Revision Checklist for AS/A Level Biology 9700

Guide for Students

UNIVERSITY of CAMBRIDGE
International Examinations

REVISION CHECKLIST for AS/A Level Biology 9700

A guide for students

How to use this guide
The guide describes what you need to know about your AS/A Level Biology examination.

It can be used to help you to plan your revision programme for the theory examinations and will explain what the examiners are looking for in the answers you write. It can also be used to help you revise by using the table in Section 3, 'What you need to know?', to check what you know and which topic areas of Biology you have covered.

The guide contains the following sections:

Section 1 - How will you be tested?
This section will give you information about the different types of theory and practical examination papers that are available.

Section 2 - What will you be tested on?
This section describes the areas of knowledge, understanding and skills that you will be tested on.

Section 3 - What you need to know
This shows the syllabus content in a simple way so that you can check:

- the topics you need to know about
- the contents of each syllabus - AS, A2 and the Options
- details about each topic in the syllabus
- how much of the syllabus you have covered

Section 4 - Appendices
This section covers the other things you need to know, including:

- information about the mathematical skills you need
- information about terminology, units and symbols, and the presentation of data
- the importance of the command words the Examiners use in the examination papers

Not all the information will be relevant to you. For example, you will need to select what you need to know in Sections 1 and 3, by knowing which examination papers you are taking.

Section 1 - How will you be tested?

1.1 The examinations you will take

There are three ways you can gain an advanced level qualification.

- take all advanced level components in the same examination session leading to the full A Level
- follow a **staged** assessment route to the A Level by taking the AS qualification in an earlier examination session. Subject to satisfactory performance you are then only required to take the final part of the assessment (referred to in this syllabus as A2) leading to the full A Level
- take the AS qualification only.

AS

You will be entered for **three** examination Papers, **two** theory Papers and **one** practical Paper.

You will take Paper 1 (theory, multiple choice), Paper 2 (theory, structured questions) and Paper 3 (practical test).

A2

You will be entered for **three** examination Papers, **two** theory Papers and **one** practical Paper.

You will take Paper 4 (core theory), Paper 5 (practical test) and Paper 6 (option theory).

You will be required to answer questions on ONE option only.

1.2 About the examination Papers

The table gives you information about the examination Papers

Paper number	How long and how many marks?	What's in the paper?	Weighting %	
			AS	A
1	1 hour (40 marks)	40 multiple-choice questions. You choose one answer you consider correct from a choice of 4 possible answers.	32	16
2	1 hour 15 min (60 marks)	Structured questions. You should write your answers in the spaces provided. The Paper tests the AS syllabus.	48	24
3	1 hour 15 min (25 marks)	A practical test, set and marked by CIE. It will include experiments and investigations based on the AS syllabus.	20	10
4	1 hour 15 min (60 marks)	Structured questions, totalling 45 marks plus a choice of free response questions that will carry a further 15 marks. Based on A2 Core syllabus, but a knowledge of AS syllabus may be required.	-	23
5	1 hour 30 min (30 marks)	A practical test set and marked by CIE. It will include experiments and investigations based on the AS syllabus and A2 core syllabus.	-	11
6	1 hour (40 marks)	Variable number of compulsory structured questions. Based on the option, but a knowledge of the core syllabus may be required.	-	16

1.3 About the practical Papers

Twenty percent of the marks for **AS** Biology are for practical work.

In **Paper 3**, you will have to handle familiar and unfamiliar biological material and will be expected to show evidence of the following skills:

- planning
- implementing
- interpreting and concluding

When unfamiliar materials or techniques are involved, you will be given full instructions. Questions could be set that will require the use of a microscope or hand lens.

If you continue to a full A level, after AS, the mark you obtained in Paper 3 will contribute ten percent of your overall mark and Paper 5 will contribute a further eleven percent.

In **Paper 5**, there will be questions in which you will be expected to design an investigation that may, or may not, be carried out.

Questions involving an understanding of the use of t- and chi-squared tests may be set. If they are, you will be provided with the formulae for these tests.

In both practical papers, when unfamiliar materials or techniques are involved, you will be given full instructions. Questions could be set that will require the use of a microscope or hand lens.

No dissection will be set in either of the practical papers.

Section 2 - What will you be tested on?

When your examination papers are marked, the **assessment objectives** describe the knowledge, skills and abilities that you will be expected to demonstrate at the end of your course.

There are three main objectives:

A – Knowledge with understanding - what you remember and how you make use of what you know in both familiar and unfamiliar situations.

B - Handling information and solving problems – how you handle information provided in the question and how well you solve the problems posed.

C – Experimental skills and investigations

The theory Papers test mainly Assessment Objectives A and Assessment Objective B. The purpose of the practical Paper is to test Assessment Objective C. Your teacher will be able to give you more information about how each of these is used in the examination Papers.

The following tables show you the range of skills you will need to develop:

Skill	**Skill area**	**You will need to demonstrate this skill in relation to :**
A1	knowledge with understanding	biological phenomena, facts, laws, definitions, concepts and theories
A2		biological vocabulary, terminology, conventions (including symbols, quantities and units)
A3		scientific instruments and apparatus used in biology, including techniques of operation and aspects of safety
A4		scientific quantities and their determination
A5		biological and technological applications with their social, economic and environmental implications

Questions testing these skills will usually begin with one of the following words:

define, state, name, describe, explain or outline. See Section 4 for an explanation of these words.

Skill	Skill area	You will need to use written, symbolic, graphical and numerical forms of presentation to :
B1	handling information and solving problems	locate, select, organise and present information from a variety of sources
B2		translate information from one form to another
B3		manipulate numerical and other data
B4		use information to identify patterns, report trends and draw inferences
B5		present reasoned explanation for phenomena, patterns and relationships
B6		make predictions and propose hypotheses
B7		apply knowledge, including principles, to novel situations
B8		solve problems

Questions testing these skills will usually begin with one of the following words: *discuss, predict, suggest, calculate* or *determine.* See Section 4 for an explanation of these words.

skill	skill area	you will need to be able to :
C1	experimental skills and investigations	follow a sequence of instructions
C2		use techniques, apparatus and materials
C3		make and record observations, measurements and estimates
C4		interpret and evaluate observations and experimental data
C5		devise and plan investigations, select techniques, apparatus and materials
C6		evaluate methods and techniques and suggest possible improvements

The theory Papers test mainly skills A and B. The purpose of the practical Paper is to test skill C. Your teacher will be able to give you more information about how each of these is used in the examination Papers.

The following table will give you a general idea of the allocation of marks to assessment objectives in the different examination papers – though the balance in each paper may vary slightly.

assessment objective	weighting (%)	examination papers
A – knowledge with understanding	45	1,2,4,6
B – handling information and solving problems	30	1,2,4,6
C – experimental skills and investigations	25	3,5

In addition, 15% of the total marks will be awarded for an awareness of the social, economic, environmental and technological implications and applications of biology. These marks will be awarded within skills A and B.

Section 3 - What you need to know

This is in the form of a table, which describes what you may be tested on in the examination. It is divided into the syllabuses for AS, A2 and the A2 Options.

How to use the table
The table is divided into a number of columns.

Theme – this is a main subject area within each syllabus. There are a varying number of themes within each syllabus;

AS	11	(A-K)
A2	5	(L-P)
Mammalian Physiology	5	(1-5)
Microbiology and Biotechnology	6	(1-6)
Growth, Development and Reproduction	5	(1-5)
Applications of Genetics	4	(1-4)

Topic – this column subdivides the main theme into a number of different topics.

You should be able to – this column gives you all the detail that you will be expected to know and understand in relation to each topic. It is arranged in bullet points.

Those bullet points highlighted with * are areas which would be suitable for practical work.

At the end of each topic in the syllabus it says that you will be expected to '*use the knowledge gained in this section in new situations or to solve related problems*'.

You can use the table throughout your course to check the topic areas you have covered.

You can also use it as a revision aid. When you think you have a good knowledge of a topic, you can place a tick in the checklist column.

The column headed **Comments** can be used:

- to add further information about the details for each bullet point
- to add learning aids
- to highlight areas of difficulty/things about which you need to ask your teacher

AS Core Material				
Theme	**Topic**	**You should be able to:**	**Checklist**	**Comments**
A. Cell structure	The microscope in cell studies Cells as basic units of living organisms + detailed structure of animal and plant cells, as seen under the electron microscope Characteristics of prokaryotic and eukaryotic cells	• *use a graticule and stage micrometer to measure cells and be familiar with units (millimetre, micrometre, nanometre) used in cell studies; • explain and distinguish between resolution and magnification, with reference to light microscopy and electron microscopy; • describe and interpret drawings and photographs of typical animal and plant cells, as seen under the electron microscope, recognising the following membrane systems and organelles - rough and smooth endoplasmic reticula, Golgi apparatus, mitochondria, ribosomes, lysosomes, chloroplasts, plasma/cell surface membrane, nuclear envelope, centrioles, nucleus and nucleolus; • outline the functions of the membrane systems and organelles listed above; • *compare and contrast the structure of typical animal and plant cells; • *draw plan diagrams of tissues (including a transverse section of a dicotyledonous leaf) and calculate the linear magnification of drawings; • describe the structure of a prokaryotic cell and compare and contrast the structure of prokaryotic cells with eukaryotic cells.		

Theme	Topic	You should be able to:	Checklist	Comments
B. Biological molecules	The structure of carbohydrates, lipids and proteins and their roles in living organisms	• *carry out tests for reducing and non-reducing sugars (including semi-quantitative use of the Benedict's test), the iodine in potassium iodide solution test for starch, the emulsion test for lipids and the biuret test for proteins; • describe the ring forms of alpha and beta glucose; • describe the formation and breakage of a glycosidic bond; • describe the molecular structure of starch (amylose and amylopectin), glycogen and cellulose and relate these structures to their functions in living organisms; • describe the molecular structure of a triglyceride and a phospholipid and relate these structures to their functions in living organisms; • describe the structure of an amino acid and the formation and breakage of a peptide bond; • explain the meaning of the terms *primary structure*, *secondary structure*, *tertiary structure* and *quaternary structure* of proteins and describe the types of bonding (hydrogen, ionic, disulphide and hydrophobic interactions) that hold the molecule in shape; • describe the molecular structure of haemoglobin as an example of a globular protein, and of collagen as an example of a fibrous protein and relate these structures to their functions (the importance of iron in the haemoglobin molecule should be emphasised);		
	Water and living organisms	• describe and explain the roles of water in living organisms and as an environment for organisms; • state one role of each of the following inorganic ions in living organisms: calcium, sodium, potassium, magnesium, chloride, nitrate, phosphate.		

Theme	Topic	You should be able to:	Checklist	Comments
C. Enzymes	The mode of	• explain that enzymes are globular proteins that catalyse		

	actions of enzymes	metabolic reactions; • explain the mode of action of enzymes in terms of an active site, enzyme/substrate complex, lowering of activation energy and enzyme specificity; • *follow the time course of an enzyme-catalysed reaction by measuring rates of formation of products (for example, using catalase) or rates of disappearance of substrate (for example, using amylase); • *investigate and explain the effects of temperature, pH, enzyme concentration and substrate concentration on the rate of enzyme-catalysed reactions, and explain these effects; • explain the effects of competitive and non-competitive inhibitors on the rate of enzyme activity.		
D. Cell membranes and transport	The fluid mosaic model of membrane structure Movement of substances into and out of cells	• describe and explain the fluid mosaic model of membrane structure, including an outline of the roles of phospholipids, cholesterol, glycolipids, proteins and glycoproteins; • outline the roles of membranes within cells and at the surface of cells; • describe and explain the processes of *diffusion*, *osmosis*, *active transport*, *facilitated diffusion*, *endocytosis* and *exocytosis* (terminology described in the IOB's publication *Biological Nomenclature* should be used; **no** calculations involving water potential will be set); • *investigate the effects on plant cells of immersion in solutions of different water potential.		

Theme	Topic	You should be able to:	Checklist	Comments
E. Cell and nuclear division	Replication and division of nuclei and cells Understanding of chromosome behaviour in mitosis	• explain the importance of mitosis in growth, repair and asexual reproduction; • explain the need for the production of genetically identical cells and fine control of replication; • explain how uncontrolled cell division can result in cancer and identify factors that can increase the chances of cancerous growth; • *describe, with the aid of diagrams, the behaviour of chromosomes during the mitotic cell cycle and the associated behaviour of the nuclear envelope, cell membrane, centrioles and spindle (names of the main stages are expected); • explain the meanings of the terms *haploid* and *diploid* and the need for a reduction division prior to fertilisation in sexual reproduction.		

F. Genetic control	The structure and replication of DNA The role of DNA in protein synthesis	• describe the structure of RNA and DNA and explain the importance of base pairing and hydrogen bonding; • explain how DNA replicates semi-conservatively during interphase; • state that a gene is a sequence of nucleotides as part of a DNA molecule, which codes for a polypeptide; • describe the way in which the nucleotide sequence codes for the amino acid sequence in a polypeptide; • describe how the information on DNA is used to construct polypeptides, including the role of messenger RNA, transfer RNA and the ribosomes; • explain that, as enzymes are proteins, their synthesis is controlled by DNA.		

Theme	Topic	You should be able to:	Checklist	Comments
G. Transport	The need for, and functioning of, a transport system in multicellular plants	• explain the need for transport systems in multicellular plants and animals in terms of size and surface area to volume ratios; • define the term *transpiration* and explain that it is an inevitable consequence of gas exchange in plants; • *describe how to investigate experimentally the factors that affect transpiration rate; • *describe the distribution of xylem and phloem tissue in roots, stems and leaves of dicotyledonous plants; • *describe the structure of xylem vessel elements, sieve tube elements and companion cells and be able to recognise these using the light microscope; • relate the structure of xylem vessel elements, sieve tube elements and companion cells to their functions; • explain the movement of water between plant cells and between them and their environment, in terms of water potential (**no** calculations involving water potential will be set); • describe the pathways and explain the mechanisms by which water is transported from soil to xylem and from roots to leaves; • *describe how the leaves of xerophytic plants are adapted to reduce water loss by transpiration; • explain translocation as an energy-requiring process transporting assimilates, especially sucrose, between the leaves (sources) and other parts of the plant (sinks); • explain the translocation of sucrose using the mass flow hypothesis; • *describe the structures of arteries, veins and capillaries and be able to recognise these vessels using the light microscope; • explain the relationship between the structure and function of arteries, veins and capillaries;		

	The need for, and functioning of, a transport system in mammals The structure and functioning of the mammalian heart	• *describe the structure of red blood cells, phagocytes and lymphocytes and explain the differences between blood, tissue fluid and lymph; • describe the role of haemoglobin in carrying oxygen and carbon dioxide; • describe and explain the significance of the dissociation curves of adult oxyhaemoglobin at different carbon dioxide levels (the Bohr effect); • describe and explain the significance of the increase in the red blood cell count of humans at high altitude; • describe the external and internal structure of the mammalian heart; • explain the differences in the thickness of the walls of the different chambers in terms of their functions; • describe the mammalian circulatory system as a closed double circulation; • describe the cardiac cycle; • explain how heart action is initiated and controlled (reference should be made to the sinoatrial node, the atrioventricular node and the Purkyne tissue).		

Theme	Topic	You should be able to:	Checklist	Comments
H. Gas exchange	The respiratory system Smoking and smoking-related diseases	• *describe the structure of the human gas exchange system, including the microscopic structure of the walls of the trachea, bronchioles and alveoli with their associated blood vessels. • *describe the distribution of cartilage, ciliated epithelium, goblet cells and smooth muscle in the trachea, bronchi and bronchioles; • describe the functions of cartilage, cilia, goblet cells, smooth muscle and elastic fibres in the gas exchange system; • describe the process of gas exchange between air in the alveoli and the blood • explain the terms *tidal volume* and *vital capacity;* • describe the effects of tar and carcinogens in tobacco smoke on the gas exchange system; • describe the signs and symptoms of emphysema, chronic bronchitis and lung cancer; • describe the effects of nicotine and carbon monoxide on the cardiovascular system with reference to atherosclerosis, coronary heart disease and strokes; • evaluate the epidemiological and experimental evidence linking cigarette smoking to disease and early death; • discuss the problems of cardiovascular disease and the ways in which smoking may affect the risk of developing cardiovascular disease.		

Theme	Topic	You should be able to:	Checklist	Comments
I. Infectious disease	Cholera, malaria, tuberculosis and AIDS	• explain what is meant by an *infectious disease*; • describe the causes of cholera, malaria, TB and HIV/AIDS; • explain how cholera, malaria, TB and HIV/AIDS are transmitted and assess the importance of these diseases worldwide; • discuss the roles of social, economic and biological factors in the prevention and control of cholera, malaria, TB and HIV/AIDS (a detailed study of the life cycle of the malarial parasite is **not** required); • discuss the global patterns of distribution of malaria and tuberculosis;		
	Antibiotics	• outline the role of antibiotics in the treatment of infectious diseases.		

Theme	Topic	You should be able to:	Checklist	Comments
J. Immunity	The immune system Vaccination	• recognise phagocytes and lymphocytes under the light microscope • describe the origin, maturation and mode of action of phagocytes • explain the meaning of the term *immune response* • distinguish between B – and T- lymphocytes in their mode of action in fighting infection and describe their origin and functions • explain the role of memory cells in long term immunity • relate the molecular structure of antibodies to their functions • distinguish between *active* and *passive, natural* and *artificial immunity* and explain how vaccination can control disease • discuss the reasons why vaccination has eradicated smallpox but not measles, TB, malaria or cholera • use the knowledge gained in this section in new situations or to solve related problems.		
K. Ecology	Levels of ecological organisation Energy flow through ecosystems Recycling of nitrogen	• define the terms *habitat*, *niche*, *population*, *community* and *ecosystem* and state examples of each; • explain the terms *producer*, *consumer* and *trophic level* in the context of food chains and food webs; • explain how energy losses occur along food chains and discuss the efficiency of energy transfer between trophic levels; • describe how nitrogen is cycled within an ecosystem, including the roles of microorganisms.		

A2 Core Material				
Theme	**Topic**	**You should be able to:**	**Checklist**	**Comments**
L. Energy and respiration	The need for energy in living organisms	• outline the need for energy in living organisms, as illustrated by anabolic reactions, active transport, movement and the maintenance of body temperature; • describe the structure of ATP as a phosphorylated nucleotide; • describe the universal role of ATP as the energy currency in all living organisms;		
	Respiration as an energy transfer process	• explain that the synthesis of ATP is associated with the electron transport chain on the membranes of the mitochondrion; • outline glycolysis as phosphorylation of glucose and the subsequent splitting of hexose phosphate (6C) into two triose phosphate molecules, which are then further oxidised with a small yield of ATP and reduced NAD;		
	Aerobic respiration	• explain that, when oxygen is available, pyruvate is converted into acetyl (2C) coenzyme A, which then combines with oxaloacetate (4C) to form citrate (6C); • outline the Krebs cycle, explaining that citrate is reconverted to oxaloacetate in a series of small steps in the matrix of the mitochondrion (no further details are required); • explain that these processes involve decarboxylation and dehydrogenation and describe the role of NAD; • outline the process of oxidative phosphorylation, including the role of oxygen (no details of the carriers are required);		
	Anaerobic respiration	• explain the production of a small yield of ATP from anaerobic respiration and the formation of ethanol in yeast and lactate in mammals, including the concept of oxygen debt;		

	The use of respirometers	• explain the relative energy values of carbohydrate, lipid and protein as respiratory substrates; • define the term *respiratory quotient* (RQ); • *carry out investigations, using simple respirometers, to measure RQ and the effect of temperature on respiration rate.		

Theme	Topic	You should be able to:	Checklist	Comments
M. Photo-synthesis	Photosynthesis as an energy transfer process	• explain that energy transferred as light is used during photosynthesis to produce complex organic molecules and that the process of respiration allows this energy to be transferred through chemical reactions so that it can be used by living organisms; • describe the photoactivation of chlorophyll resulting in the photolysis of water and in the transfer of energy to ATP and reduced NADP (cyclic and non-cyclic photophosphorylation should be described in outline only); • describe the uses of ATP and reduced NADP in the light-independent stage of photosynthesis; • describe in outline the Calvin cycle involving the light-independent fixation of carbon dioxide by combination with a 5C compound (RuBP) to yield two molecules of a 3C compound GP (PGA), and the conversion of GP into carbohydrates, lipids and amino acids (the regeneration of RuBP should be understood in outline only, and a knowledge of C4 and CAM plants is not required); • *describe the structure of a dicotyledonous leaf, a palisade cell and a chloroplast and relate their structures to their roles in photosynthesis;		
	The investigation of Limiting Factors	• *discuss limiting factors in photosynthesis and carry out investigations on the effects of light, carbon dioxide and temperature on the rate of photosynthesis;		

Theme	Topic	You should be able to:	Checklist	
N. Regulation and control	The importance of homeostasis Excretion Control of water and metabolic wastes Nervous and hormonal communication	• discuss the importance of homeostasis in mammals and explain the principles of homeostasis in terms of receptors, effectors and negative feedback; • define the term *excretion* and explain the importance of removing nitrogenous waste products and carbon dioxide from the body; • *describe the gross structure of the kidney and the detailed structure of the nephron with the associated blood vessels (candidates are expected to be able to interpret the histology of the kidney, as seen in sections using the light microscope); • explain the functioning of the kidney in the control of water and metabolic wastes, using water potential terminology; • outline the need for communication systems within mammals to respond to changes in the internal and external environment; • outline the role of sensory receptors in mammals in converting different forms of energy into nerve impulses; • describe structure of a sensory neurone and a motor neurone and outline their functions in a reflex arc; • describe and explain the transmission of an action potential in a myelinated neurone (the importance of sodium and potassium ions in the impulse transmission should be emphasised);		

	Communication and control in flowering plants Plant growth regulators	• explain the importance of the myelin sheath (saltatory conduction) and the refractory period in determining the speed of nerve impulse transmission; • describe the structure of a cholinergic synapse and explain how it functions (reference should be made to the role of calcium ions); • outline the roles of synapses in the nervous system in determining the direction of nerve impulse transmission and in allowing the interconnection of nerve pathways; • explain what is meant by the term *endocrine gland*; • describe the cellular structure of an islet of Langerhans from the pancreas and outline the role of the pancreas as an endocrine gland; • explain how the blood glucose concentration is regulated by negative feedback control mechanisms, with reference to insulin and glucagon; • outline the need for, and the nature of, communication systems within flowering plants to respond to changes in the internal and external environment; • describe the role of auxins in apical dominance; • describe the roles of gibberellins in stem elongation and in the germination of wheat or barley; • describe the role of abscissic acid in the closure of stomata.		

Theme	Topic	You should be able to:	Checklist	Comments
O. Inherited change and gene technology	The passage of information from parent to offspring The nature of genes and alleles and their role in determining phenotype + monohybrid and dihybrid crosses Recombinant DNA technology	• *****describe, with the aid of diagrams, the behaviour of chromosomes during meiosis, and the associated behaviour of the nuclear envelope, cell membrane and centrioles (names of the main stages are expected, but not the sub-divisions of prophase); • explain how meiosis and fertilisation can lead to variation; • explain the terms *locus*, *allele*, *dominant*, *recessive*, *codominant*, *homozygous*, *heterozygous*, *phenotype* and *genotype*; • use genetic diagrams to solve problems involving monohybrid and dihybrid crosses, including those involving sex linkage, codominance and multiple alleles (but not involving autosomal linkage or epistasis); • use genetic diagrams to solve problems involving test crosses; • use the chi-squared test to test the significance of differences between observed and expected results (the formula for the chi-squared test will be provided); • explain, with examples, how mutation may affect the phenotype; • explain, with examples, how the environment may affect the phenotype; • explain how a change in the nucleotide sequence in DNA may affect the amino acid sequence in a protein and hence the phenotype of the organism; • outline the use of restriction enzymes for removing sections of DNA; • describe the formation of recombinant DNA;		
		• outline the use of recombinant DNA technology in biotechnology, with reference to the synthesis of human		

		• insulin by bacteria and production of Factor VIII; • explain the advantages of treating diabetics with human insulin produced by genetic engineering; • describe the benefits and hazards of genetic engineering, with reference to specific examples; • discuss the social and ethical implications of genetic engineering;		

Theme	Topic	You should be able to:	Checklist	Comments
P. Selection and evolution	Natural and artificial selection	• explain how natural selection may bring about evolution; • explain why variation is important in selection; • explain how all organisms can potentially overproduce; • explain, with examples, how environmental factors can act as stabilising or evolutionary forces of natural selection; • describe the processes that affect allele frequencies in populations with reference to the global distribution of malaria and sickle cell anaemia; • explain the role of isolating mechanisms in the evolution of new species; • describe one example of artificial selection;		

A2 Option 1 – MAMMALIAN PHYSIOLOGY				
Theme	**Topic**	**You should be able to :**	**Checklist**	**Comments**
1. Mammalian nutrition	Principles of heterotrophic nutrition Structure of human gut and associated organs + digestion and absorption Nervous and hormonal control of digestion	• explain what is meant by and outline the basic principles of *heterotrophic nutrition*; • explain what is meant by the terms *ingestion, digestion, absorption* and *egestion*; • distinguish between mechanical and chemical digestion; • *recognise on photographs and diagrams and by using the light microscope, the following main regions of the gut: stomach, ileum and colon; • describe the structure of the stomach and its functions in digestion and absorption; • describe the structure of the ileum and its functions in digestion and absorption; • describe the functions of the colon in absorption; • *describe the gross structure and histology of the pancreas and explain its functions as an exocrine gland; • state the site of production and action, and explain the functions of pepsin, trypsin, chymotrypsin, exopeptidases, amylases, maltase, lipase and bile salts; • describe the specialisation of teeth and digestive systems in a **named** ruminant and a **named** carnivore; • outline the role of the nervous system and hormones in the control of digestion.		

Theme	Topic	You should be able to:	Checklist	Comments
2. The liver	Gross structure and histology Roles in metabolism Metabolism of alcohol	• describe the gross structure of the liver, including its associated blood vessels; • *describe the histology of the liver and recognise this using the light microscope; • explain the roles of the liver in carbohydrate metabolism and the production of glucose from amino acids; • explain the roles of the liver in fat metabolism, including the use of fats in respiration, the synthesis of triglycerides from excess carbohydrate and protein, the synthesis and regulation of cholesterol, and the transport of lipids to and from the liver as lipoproteins (**no** biochemical details are required); • explain the roles of the liver in deamination, transamination and urea formation (an outline of the ornithine cycle is all that is expected); • describe the production and use of bile; • describe the production, and explain the roles, of the plasma proteins fibrinogen, globulins and albumin; • outline the roles of the liver in detoxification; • describe the metabolism of alcohol in the liver and the long-term consequences of excessive alcohol consumption.		

Theme	Topic	You should be able to:	Checklist	Comments
3. Support and locomotion	The skeletal system and movement Histology of bone, cartilage and striated muscle Effects of ageing	• *identify the major limb bones of a mammal (reference should be made to the structure of the pentadactyl limb); • *relate the structure of a thoracic and a lumbar vertebra to their functions; • describe the lever action of the human arm (the importance of antagonistic muscles in movement should be appreciated); • *use the light microscope to interpret the structure of compact bone and hyaline cartilage; • describe the structure of a synovial joint and identify the different types of joint; • *describe the histology and ultrastructure of striated muscle; • describe the structure of a neuromuscular junction and explain how a nerve impulse causes muscle to contract; • describe the sliding filament theory of muscle contraction (the roles of the control proteins troponin and tropomyosin should be considered); • outline the effects of ageing on the locomotory system with reference to osteoarthritis and osteoporosis.		

Theme	Topic	You should be able to:	Checklist	Comments
4. The nervous system	Organisation of the mammalian nervous system Roles of the autonomic nervous system Brain structure and function Alzheimer's disease	• describe the organisation of the nervous system with reference to the central and the peripheral systems; • outline the organisation of the autonomic nervous system into a sympathetic and a parasympathetic system; • outline the roles of the autonomic nervous system in controlling the digestive system, heart action and the size of the pupil in the eye; • describe the gross structure of the mammalian brain; • outline the functions of the cerebrum, hypothalamus, cerebellum and medulla oblongata; • describe the symptoms and possible causes of Alzheimer's disease as an example of brain malfunction;		
5. Sense organs and the reception of stimuli	Structure and functions of the eye Effects of ageing on the eye Structure and functions of the ear	• describe the gross structure of the eye and outline the functions of its parts, including accommodation; • *describe the structure of the retina, with reference to the arrangement of rods, cones, bipolar cells and ganglion cells; • relate the structure of the eye to visual acuity, colour vision and sensitivity to different light intensities; • outline the general principles involved in the reception and recognition of visual stimuli by the brain; • discuss the effects of ageing on the eye, with reference to cataracts and their treatment; • describe the gross structure of the ear and outline the functions of its parts in hearing and balance;		

A2 Option 2 – MICROBIOLOGY and BIOTECHNOLOGY				
Theme	**Topic**	**You should be able to :**	**Checklist**	**Comments**
1. Micro-biology	Viruses, Prokaryotae and fungi Bacteriophage and retrovirus E coli Gram staining Penicillium	• describe the distinguishing features of Viruses, Prokaryotae and Fungi; • describe the general structure of viruses; • describe the life cycles of the lysogenic bacteriophage, λ, and the Human Immunodeficiency Virus (HIV); • describe the organisation of the genetic material inside bacterial cells and viruses; • describe the structure and asexual reproduction of *Escherichia coli*; • *use the Gram staining technique to identify Gram positive and Gram negative bacteria; • describe the differences in bacterial cell wall structure that are the basis of the Gram staining technique; • describe the structure and asexual reproduction of penicillium and explain its mode of nutrition.		

Theme	Topic	You should be able to:	Checklist	Comments
2. Techniques used in micro-biology, cell culture and gene banking	Scientific and economic reasons for culturing microorganisms and plant cells In vitro growth requirements Techniques used for the preparation and growth of microorganisms and plant cells Specialist laboratory requirements	• outline the techniques of plant tissue culture (e.g. protoplast, explant and pollen culture) and explain its importance (reference should be made to cloning, conservation of endangered species, raising disease-free plants, genetic modification and production of secondary plant products); • describe the *in vitro* growth requirements of bacteria, fungi and plant cells with reference to carbon and nitrogen sources, mineral nutrients, temperature, pH and aeration; • *prepare a nutrient broth and pour nutrient agar plates; • explain the reasons for safe working practices and the need for risk assessments to be made when using microorganisms; • *use aseptic (sterile) techniques to inoculate solid and liquid media (reference should be made to the use of inoculating loops, spreaders and to the stab technique); • *measure bacterial population growth by means of dilution plating and turbidimetry, and use a haemocytometer (a comparison of the techniques and the distinction between viable and total cell counts is expected); • describe the specialist structural features and safety equipment of laboratories working with microorganisms, which are designed to prevent contamination of workers and the environment (reference should be made to the use of negative pressure and air flow hoods); • explain the need to maintain a gene bank for possible future use, including conserving wild types and rare breeds as genetic resources; • describe the maintenance and use of seed banks and of sperm banks.		

Theme	Topic	You should be able to:	Checklist	Comments
3. Large-scale production	Batch and continuous culture Large-scale production methods and associated problems Fermentation conditions	• explain what is meant by the terms *batch culture* and *continuous culture* and compare their advantages and disadvantages with reference to the production of penicillin as a secondary metabolite, ethanol, protease enzymes and mycoprotein; • describe the general structural features of a fermenter used for large-scale production; • explain the stages involved and the major problems associated with scaling up laboratory processes to large-scale fermentation processes (reference should be made to the production of penicillin); • *carry out experiments to show the effects of varying conditions on microorganisms (this can be carried out by fermenting glucose or milk in small plastic fizzy drink bottles, or simulation software may be used if fermentation equipment is not available).		

Theme	Topic	You should be able to:	Checklist	Comments
4. Biotechnology in food production	Use of microorganisms and enzymes in food production Production of novel genomes by genetic modification	• describe and explain the role of biotechnology in the production of cheese, beer, yoghurt and tenderised meat; • describe the use of microorganisms as a food source, with reference to the production of mycoprotein and yeast extract; • describe the production of novel genomes by the isolation of a desired gene from one species of organism, followed by its insertion usually into a different species of host organism (reference should be made to the genetic modification of crop plants); • appreciate the potential social, economic, ethical and environmental implications of biotechnology and genetic modification.		

Theme	Topic	You should be able to:	Checklist	Comments
5. Biotechnology and medicine	Use of biosensors Monoclonal antibodies Proteins of medical importance Benefits and hazards of genetic engineering	• explain what is meant by the term *biosensor*; • describe the components of a biosensor and its use with reference to the monitoring of blood glucose; • outline the hybridoma method for the production of a monoclonal antibody; • describe the use of monoclonal antibodies in diagnosis and treatment and in pregnancy testing; • describe the detailed sequence of steps that can be used to produce a protein of medical importance, such as human growth hormone; • explain the reasons for using microorganisms in processes designed for the large-scale production of insulin and human growth hormone; • discuss the benefits and hazards of genetic modification with reference to suitable examples; • Describe, for penicillin, as an example of an antibiotic, the mode of action on bacteria, use as a chemotherapeutic agent in bacterial but not viral infections and causes and effects of antibiotic resistance;		

Theme	Topic	You should be able to:	Checklist	Comments
6. Biotechnology in industry and public health	Immobilised enzymes and their use in industry Biogas and gasohol Waste treatment Extraction of heavy metals	• explain the ways in which enzymes can be immobilised. • explain the advantages of using immobilised enzymes in manufacturing industries; • *carry out an experiment to demonstrate the use of immobilised enzymes, such as amylase immobilised in alginate; • describe the use of **named** microorganisms and substrates in the production of biogas and gasohol; • describe the use of microorganisms for the treatment of domestic sewage and industrial wastes; • describe the use of microorganisms in the extraction of heavy metals from low grade ores.		

A2 Option 3 – GROWTH, DEVELOPMENT and REPRODUCTION

Theme	Topic	You should be able to :	Checklist	Comments
1. Growth and development	Growth is an irreversible increase in mass Development results in an increasing complexity of organisms	• explain how cell division and enlargement lead to growth; • describe the techniques for the measurement of the growth of microorganisms, plants and animals and discuss the problems of measurement; • *measure the growth of a chosen organism, including dry mass assessment; • distinguish between *absolute* and *relative growth rates*; • recognise different types of growth curve and explain patterns of growth; • explain development as a progressive series of changes, including the specialisation of cells.		

Theme	Topic	You should be able to:	Checklist	Comments
2. Asexual reproduction	Natural and artificial means of asexual reproduction leading to genetic uniformity	• describe the range of asexual reproduction in organisms using **one** example from each of the five kingdoms: Prokaryotae, Protoctista, Fungi, Plantae, Animalia; • discuss the natural advantages and disadvantages of asexual reproduction and explain its evolutionary consequences; • describe how knowledge of growth and development has been used commercially to develop methods of artificial propagation; • describe the cloning of plants from tissue culture; • discuss the advantages and disadvantages of cloning (reference to the cloning of food plants is expected but **no** practical details of tissue culture are required);		
3. Sexual reproduction in flowering plants	Sexual reproduction requires specialist structures for pollination Fertilisation produces new genetic combinations Changes after fertilisation, leading to development of the seed and fruit	• *recognise and name main parts of typical, simple flower; • *describe and explain the structural features of a **named**, insect-pollinated and a **named**, wind-pollinated plant; • describe the mechanisms and compare the outcomes of self-pollination and cross-pollination; • *describe anther structure and pollen formation; • *describe ovule development; • describe, and explain the significance of, double fertilisation in the embryo sac; • describe the structural changes that occur after fertilisation leading to the development of the embryo within the seed and the ovary into the fruit; • *investigate embryo development experimentally by using ovules at different stages of development, e.g. shepherd's purse; • *describe seed structure and germination in a **named**, dicotyledonous plant;		

Theme	Topic	You should be able to:	Checklist	Comments
4. Sexual reproduction in humans	Sexual reproduction in humans requires specialised cells	• identify and name the parts of the male and female urinogenital systems; • *recognise and describe the microscopic structure of the ovary and testis (prepared slides from a small mammal may be used); • describe and explain *gametogenesis*; • describe the structures of egg and sperm; • explain how gametogenesis is controlled by hormones; • describe and explain the *menstrual cycle*;		
	Fusion of gametes produces a zygote	• describe the passage of sperm from the testes to the oviduct during sexual intercourse; • state how and where fertilisation occurs; • discuss contraception, *in vitro* fertilisation and abortion from biological and ethical viewpoints;		
	Early development depends on maternal resources	• describe the structure of the placenta; • describe and explain the roles of the placenta and the transport mechanisms involved in placental transfer; • describe the functions of the amnion; • discuss the effect of the actions of the mother on fetal development.		

Theme	Topic	You should be able to:	Checklist	Comments
5. Control of growth and reproduction	Growth and development depend on genetic and environmental factors Plant growth regulators in flowering plants and hormones in mammals form the basis of control mechanisms	• explain the factors that control flowering in short-day and long-day plants; • describe the use of plant growth regulators in fruit maturation; • *design and carry out an investigation to identify the major factors affecting germination; • describe the reasons for, and the advantages of, seed dormancy; • explain the interactions of plant growth regulators in the control of seed dormancy; • describe the roles of hormones in the menstrual cycle, pregnancy, birth and lactation; • outline the roles of hormones in pre-menstrual tension, hormone replacement therapy and the menopause; • outline the roles of the hypothalamus and the pituitary gland in human growth and development; • describe the role of thyrotrophin releasing hormone (TRH) from the hypothalamus and thyroid stimulating hormone (TSH) from the pituitary gland in the control of thyroxine secretion; • describe the role of the thyroid gland and the functions of thyroxine.		

A2 Option 4 – APPLICATIONS OF GENETICS				
Theme	**Topic**	**You should be able to :**	**Checklist**	**Comments**
1. Variation	Mutations	• explain, with examples, what is meant by the terms *gene mutation* and *chromosome mutation*; • describe the difference between *continuous* and *discontinuous variation*; • explain the genetic basis of continuous and discontinuous variation by reference to the number of genes that control the characteristic;		
	Effect of genotype and environment on phenotype	• recognise that both genotype and environment contribute to phenotypic variance • ($V_P = V_G + V_E$) (**no** calculations of heritability will be expected); • describe **two** examples of the effect of the environment on the phenotype;		
	Interaction between loci	• describe interaction at **one** locus (dominance and codominance); • describe gene interaction between loci (epistasis); • predict phenotypic ratios in problems involving epistasis;		
	Linkage and crossing-over	• explain the meaning of the terms *linkage* and *crossing-over ;* • explain the effect of linkage and crossing-over on the phenotypic ratios from dihybrid crosses; • use the chi-squared test to test the significance of differences between observed and expected results (the formula for the chi-squared test will be provided); •		

Theme	Topic	You should be able to :	Checklist	Comments
2. Selective breeding	The selection of desirable characteristics of organisms by selective breeding	• outline the principle of selective breeding and explain why selective breeding is carried out; • explain, with practical details, how the process of selective breeding may be carried out in **one named** plant example and **one named** animal example; • compare selective breeding with the evolutionary process;		
	Progeny testing	• explain the use of progeny testing;		
	Artificial insemination	• discuss the advantages, disadvantages and use of artificial insemination (AI);		
	Embryo transplantation	• describe the use of, and the techniques used in, embryo transplantation;		
	Social and ethical implications of these techniques	• discuss the ethical implications of the use of AI, *in vitro* fertilisation and embryo transplantation in animals and their social and ethical implications in humans.		

Theme	Topic	You should be able to :	Checklist	Comments
3. Genetic diversity	Problems of inbreeding Need to maintain genetic resourses Development of resistance	• describe the harmful effects of inbreeding; • explain the need to maintain a gene bank for possible future use, including conserving wild types and rare breeds as genetic resources; • describe the maintenance and use of seed banks and sperm banks; • describe the process of cloning plants from tissue culture; • describe the genetic basis of resistance in prokaryotes and in eukaryotes; • explain, with specific examples, how selective breeding is used to produce disease-resistant varieties in plants and animals; • describe the evolution of antibiotic resistance in bacteria and pesticide resistance in insects, and discuss the implications of the evolution of such resistance.		

Theme	Topic	You should be able to :	Checklist	Comments
4. Human genetics	Genetic disorders in humans	• describe cystic fibrosis, Huntington's disease (chorea) and Down's syndrome in humans, and explain how they are inherited (issues related to these genetic conditions may need to be handled with sensitivity);		
	Genetic screening and counselling	• describe how genetic screening is carried out; • discuss the advantages and disadvantages of genetic screening and the need for genetic counselling;		
	Gene therapy	• explain the theoretical basis of gene therapy and discuss its possible benefits and hazards;		
	Genetic fingerprinting	• explain the theoretical basis of genetic fingerprinting and outline how it is carried out;		
	Significance of genetic constitution for tissue compatibility in transplant surgery	• explain the significance of genetic compatibility in transplant surgery, with reference to ABO blood groups and the major histocompatibility (HLA) system.		

Section 4 - Appendices

4.1 The mathematical skills you need

This is a checklist of the mathematical skills you need for your Biology examination. You should tick each box in the checklist when you know that you have learned the skill.
Ask your teacher to explain any skill you are unsure about. The 'Comments' column is for extra notes and examples.

You can use a calculator for all the examination Papers. If your calculator is one that can be programmed, you should make sure that any information in it is removed before the examination.

You should be able:	***Checklist***	***Comments***
• add, subtract, multiply and divide		
Use: • averages • decimals • fractions • percentages • ratios • reciprocals		
• recognise standard notation (notation is putting symbols for numbers e.g. x = 2, y = 5, atomic mass, Z = 12) • use standard notation		
• use direct proportion (stepwise increases) • use inverse proportion (inverse means turned up side down)		the inverse of 4 is ¼ (= 0.25)
• use numbers to the 'power of 10' e.g. $1x10^2 = 100$		Your calculator will often show number to the power of 10 when you do calculations. Do not worry too much though – your calculator does the work for you.
• draw charts • graphs with line of best fit		You will be given the data

interpret: • bar graphs • pie charts • line graphs		

• select suitable scales and axes for graphs		
• make approximations		
use the formulas: • area = length x width • volume = length x width x height • use and convert metric units into one another		e.g. 100cm = 1 m 1000g = 1 kg
• use mathematical an measuring instruments e.g. ruler, compasses, protractor		
understand the meaning of : • radius • diameter • square • rectangle		

You should know how to apply a t-test and a chi-squared test. t-tests are of value in much of Biology, while the chi-squared test allows the evaluation of the results of breeding experiments and ecological sampling. Each of these tests is dealt with fully in many books on statistics for Biology.

You will **not** be expected to remember the following equations **nor** to remember what the symbols stand for. You are expected to be able to use the equations to calculate standard deviations, to test for significant differences between the means of two small, unpaired samples and to perform a chi-squared test on suitable data from genetics or ecology. You will be given access to the equations, the meaning of the symbols, a t-table and a chi-squared table.

You are **not** expected to be familiar with the term standard error, **nor** to appreciate the difference between s_n (σ_n) and s_{n-1} (σ_{n-1}). You should have a brief understanding of what is meant by the term 'normal distribution' and appreciate levels of significance. (Tables will be provided by CIE.)

Questions involving the use of a t-test or a chi-squared test may be set on Paper 6. Questions involving an **understanding** of the use of the tests may be set on Paper 5, but detailed computation will **not** be required.

4.2 Other important information you need for your Biology Examination

The terms used in Biology examination Papers are given in the sections that follow. It is very important that you know and understand all of them before you take your examination. You should ask your teacher to explain anything that you are unsure about.

4.2.1. Numbers

The decimal point will be placed on the line, e.g. 52.35.

Numbers from 1000 to 9999 will be printed without commas or spaces.

Numbers greater than or equal to 10 000 will be printed without commas. A space will be left between each group of three whole numbers, e.g. 4 256 789.

4.2.2 Units

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

(a) **SI units commonly used in Biology are listed below.**

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

Quantity	*Name of unit*	*Symbol for unit*
length	kilometre	km
	metre	m
	centimetre	cm
	millimetre	mm
	micrometer	µm
mass	tonne (1000 kg)	(no symbol)
	kilogram	kg
	gram	g
	milligram	mg
	microgram	µg
time	year	y
	day	d
	hour	h
	minute	min
	second	s
amount of substance	mole	mol

(b) **Derived SI units are listed below.**

energy	kilojoule	kJ
	joule	J
	(calorie is obsolete)	

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

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

(d) **Use of Solidus**

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

4.2.3. Presentation of data

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

(a) **Tables**

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

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

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

(b) **Graphs**

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

(ii) Each axis will be labelled with the physical quantity and the appropriate unit, e.g. time / s.

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

(iv) Curves and lines joining points on the graph should be referred to as 'curves'.

(v) Points on the curve should be clearly marked as crosses (x) or encircled dot○( ). If a further curve is included, vertical crosses (+) may be used to mark the points.

(c) **Pie Charts**

These should be drawn with the sectors in rank order, largest first, beginning at 'noon' and proceeding clockwise. Pie Charts should preferably contain no more than six sectors.

(d) **Bar Charts**

These are drawn when one of the variables is not numerical, e.g. percentage of vitamin C in different fruits. They should be made up of narrow blocks of equal width that do **not** touch.

(e) **Column Graphs**

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

(f) **Histograms**

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

4.2.4 Taxonomy

Taxonomy is the study of the principles of the organisation of taxa into hierarchies. There are seven levels of taxon - kingdom, phylum, class, order, family, genus and species. These may be used when teaching the concept and use of a classificatory system, the variety of organisms, and the binomial system. The following should apply:

(a) Five Kingdoms are now recognised as

prokaryotes	(Prokaryotae), including bacteria and blue-green bacteria
protoctists	(Protoctista), including green, red and brown algae and protozoans
fungi	(Fungi)
plants	(Plantae)
animals	(Animalia)

The viruses cannot be fitted into this classificatory system.

(b) The binomial system of naming gives each organism a two-word name. The first word is the generic name and the second word is the trivial name, e.g. *Homo sapiens*. The trivial name should never be used by itself.

(c) Generic and trivial names are distinguished from the rest of the text either by underlining (when written or typed) or by being set in italics (in print).

(d) The generic name always takes an initial capital letter. It can be accepted as a shorthand for the species name where the intent is obvious, e.g. *Plasmodium,* and in these circumstances can stand alone.

(e) The common name should not normally be written with an initial capital letter, e.g. cat and dog. The exception is Man, where it is the common name for a species where the two sexes are distinguished by the terms man and woman.

(f) A species is not easy to define but an acceptable general definition is as follows.

'A group of organisms capable of interbreeding and producing fertile offspring.'

4.2.5. Genetics

(a) The terms *gene* and *allele* are not synonymous.

A gene is a specific length of DNA occupying a position called a locus. A specific function can be assigned to each gene. An allele is one of two or more different forms of a gene.

(b) A standard form of presenting genetic crosses should be adopted. The following symbols should be used as shown.

P designates the cross of pure-breeding (homozygous) individuals.
F_1 designates the offspring of homozygous parents.
F_2 designates the offspring produced by crossing F_1 parents.

(c) The format for the course of a genetic cross should be labelled as shown.

parental phenotypes
parental genotypes
gametes
offspring genotypes
offspring phenotypes
etc.

(d) The gene should be designated by a letter or letters so that upper and lower case versions are easily distinguishable, e.g. B and b. The upper case letter indicates the dominant allele and the lower case letter indicates the recessive allele.

(e) The symbols for gametes should be circled to indicate the discrete nature of each gamete.

(f) Some form of checkerboard should be used to demonstrate genotypes that can result from random fusion of gametes. Students should understand that genotypes are only possible combinations and that only a very large number of offspring can result in all combinations being achieved.

(g) The term *incomplete dominance* should be discontinued and in the particular case where alleles are equally dominant it should be called *codominance.* Thus codominance should be used where the influence of both alleles is shown in the phenotype, e.g. the AB blood group in humans.

4.2.6 Additional Information

Modern Biological Sciences draw extensively on concepts from the physical sciences. It is desirable, therefore, that by the end of the course, you should have a knowledge of the following topics, sufficient to aid understanding of biological systems, but **no** questions will be set directly on them.

- The electromagnetic spectrum
- Energy changes (potential energy, activation energy and chemical bond energy)
- Molecules, atoms, ions and electrons
- Acids, bases, pH and buffers
- Isotopes, including radioactive isotopes
- Oxidation and reduction
- Hydrolysis and condensation

4.2.7 Terminology

(a) Wherever possible, English terms should be used in preference to Latin or Greek terms, e.g. the term red blood cell should be used and **not** erythrocyte.

(b) Generalised terms should be stated in English, e.g. small intestine.

(c) Where no suitable English terms exist, latinised terms are unavoidable and will need to be used, e.g. atrium, bronchi, villi.

4.3 Command words and phrases used in Biology examination papers

Examiners use command words to help you to understand what they are looking for in your answer. This table explains what each of these words or phrases means and will help you to understand the kind of answer you should write. The list of command words is in alphabetical order. You should remember that the meaning of a term may vary slightly according to how the question is worded.

Calculate	A numerical answer is needed. You should show any working, especially when there are two or more steps in a calculation. You should always include relevant units or symbols. *e.g. calculate the magnification of a specimen*
Deduce	This is used in a similar way to *predict*, except you will need to support your answer with a statement e.g. referring to a principle, or theory, or including reasoning with your prediction.
Define	You need to state the meaning of something *e.g. respiration is the release of energy from food substances in living cells*
Describe	You need to state the main points about something (using labelled diagrams if this helps you). *e.g. describe the parts played by the liver and the pancreas in the digestion of fats* You may also be asked to describe a particular process *e.g. describe how the pollination of a flower is brought about by insects* You may be asked to describe how to do a particular experiment *e.g. describe how you can test a food for starch and simple sugar*
Determine	This often indicates that the quantity cannot be directly measured but has to be found by calculation. *e.g. Determine the amount of protein needed in a particular diet.*
Discuss	You have to write down points **for** and **against** an argument *e.g. discuss points for and against the use nitrogen fertilisers*
Estimate	You need to work out an **approximate** value for a quantity, based on your knowledge of theory and the information provided. *e.g. estimate the amount of energy needed by an office worker in a day.*
Explain	You may have to give reasons or refer to a theory depending on the context of the question. *e.g. explain why the rate of transpiration changes with changes in light intensity*
Find	This is a general term which can mean several similar things, such as calculate, measure, determine etc.
Give a reason / reasons	See 'Explain'
List	Write down a number of separate points. Where the number of points is stated in the question, you should not write more than this number. *e.g. list **three** features of insect-pollinated flowers*
Meant (what is meant by the term…)	See 'Understand'
Measure	You are expected to find a quantity by using a measuring instrument

	e.g. length (by using a ruler), volume (by using a measuring cylinder)
Outline	State the main points briefly *e.g. outline the process of the water cycle*
Predict	This may be used in two ways: (i) You find the answer by working out the patterns in the information provided and drawing logical conclusions from this. e.g. predict the effect of the death of an organism in a food web on the populations of other food web members (ii) You may need to use information from tables and graphs or do calculations. e.g. predict the optimum temperature for lipase
Sketch	(i) When drawing graphs, this means that you may draw the approximate shape and/or position of the graph BUT you need to make sure that any important details, such as the line passing through the origin or finishing at a certain point, are drawn accurately. (ii) When drawing a specimen or other diagrams, a simple line drawing is all that is needed, but you must make sure the proportions are correct and the most important details are shown. You should always remember to label your diagrams.
State	You should give a short answer without going into any detail, e.g. state the name of the mineral needed to make chlorophyll BUT, remember that 'state the meaning of…' is different. It is more like 'understand'.
Suggest	This may be used in two ways: (i) There may be more than one correct answer to the question. e.g. suggest two reasons why a plant's seeds should be widely dispersed (ii) You are being asked to apply your general knowledge of biology or reasoning skills to a topic area that is not directly on the syllabus e.g. applying ideas about competition and feeding relationships to a unfamiliar food web
Understand (what do you understand by the term..)	You should (i) define something and (ii) make a more detailed comment about it. The amount of detail depends on the number of marks awarded. e.g. what do you understand by the term digestion