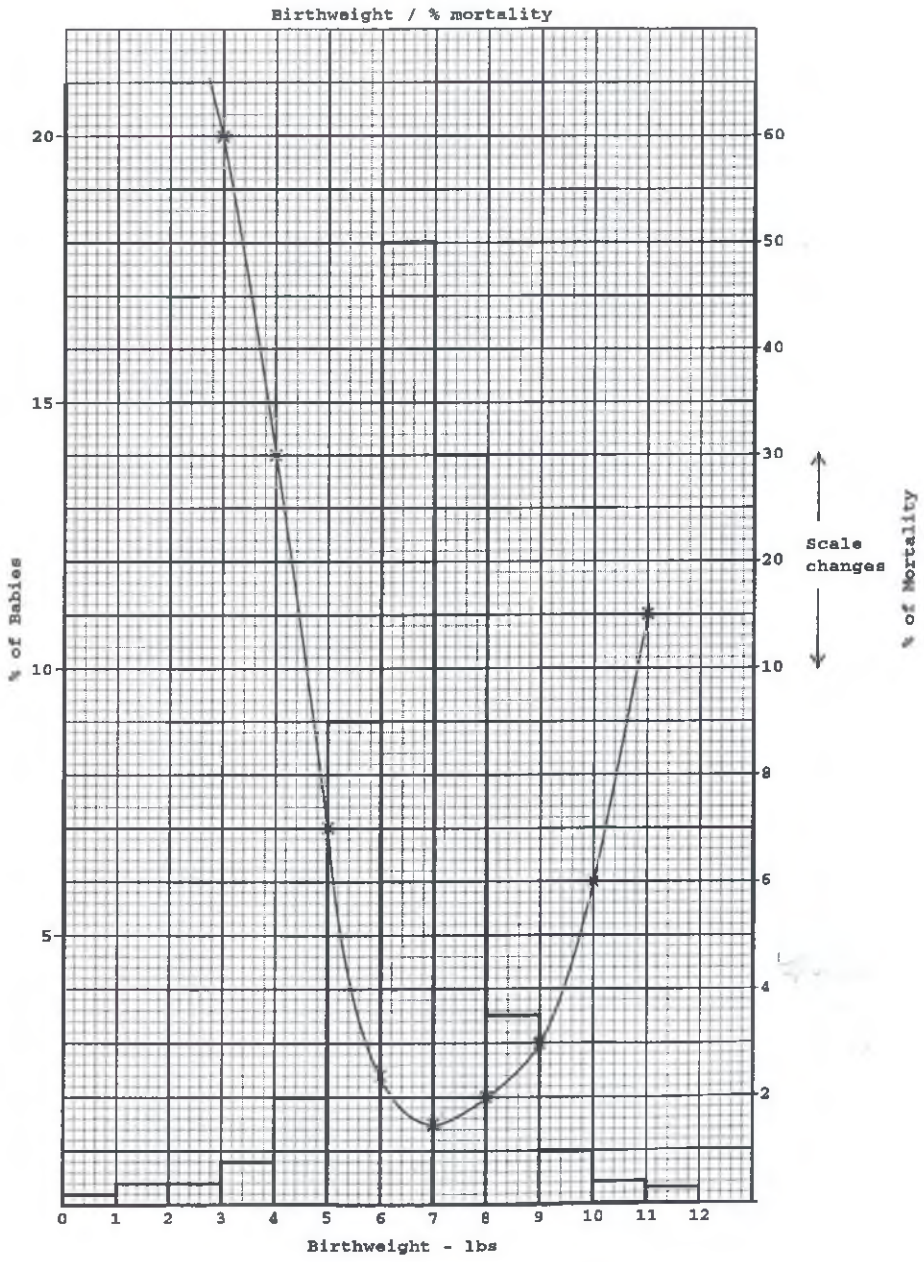
Question 3.

CAPE BIOLOGY

UNIT 2 - PAPER 03

MARK SCHEME

(a)



Histogram: **4 - 5 bars well drawn - 4 marks**
3 bars well drawn - 3 marks

Graph: **All points correct, well drawn - 2 marks**
1 error or poorly drawn - 1 mark

4 marks from Histogram + 2 marks from graph = 6 marks

6

UK	XS

Question 3. (continued)

CAPE BIOLOGY

UNIT 2 – PAPER 03

MARK SCHEME

(b)
- Babies of 6 – 7 lbs (which constitute 18% of births) have the lowest mortality (2.5 and 1.5%).
- Babies of 3 – 4 lbs have the highest percentage mortality of 90%.
- Babies of 11 lbs also show high % mortality of 15%.

3 correct points, using data from the table - 3 marks — 3

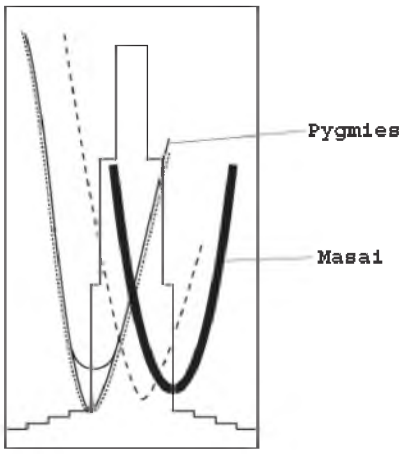
(c)
- The next generation would receive more genes associated with mean birth-weight.
- Fewer genes for very low, or high birth-weight would be passed to the next generation.

One correct point – 1 mark — 1

(d) Directional

Correct – 1 mark — 1

(e) (i) & (ii)



Labelled and correctly placed graphs – 1 mark each — 2

UK	XS

Question 3. (continued)

(f) (i)

No.	3 wks.	6 wks.	
3	(2.8)	(2.7)	**both correct – 1 mark**
9	(8.2)	(7.8)	**both correct – 1 mark**
15	(11)	(8)	**both correct – 1 mark**

Correct figures are in brackets – allow very slight — 3

CAPE BIOLOGY

UNIT 2 – PAPER 03

MARK SCHEME

	variations		
(ii)	11 – 12 piglets per litter. These piglets have the maximum survival after 6 weeks. **Correct number with reason – 1 mark**		**1**
(iii)	• Retain piglets from litters of 10 – 12 piglets, and use for breeding. • Retain sows from litters of 10 – 12 piglets and use for breeding (with champion boar). **Either of the above – 1 mark**	**1**	
		6	**12**

Specific Objectives: