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Mark Scheme Summer 2008

GCE

GCE Biology (8040/9040 & 8042/9042)

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Summer 2008

Publications Code UA020010

Contents

Mark Schemes

GENERAL INTRODUCTION

Mark schemes are prepared by the Principal Examiners and revised, together with the relevant questions, by a panel of senior examiners and subject teachers. The schemes are further amended at the Standardisation meetings attended by all examiners. The Standardisation meeting ensures as far as possible that the mark scheme covers the candidates' actual responses to questions and that every examiner understands and applies it in the same way.

The schemes in this document are the final mark schemes used by the examiners in this examination and include the amendments made at the meeting. They do not include any details of the discussions that took place in the meeting, nor do they include all of the possible alternative answers or equivalent statements that were considered to be worthy of credit.

It is emphasised that these mark schemes are working documents that apply to these papers in this examination. Every effort is made to ensure a consistent approach to marking from one examination to another but each marking point has to be judged in the context of the candidates' responses and in relation to the other questions in the paper. It should not be assumed that future mark schemes will adopt exactly the same marking points as this one.

Edexcel cannot under any circumstances discuss or comment informally on the marking of individual scripts. Any enquiries about the marks awarded to individual candidates can be dealt with only through the official Enquiry about Results procedure.

Unit Codes and Unit Titles

These Mark Schemes cover the units offered in this examination for Advanced Subsidiary Biology and Biology (Human) (8040 and 8042) and Advanced Biology and Biology (Human) (9040 and 9042). The units available in this examination series for the complete qualifications are listed in the table below.

Level	Unit	Biology		Biology (Human)	
AS	1	**6101**	Molecules and cells		**6101**
	2	**6102**	Exchange, transport and reproduction	Exchange, transport and reproduction in humans	**6112**
	3	**6103**	Energy and the environment and Practical Assessment		**6103**
A2	4	**6104**	Respiration and coordination and Options		**6104**
	5	**6105**	Genetics, evolution and biodiversity	Genetics, human evolution and biodiversity	**6115**
	6	**6106**	Synoptic and Practical Assessment		**6106**

Cashing in

The following tables show the units that must be taken in order to obtain an award for AS or Advanced GCE Biology, or for AS or Advanced GCE Biology (Human).

Advanced Subsidiary

Level	Unit	8040 Biology	8042 Biology (Human)
AS	1	**6101**	**6101**
	2	**6102**	**6112**
	3	**6103**	**6103**

Advanced GCE

Level	Unit	9040 Biology	9042 Biology (Human)
AS	1	**6101**	**6101**
	2	**6102**	**6112**
	3	**6103**	**6103**
A2	4	**6104**	**6104**
	5	**6105***	**6115***
	6	**6106***	**6106***

* Only available in Summer examination series.

GENERAL INFORMATION

The following symbols are used in the mark schemes for all questions:

Symbol	Meaning of symbol
; semi colon	Indicates the end of a marking point
eq	Indicates that credit should be given for other correct alternatives to a word or statement, as discussed in the Standardisation meeting
/ oblique	Words or phrases separated by an oblique are alternatives to each other
{} curly brackets	Indicate the beginning and end of a list of alternatives (separated by obliques) where necessary to avoid confusion
() round brackets	Words inside round brackets are to aid understanding of the marking point but are not required to award the point
[] square brackets	Words inside square brackets are instructions or guidance for examiners
[CE] or [TE]	Consecutive error / transferred error

Crossed out work

If a candidate has crossed out an answer and written new text, the crossed out work can be ignored. If the candidate has crossed out work but written no new text, the crossed out work for that question or part question should be marked, as far as it is possible to do so.

Spelling and clarity

In general, an error made in an early part of a question is penalised when it occurs but not subsequently. The candidate is penalised once only and can gain credit in later parts of the question by correct reasoning from the earlier incorrect answer.

No marks are awarded specifically for quality of language in the written papers, except for the essays in the synoptic paper. Use of English is however taken into account as follows:

- the spelling of technical terms must be sufficiently correct for the answer to be unambiguous
  e.g. for amylase, 'ammalase' is acceptable whereas 'amylose' is not
  e.g. for glycogen, 'glicojen' is acceptable whereas 'glucagen' is not
  e.g. for ileum, 'illeum' is acceptable whereas 'ilium' is not
  e.g. for mitosis, 'mytosis' is acceptable whereas 'meitosis' is not

- candidates must make their meaning clear to the examiner to gain the mark.

- a correct statement that is contradicted by an incorrect statement in the same part of an answer gains no mark – irrelevant material should be ignored.

Unit 1 (6101/01) Molecules and cells

<table>
<tr><th>Question Number</th><th>Answer</th><th>Mark</th></tr>
<tr><td>1</td><td>
<table>
<tr><th>Process</th><th>Requires transport proteins</th><th>Requires energy in the form of ATP</th></tr>
<tr><td>Simple diffusion</td><td>×</td><td>×</td></tr>
<tr><td>Facilitated diffusion</td><td>✓</td><td>×</td></tr>
<tr><td>Osmosis</td><td>×</td><td>×</td></tr>
<tr><td>Active transport</td><td>✓</td><td>✓</td></tr>
</table>
NB 1 mark for every two correct answers
</td><td>(4)</td></tr>
</table>

Question Number	Answer	Mark
2	1. hydrophobic / non-polar / not charged ; 2. glycerol / propan-(1,2,3)-triol ; 3. (saturated / unsaturated) fatty acids ; 4. ester / covalent ; 5. insulation / buoyancy / energy store / protection / source of metabolic water ;	**(5)**

Question Number	Answer	Mark
3		**(6)**

Name of cell structure	**Description of cell structure**	**Diagram of cell structure**
nucleolus ; **(1)**		
		pair of cylinders ; at right angles to each other ; **(2)**
	1. spherical (structures) ; 2. single membrane ; 3. containing {hydrolytic / eq} enzymes ; **max (2)**	
microtubules; **(1)**		

Question Number	Answer	Mark
4(a)	1. size: drawing is correct length ; 2. shape is accurate ; 3. cell content - nucleus drawn in correct position with nucleoli shown ;	**(3)**

Question Number	Answer	Mark
4(b)	1. {fatty acids / tails} are {hydrophobic / non-polar / eq} ; 2. (so orientate themselves) away from {water / polar environment / eq} ; 3. {phosphate/heads} are {hydrophilic / polar / eq} ; 4. (so orientate themselves) towards {water / polar environment} ; 5. idea that phospholipids arranged in bilayer due to aqueous environment on both sides of membrane / eq ;	**max (3)**

Question Number	Answer	Mark
5(a)	1. cell cycle is shorter in A than B /eq ; 2. {interphase / eq} is shorter in A than B / eq ; 3. {mitosis / eq} is shorter in A than B / eq ; 4. {S phase / eq} is the same duration ; 5. comparative figures ;	**max (3)**

Question Number	Answer	Mark
5(b)	1. cells preparing to divide /eq ; 2. reference to S phase ; 3. reference to replication (of DNA) ; 4. reference to semi-conservative (replication) or a description of it ; 5. idea that new cells will have same quantity of DNA as parent / eq ;	**max (2)**

Question Number	Answer	Mark
5(c)	1. chromosomes {move to / at} opposite poles of cell / eq ; 2. reference to formation of nucleus / eq ; 3. reference to formation of cell {plate / wall} ; 4. {cell splits in two / eq} / reference to cytokinesis;	**max (2)**

Question Number	Answer	Mark
6(a)(i)	1. solution A contains starch **but** neither reducing sugar nor protein / contains **ONLY** starch ; 2. solution B contains a reducing sugar **but** neither protein nor starch / contains **ONLY** reducing sugar ;	**(2)**

Question Number	Answer	Mark
6(a)(ii)	1. {starch / (named) non-reducing sugar} has been {hydrolysed / eq} ; 2. to form a reducing sugar ;	**(2)**

Question Number	Answer	Mark
6(a)(iii)	solution C contained a lower concentration of (reducing) sugar than solution B ;	**(1)**

Question Number	Answer	Mark
6(b)	1. use equal volumes of each (protein) solution ; 2. use equal {volumes / concentrations} of biuret reagent /eq ; 3. {purple / lilac / mauve / violet} colour produced /eq ; 4. {compare intensity of colour / eq} / use a colorimeter ; 5. (deeper colour / eq) shows higher protein (concentration) / eq ;	**max (3)**

Question Number	Answer	Mark
7(a)	1. idea that part of the DNA helix unwinds ; 2. DNA strands separate ; 3. hydrogen bonds are broken ; 4. idea of one strand acting as a template ; 5. (RNA) (mono)nucleotides line up against complementary (DNA) bases ; 6. reference to formation of phosphodiester bonds / eq ; 7. correct reference to {RNA polymerase / DNA helicase} ; 8. reference to detachment of mRNA (molecule) from the DNA ;	**max (4)**

Question Number	Answer	Mark
7(b)	1. reference to translation / eq ; 2. mRNA becomes {associated / eq} with ribosomes ; 3. idea that a ribosome hold two transfer RNA molecules ; 4. reference to transfer RNA attached to amino acid; 5. peptide bonds formed (between adjacent amino acids) ; 6. reference to ribosome moving along mRNA ;	**max (3)**

Question Number	Answer	Mark
7(c)(i)	GGG CGC UCG AAA;; [1 mistake : 1 mark]	**(2)**

Question Number	Answer	Mark
7(c)(ii)	(glycine) arginine serine lysine;; [1 mistake = 1 mark]	**(2)**

Question Number	Answer	Mark
7(c)(iii)	ATT / ATC / ACT;	**(1)**

Question Number	Answer	Mark
8(a)(i)	1. A: can be re-used ; E: reduces overall cost / more economical / eq ; 2. A: process is continuous / eq ; E: saves time / can be automated / reduces cost ; 3. A: enzymes more stable ; E: less likely to be {denatured / affected by temperature changes / affected by pH changes} ; 4. A: enzymes can be used at higher temperatures ; E: faster reaction / saves time ; 5. A: enzymes does not have to be separated from product / eq ; E: reduces cost / saves time ; 6. A: more than one enzyme can be fixed in order ; E: greater control over process / saves time / more efficient ; 7. A: idea that enzyme is safer to handle e.g. allergic reaction / irritant ; E: enzyme only activated when in use ;	**max (4)**

Question Number	Answer	Mark
8(a)(ii)	1. lactose {hydrolysed / eq} to glucose and galactose / eq ; 2. production of lactose–reduced milk / eq ; 3. reference to lactose intolerance / eq ; 4. reference to (change in) sweetness / use in confectionery industry / eq ;	**max (3)**

Question Number	Answer	Mark
8(b)(i)	1. cyanide binds to active site of cyanidase ; 2. {linear / eq} up to 38/40 (minutes) ; 3. decrease in rate between 38/40 and 68/70 minutes / eq ; 4. maximum concentration {reached at 68/70 (minutes) / is 0.325 (au) } ; 5. maximum rate is 0.0069 au per minute ;	**max (3)**

Question Number	Answer	Mark
8(b)(ii)	1. idea that substrate has to penetrate into gel / bead / support material; 2. idea that not all active sites may be on / near surface of bead; 3. immobilised enzyme has little kinetic energy / {fewer / less energetic} collisions ; 4. fewer enzyme-substrate complexes formed;	**max (2)**

Unit 2B (6102/01) Exchange, transport and reproduction

Question Number	Answer	Mark
1	1. anterior ; 2. follicle stimulating hormone / FSH ; 3. follicles ; 4. secondary oocyte ;	**(4)**

Question Number	Answer	Mark
2(a)	**A** erythrocyte / red blood cell / red blood corpuscle ; **B** lymphocyte /agranulocyte ;	**(2)**

Question Number	Answer	Mark
2(b)	1. reference to biconcave (disc) / thin / large surface area / description of shape ; 2. reference to diffusion of respiratory gases / oxygen / carbon dioxide ; **OR** 1. small / flexible / eq ; 2. to pass through capillaries ;	**(2)**

Question Number	Answer	Mark
2(c)	1. {neutrophils / eosinophils} are {phagocytic / eq} ; 2. monocytes are {phagocytic / eq} ; 3. reference to phagocytosis of {bacteria /eq} ; 4. (B) lymphocytes secrete antibodies /eq ; 5. in presence of antigens / function of antibody / antitoxins / eq ; 6. reference to production of memory cells **;**	**max (3)**

Question Number	Answer	Mark
3(a)	1. capillaries {have thin walls / made of flattened epithelium / thin cells / eq} ; 2. reference to presence of <u>pores</u> ; 3. reference to basement membrane ; 4. reference to permeability of capillary wall /eq ;	**max (3)**

Question Number	Answer	Mark
3(b)	1. proteins are large (molecules) ; 2. cannot pass through capillary wall / eq ;	**(2)**

Question Number	Answer	Mark
3(c)	1. idea of reduced concentration of plasma proteins / eq ; 2. therefore reduced osmotic effect / eq ;	**(2)**

Question Number	Answer	Mark
4(a)	1. reference to (salivary / pancreatic) amylase ; 2. breaks down starch to maltose (and dextrins) ; 3. maltase ; 4. breaks down maltose to (α) glucose ;	**max (3)**

Question Number	Answer	Mark
4(b)(i)	1. (villi) increase the surface area ; 2. reference to increasing diffusion ;	**(2)**

Question Number	Answer	Mark
4(b)(ii)	1. reference to transport (of (absorbed) monosaccharides / named monosaccharides) ; 2. maintains {diffusion / concentration} gradient / eq ;	**(2)**

Question Number	Answer	Mark
4(c)(i)	1. uptake of galactose is {fastest / faster than glucose / fructose} ; 2. uptake of fructose is {slowest / slower than glucose / galactose} ; 3. glucose and galactose have similar rates of uptake ;	**max (2)**

Question Number	Answer	Mark
4(c)(ii)	reference to {specific / more} glucose {carrier proteins / eq} / glucose is absorbed actively, but fructose by (facilitated) diffusion / glucose is absorbed by glucose-sodium co-transport, fructose by diffusion ;	**(1)**

Question Number	Answer	Mark
5(a)	1. thick cuticle ; 2. reduces {transpiration / water loss / eq} ; 3. leaves rolled / folded / curled up / eq ; 4. reduces (exposed) surface area / stomata enclosed / reduces air movements / eq ; 5. sunken / fewer stomata ; 6. reduces {transpiration / water loss / eq} ; 7. presence of spines / spikes / hairs ; 8. trap water vapour near leaf / reduces air movement / eq ; 9. reference to hinge cells ; 10. (which) cause the leaf to roll up / eq ;	**max (6)**

Question Number	Answer	Mark
5(b)	leaf not rolled / no hairs / no spines / thin cuticle / no cuticle / air spaces / aerenchyma / no stomata / stomata on upper epidermis only / stomata on upper surface only / less supporting tissue / stomata not sunken / leaves feathery / eq ;	**(1)**

Question Number	Answer	Mark
6(a)(i)	to {reset / level the} liquid in capillary tube / to calibrate the scale / eq ;	**(1)**

Question Number	Answer	Mark
6(a)(ii)	to {absorb / take up / remove} carbon dioxide ;	**(1)**

Question Number	Answer	Mark
6(b)	1. to keep the temperature constant / eq ; 2. idea that temperature affects gas volumes ; 3. idea that temperature affects respiration / metabolic rates ;	**max (2)**

Question Number	Answer	Mark
6(c)	12×0.19 (or 2.28) ; $\div 15$; $= 0.15(2)$;	**(3)**

Question Number	Answer	Mark
7(a)	1. apoplast pathway described ; 2. symplast pathway described ; 3. reference to the vacuolar pathway ; 4. reference to the endodermis and {Casparian strip / layer of suberin / waxy layer} ; 5. function of the Casparian strip ;	**max (4)**

Question Number	Answer	Mark
7(b)(i)	1. reference to increase from {08.00 / start} until 10 / 12 / 14 ; 2. reference to maximum at 14.00 / peaks at 50 au ; 3. reference to decrease from 14.00 ; 4. credit a manipulated quantitative comment ;	**max (3)**

Question Number	Answer	Mark
7(b)(ii)	**08.00 to 14.00**: stomata open / increase in light (intensity) / increase in temperature / increase in wind speed / decrease in humidity ; **14.00 to 20.00**: converse of points above ;	**(2)**

Question Number	Answer	Mark
8(a)(i)	0.6 to 0.65 ;	**(1)**

Question Number	Answer	Mark
8(a)(ii)	3.1 to 3.15 ;	**(1)**

Question Number	Answer	Mark
8(b)	1. idea that oxygen is transferred from haemoglobin to myoglobin ; 2. myoglobin acts as a {store / eq} of oxygen ; 3. in muscle (tissue) ; 4. oxygen released from myoglobin at (very) low partial pressures / during {extreme / strenuous / eq} exercise ; 5. this allows <u>aerobic</u> respiration to continue / eq ;	**max (3)**

Question Number	Answer	Mark
8(c)	1. idea that respiring {tissues / cells} produce carbon dioxide ; 2. reference to reduced <u>affinity</u> for oxygen ; 3. oxygen is released (more) readily / (more) oxygen is released / haemoglobin is less saturated with oxygen / percentage saturation decreases / eq ; 4. at {a given / the same} partial pressure of oxygen / eq ; 5. (oxygen released) to tissues / cells / muscle /eq ;	**max (4)**

Unit 2H (6112/01) Exchange, transport and reproduction in humans

Question Number	Answer	Mark
1	5. anterior ; 6. follicle stimulating hormone / FSH ; 7. follicles ; 8. secondary oocyte ;	**(4)**

Question Number	Answer	Mark
2(a)	**A** erythrocyte / red blood cell / red blood corpuscle ; **B** lymphocyte /agranulocyte ;	**(2)**

Question Number	Answer	Mark
2(b)	3. reference to biconcave (disc) / thin / large surface area / description of shape ; 4. reference to diffusion of respiratory gases / oxygen / carbon dioxide ; **OR** 3. small / flexible / eq ; 4. to pass through capillaries ;	**(2)**

Question Number	Answer	Mark
2(c)	7. {neutrophils / eosinophils} are {phagocytic / eq} ; 8. monocytes are {phagocytic / eq} ; 9. reference to phagocytosis of {bacteria /eq} ; 10. (B) lymphocytes secrete antibodies /eq ; 11. in presence of antigens / function of antibody / antitoxins / eq ; 12. reference to production of memory cells **;**	**max (3)**

Question Number	Answer	Mark
3(a)	5. capillaries {have thin walls / made of flattened epithelium / thin cells / eq} ; 6. reference to presence of <u>pores</u> ; 7. reference to basement membrane ; 8. reference to permeability of capillary wall /eq ;	**max (3)**

Question Number	Answer	Mark
3(b)	3. proteins are large (molecules) ; 4. cannot pass through capillary wall / eq ;	**(2)**

Question Number	Answer	Mark
3(c)	3. idea of reduced concentration of plasma proteins / eq ; 4. therefore reduced osmotic effect / eq ;	**(2)**

Question Number	Answer	Mark
4(a)	5. reference to (salivary / pancreatic) amylase ; 6. breaks down starch to maltose (and dextrins) ; 7. maltase ; 8. breaks down maltose to (α) glucose ;	**max (3)**

Question Number	Answer	Mark
4(b)(i)	3. (villi) increase the surface area ; 4. reference to increasing diffusion ;	**(2)**

Question Number	Answer	Mark
4(b)(ii)	3. reference to transport (of (absorbed) monosaccharides / named monosaccharides) ; 4. maintains {diffusion / concentration} gradient / eq ;	**(2)**

Question Number	Answer	Mark
4(c)(i)	4. uptake of galactose is {fastest / faster than glucose / fructose} ; 5. uptake of fructose is {slowest / slower than glucose / galactose} ; 6. glucose and galactose have similar rates of uptake ;	**max (2)**

Question Number	Answer	Mark
4(c)(ii)	reference to {specific / more} glucose {carrier proteins / eq} / glucose is absorbed actively, but fructose by (facilitated) diffusion / glucose is absorbed by glucose-sodium co-transport, fructose by diffusion ;	**(1)**

Question Number	Answer	Mark
5		**max (6)**

Epithelia	Name	One location
	squamous / pavement ;	alveoli ;
	columnar ;	ileum ;
	cuboidal ;	nephron ;

Question Number	Answer	Mark
6(a)	1. evaporation of water (in sweat) ; 2. (evaporation) has a cooling effect / eq ; 3. appropriate {reference to / description of} latent heat ;	**max (2)**

Question Number	Answer	Mark
6(b)(i)	1. temperature dropped {from 0 to 15 minutes / when in the bath} ; 2. increased {from 15 to 25 minutes / when sitting on the chair} ; 3. lowest {at 15 minutes / when 'he got out of bath'}; 4. credit a manipulated change in temperature ;	**max (3)**

Question Number	Answer	Mark
6(b)(ii)	**5 to 10 minutes:** 1. temperature of water lower than body temperature / eq ; 2. heat lost by conduction (to water) ; **15 to 25 minutes**: 3. increased metabolism / shivering / eq ; 4. generates heat / eq ;	**max (3)**

Question Number	Answer	Mark
7(a)(i)	1. soda lime {absorbs / eq} carbon dioxide ; 2. prevents carbon dioxide accumulating / eq (in spirometer) ; 3. reference to harmful effect of breathing increased carbon dioxide ; 4. can also measure the volume of oxygen used ;	**max (2)**

Question Number	Answer	Mark
7(a)(ii)	1. nose clip on person ; 2. reference to calibrating chart ; 3. switch on chart recorder ; 4. person breathes through mouthpiece ; 5. deep breath in then {fully out / eq} / VC = IRV + TV + ERV ; 6. read volume from chart;	**max (3)**

Question Number	Answer	Mark
7(b)(i)	1. calculation ; 2. answer (= 92.9) ;	**(2)**

Question Number	Answer	Mark
7(b)(ii)	1. (as cycling speed increases) more carbon dioxide produced ; 2. {carbon dioxide / low pH} stimulates breathing / eq ; 3. increased need for oxygen / eq ;	**max (2)**

Question Number	Answer	Mark
8(a)(i)	0.6 to 0.65 ;	**(1)**

Question Number	Answer	Mark
8(a)(ii)	3.1 to 3.15;	**(1)**

Question Number	Answer	Mark
8(b)	6. idea that oxygen is transferred from haemoglobin to myoglobin ; 7. myoglobin acts as a {store / eq} of oxygen ; 8. in muscle (tissue) ; 9. oxygen released from myoglobin at (very) low partial pressures / during {extreme / strenuous / eq} exercise ; 10. this allows <u>aerobic</u> respiration to continue / eq ;	**max (3)**

Question Number	Answer	Mark
8(c)	6. idea that respiring {tissues / cells} produce carbon dioxide ; 7. reference to reduced <u>affinity</u> for oxygen ; 8. oxygen is released (more) readily / (more) oxygen is released / haemoglobin is less saturated with oxygen / percentage saturation decreases / eq ; 9. at {a given / the same} partial pressure of oxygen / eq ; 10. (oxygen released) to tissues / cells / muscle /eq ;	**max (4)**

Unit 3 (6103/02) Written alternative to coursework

Question Number	Answer	Mark
1(a)	<table><tr><th rowspan="2">Distance of grapefruit from rainforest / metres</th><th colspan="4">Number of bee visits / branch^{-1} 15 minutes^{-1} on days</th><th rowspan="2">Mean number of bee visits / 15 minutes^{-1}</th></tr><tr><th>1</th><th>2</th><th>3</th><th>4</th></tr><tr><td>Edge / 0</td><td>10</td><td>8</td><td>6</td><td>9</td><td>8.25</td></tr><tr><td>10</td><td>12</td><td>7</td><td>3</td><td>8</td><td>7.50</td></tr><tr><td>100</td><td>9</td><td>9</td><td>4</td><td>11</td><td>8.25</td></tr><tr><td>500</td><td>8</td><td>7</td><td>3</td><td>6</td><td>6.00</td></tr><tr><td>1000</td><td>1</td><td>1</td><td>0</td><td>1</td><td>0.75</td></tr></table> neat table correctly formatted (shaded area optional) ; correct rows and columns with labels and units ; mean average values correctly calculated ;;	**(4)**

Question Number	Answer	Mark
1(b)	**A**xes – correct orientation and labels ; **S**cale – use more than half paper and correct scale matched to graph format; **P**lots – all points plotted correctly ; **F**ormat – bar chart / line graph with accurate lines;	**(4)**

Question Number	Answer	Mark
1(c)	1. general point as distance increases number of bee visits decreases / eq ; 2. 0 to 100 metres: bee visits fluctuate / reference to bee visits decreasing at 10m / eq ; 3. 500 to 1000 metres: greatest decrease [not rapid] ; 4. correct manipulation of numbers ;	**max (3)**

Question Number	Answer	Mark
1(d)	1. different pairs counting bees at each site /eq ; 2. no definition of 'bee visits' ; 3. identification of insects as bees ; 4. no account taken of named environmental condition (e.g. cloud, sun, shade, rain, wind) ; 5. height / aspect of branches may be different ; 6. variation in flowers (e.g. number, size) ;	**max (3)**

Question Number	Answer	Mark
2(a)	1. **TWO** methods of standardising leaves e.g. same plant / species, same position on branch, mass, area, width ; 2. leaves placed in dark for stated time ; 3. same volume of potassium chloride solution for each test ; 4. minimum of 5 different concentrations used in addition to control ; 5. deionised/distilled water (as control) ; 6. leaves placed in solutions for same time ; 7. underside of leaf {painted with nail varnish /eq} / lower epidermis peeled off ; 8. site of stomatal sampling stated for each leaf ; 9. use same magnification / objective lens for each measurement ; 10. count total of stomata visible ; 11. count stomatal numbers open / closed ; 12. min. three counts in total for each leaf ; 13. details of exactly what is to be counted / how open or closed to be judged ;	**max (9)**

Question Number	Answer	Mark
2(b)	1. suitable table with units and correct rows and columns to include all raw data to match suggested method ; 2. calculation of % open/closed ; 3. line graph format ; 4. correct orientation of axes with labels and units ;	**max (3)**

Question Number	Answer	Mark
2(c)	**Limitations** 1. difficult to judge open / closed ; 2. changes may take place during time for measurement ; 3. leaves not normally immersed in liquid / eq ; 4. chloride ions also present may have an effect ; 5. area observed may not be representative of whole leaf / eq ; **Further Work** 1. repeat with different potassium salt solutions ; 2. test different species of leaves ; 3. measure actual sizes of stoma over time (if not included in method) ;	**max (6)**

Unit 3 (6103/03) Energy and the environment

Question Number	Answer	Mark
1(a)	1. reference to difference in energy source /eq ; 2. reference to source of organic matter /eq ;	**(2)**

Question Number	Answer	Mark
1(b)	i. holozoic /eq ; ii. mutualistic / symbiotic / eq ; **NOT** commensal iii. parasitic /eq ; iv. saprobiontic / saprophytic / eq ;	**(4)**

Question Number	Answer	Mark
2(a)	nutrient enrichment of water / eq;	**(1)**

Question Number	Answer	Mark
2(b)(i)	1. 6200/800 x 100 ; **OR** [(7000 – 800) ÷ 800] x 100 2. 775(%) ;	 **(2)**

Question Number	Answer	Mark
2(b)(ii)	(1971 to 1975 / increase) 1. (treatment / nitrate) {provided / used} for {protein / amino acid} synthesis ; 2. so increased growth /eq ; (1975 to 1976 / decrease) 3. growth of algae {limited / eq} by the supply of nutrients ; 4. (algae) started to die ; 5. animals eating them ; 6. another factor became limiting e.g. competition for light / shading effects ;	 **max (4)**

Question Number	Answer	Mark
2(c)	1. more algae would mean more food for {primary consumer / herbivores / eq} ; 2. (primary consumers) would increase in number / eq ; 3. reference to effect on organisms further up the food chain ; 4. reference to algae shading out other plants / algae release toxins which kill {animals / organisms / eq} ; 5. {bacteria / decomposers} {increase in number / eq} ; 6. (bacteria) would {use up oxygen in the water / increase the BOD / eq} ; 7. reference to the change in oxygen affects {aerobic / anaerobic} organism e.g. fish die / bloodworms increase ;	**max (3)**

Question Number	Answer	Mark
2(d)(i)	1. idea of collecting pondweed growing in {stated / known} {volume / area} of water ; 2. separate weed from water / dry the weed ; 3. find the {mass / weight} of weed / eq ; 4. reference to repeats / more than one sample taken ; 5. (estimate) the {volume / area} of the pond / eq ; 6. idea of how the total biomass of pond calculated ;	**max (4)**

Question Number	Answer	Mark
2(d)(ii)	1. biomass takes into account the {mass / size / eq} of organisms / numbers take no account of {mass / size} of organisms / eq ; 2. (therefore) possible to compare with other biomass values / (valid) comparisons not possible with numbers / eq ;	**(2)**

Question Number	Answer	Mark
3(a)	A photosynthesis ; B respiration / decomposition / putrefaction ; **NOT** decay C combustion ;	**(3)**

Question Number	Answer	Mark
3(b)	1. overall trend {increasing / eq} ; 2. {steady / linear / eq} increase to {1973 / 1974} ; 3. period of {increase and decrease / fluctuation} between {1973 / 1974} and {1982 / 1983 / 1984 / 1985} ; 4. decrease between 1979 and 1983 ; 5. increase from 1983 (with some fluctuations) ; 6. correct manipulation of data e.g. overall 58 x 10^6 barrels per day ;	**max (3)**

Question Number	Answer	Mark
3(c)	**YES**, because - 1. there is an overall increasing trend in both graphs / eq ; 2. there are fluctuations on both graphs / eq ; **NO**, because - 3. the {peaks and troughs / fluctuations} of the graphs do not match / eq ;	**max (2)**

Question Number	Answer	Mark
3(d)	1. {traps / eq} {heat / infrared / eq} (in the atmosphere) / eq ; 2. methane / CFC / nitrous oxide / water vapour / eq ;	**(2)**

Question Number	Answer	Mark
3(e)	natural gas / coal / lignite / anthracite ;	**(1)**

Question Number	Answer	Mark
3(f)	1. idea of meeting present needs ; 2. idea of ensuring future supplies / last a long time / eq ; 3. (energy crops) are a renewable resource / eq ;	**max (2)**

Question Number	Answer	Mark
3(g)	1. none of the habitats supported all three species ; 2. planting willow {removes / eq} lapwing / eq ; 3. planting willow increases the numbers of snipe /eq ; 4. planting willow allows woodcock to appear / eq ; 5. credit any correct manipulation of data ;	**max (3)**

Unit 4 (6104: Core) Respiration and coordination

<table>
<tr><th>Question Number</th><th>Answer</th><th>Mark</th></tr>
<tr><td>1</td><td>
<table>
<tr><th>Hormone</th><th>Site of secretion</th><th>One function</th></tr>
<tr><td>glucagon ;</td><td></td><td></td></tr>
<tr><td>oxytocin ;</td><td></td><td></td></tr>
<tr><td></td><td>anterior pituitary (gland);</td><td></td></tr>
<tr><td></td><td></td><td>raises blood glucose concentration/increases heart rate / increases stroke volume / dilates pupils / constricts arterioles in skin / dilates arterioles in muscles / suppresses immune system / increases breathing rate / causes conversion of glycogen to glucose ;</td></tr>
</table>
</td><td>(4)</td></tr>
</table>

Question Number	Answer	Mark
2(a)(i)	pyruvate / pyruvic acid ;	**(1)**

Question Number	Answer	Mark
2(a)(ii)	1. (stage) 1 ; 2. (stage) 3 ;	**(2)**

Question Number	Answer	Mark
2(b)(i)	a {series / sequence / eq} of (chemical) reactions / each step is controlled by an enzyme / product of one reaction is the substrate for the next / eq ;	**(1)**

Question Number	Answer	Mark
2(b)(ii)	matrix of a mitochondrion ;	**(1)**

Question Number	Answer	Mark
2(c)	(stages) B, C, D (and) F ;	**(1)**

Question Number	Answer	Mark
3(a)	1. (rods contain) rhodopsin; 2. reference to convergence / summation / eq ; 3. therefore the dog will have better {vision in dim light /night vision} / eq ; 4. idea that dog can look directly at object (in dark) / eq ; 5. dogs are {more active at night / nocturnal} / eq ;	**max (3)**

Question Number	Answer	Mark
3(b)	1. idea that in dogs only one type of cone stimulated ; 2. therefore the brain receives similar impulses / information / eq ; 3. idea that in humans two types of cone are stimulated ; 4. idea that the colour perceived by the brain depends on the relative stimulation of each photoreceptor ;	**max (2)**

Question Number	Answer	Mark
3(c)	1. reference to phytochromes ; 2. name two forms {PFR and PR / P_{730} and P_{660}} ; 3. reference to absorption of light (by phytochromes) ; 4. conversion of PR to PFR **AND** reference to red light ; 5. conversion of PFR to PR **AND** reference to far red light ;	**max (3)**

Question Number	Answer	Mark
4(a)(i)	**A** = Bowman's capsule **B** = proximal convoluted tubule ;	**(1)**

Question Number	Answer	Mark
4(a)(ii)	1. reference to facilitated diffusion / eq ; 2. active transport / eq ; 3. correct reference to involvement of proteins ; 4. co-transport with Na^+ / eq ; 5. reference to microvilli providing large surface area ;	**max (2)**

Question Number	Answer	Mark
4(b)(i)	1. correct readings from graph (300 and 60) ; 2. correct subtraction 300 - 60 (x 100) ; 3. correct division ÷ 300 (= 80%) ;	**(3)**

Question Number	Answer	Mark
4(b)(ii)	1. overall, an increase in concentration with high ADH and a decrease in concentration with low ADH / eq ; 2. {A to D / eq}: the change in concentrations are the same with low or high ADH / eq ; 3. C / D to E : greater decrease with low ADH / eq ; 4. E to F / G: the concentration rises when ADH is high but {decreases / stays the same} when ADH is low / eq ; 5. comparative use of figures ;	**max (3)**

Question Number	Answer	Mark
4(b)(iii)	1. reference to increase in concentration (of fluid) at { E / F / G / collecting duct / distal convoluted tubule} ; 2. (rise in ADH) increases permeability of {collecting ducts / distal convoluted tubule / E / F / G} to water / eq ; 3. more water is reabsorbed / eq ; 4. by osmosis ; 5. reference to aquaporins ; 6. idea that same amount of solute in less water so that solution is more concentrated ;	**max (3)**

Question Number	Answer	Mark
5	**Sensory** 1. transmits {impulses / action potentials} from sense organ to CNS / eq ; 2. pseudo-unipolar cells / cell body in centre of {cell / axon} / single dendrite ; 3. myelinated ; **Relay** 4. correct reference to (relay neurone transmitting impulses) {between sensory and motor neurone / to other neurones} ; 5. short axons ; 6. no myelination / eq ; **Effector (motor)** 7. transmits {impulses / action potentials} from CNS to {effector / named effector} / eq ; 8. multipolar cells / short dendrites / many dendrites from cell body / cell body at end of cell ; 9. long axon ; 10. myelinated ; **General** 11. reference to {Schwann cells / nodes of Ranvier} ; 12. reference to myelin causing faster impulse / eq ; 13. reference to synapses (between neurones) ; 14. reference to secretion of {neurotransmitter / named neurotransmitter} ; 15. credit structural detail of synapse e.g. mitochondria in presynaptic knob / receptor molecules on postsynaptic membrane / sodium channels in postsynaptic membrane ;	**max (10)**

Unit 4 (6104/01) Microbiology and biotechnology

Question Number	Answer	Mark
6	1. mould / fungus / yeast / eukaryotic ; 2. virus; 3. bacterium / prokaryotic ; 4. bacterium / prokaryotic ;	**(4)**

Question Number	Answer	Mark
7(a)	1. selective only allows the growth of some microorganisms / prevents the growth of others /eq ; 2. results in {different coloured colonies / changes in colour medium} ; 3. due to pH changes ; 4. used in isolation / identification ; [award **once** in either part]	**max (3)**

Question Number	Answer	Mark
7(b)	1. *Azotobacter* ; 2. *Clostridium*: oxygen supplied / it respires anaerobically / eq ; 3. *Nitrosomonas*: no ammonium (ions) / no carbon dioxide ; 4. *Nitrobacter*: no nitrite (ions) / no carbon dioxide ;	**max (3)**

Question Number	Answer	Mark
8(a)	1. reference to use of *Penicillium* ; 2. reference to batch fermentation ; 3. all nutrients added (at start) / no products removed /eq ; 4. reference to {stirring / aeration} ; 5. reference to maintaining {pH / temperature} ; 6. idea that penicillin {produced at end of growth phase / during stationary phase / is a secondary metabolite} ; 7. idea that penicillin is found in the culture fluid ;	**max (4)**

Question Number	Answer	Mark
8(b)(i)	1. reference to use of optical methods / counting chambers to obtain total cell count ; 2. credit details of method ; 3. reference to use of dilution plating / exclusion dye (counting chamber) (to obtain viable cell count) ; 4. credit details of method ; 5. idea that samples need to be taken from bacteria cultured with each antibiotic (at a range of concentrations) ; 6. need for thorough mixing when taking samples / aseptic technique ; 7. credit explanation of how percentage viability is calculated ;	**max (4)**

Question Number	Answer	Mark
8(b)(ii)	1. *antibiotic X kills the bacteria at all concentrations but Y has no effect until 10 / 11 arbitrary units /eq ;* 2. (at concentrations above 10 / 11 arbitrary units) the decrease in viability of bacteria is linearly proportional to the concentration of Y but decrease for X is not linear / eq ; 3. idea that gradient of Y is steeper than X ; 4. a lower concentration of Y than X kills all the bacteria / eq ; 5. X is more toxic at lower concentrations (below 26 / 27 arbitrary units) and Y is more toxic at higher concentrations (above 26/ 27 arbitrary units) / eq ; 6. idea of same effect at 26 / 27 au ; 7. credit comparative manipulated figures ;	**max (3)**

Question Number	Answer	Mark
9(a)(i)	1. generally as bacteria numbers increase pH decreases /eq ; 2. 0 – {30 / 60 / 90 / 120} minutes rapid increase in bacterial numbers as pH decreases at a rapid rate /eq ; 3. {90 / 120} – 210 minutes rate of increase in bacteria numbers decrease whereas there is a small decrease in pH / eq ; 4. after 210 minutes no change in bacteria numbers and pH remains constant /eq ; 5. credit manipulation of figures ;	**max (3)**

Question Number	Answer	Mark
9(a)(ii)	1. correct readings; 2. correct substitution into formula; 3. correct answer given as whole generations / rounded down ;	**(3)**

Question Number	Answer	Mark
9(b)	1. reference to production of lactic acid ; 2. idea that lactic acid causes drop in pH ; 3. this causes coagulation of the (milk) proteins /eq ; 4. resulting in thickening of yoghurt / eq ; 5. idea that {metabolites / eq} give (characteristic) flavour (of yoghurt) ;	**max (3)**

Unit 4 (6104/02) Food science

Question Number	Answer	Mark
6	1. (vitamin) A / retinol; 2. calcium / Ca^{2+} / (vitamin) D ; 3. (vitamin) C / ascorbic acid; 4. iron / Fe^{2+} / (vitamin) B (12) ;	**(4)**

Question Number	Answer	Mark
7(a)	bruising / discoloration / presence of {fungus / mould} / shrivelling / liquefying / eq ;	**(1)**

Question Number	Answer	Mark
7(b)(i)	1. idea that lower levels of oxygen {slow down the rate of decay / reduce visible defects} ; 2. reference to low levels of oxygen increasing shelf life ; 3. in low oxygen levels, raspberries fit for sale for 5 days ; 4. in high oxygen levels, raspberries fit for sale for 3 days ;	**max (3)**

Question Number	Answer	Mark
7(b)(ii)	1. (lower oxygen levels mean) reduced {aerobic respiration / ATP production} (of microorganisms) ; 2. slower growth of microorganisms / eq ; 3. reference to less ethene being produced (by the raspberries) ;	**max (2)**

Question Number	Answer	Mark
8(a)	1. increase in sweetness / eq ; 2. due to {accumulation / eq} of fructose / glucose / sucrose ; 3. (and) decrease in {organic acids / malic acid} ; 4. reference to change in colour ; 5. due to change in {carotenoids / named carotenoid} ; 6. increase in softness /eq ; 7. due to breakdown of {pectic substances / pectin / middle lamella} ; 8. details of {enzymes / enzyme action} / reference to ethene ;	**max (4)**

Question Number	Answer	Mark
8(b)	<u>Concentration of sugar:</u> 1. very little change during fruit development / idea of an increase and then a decrease ; 2. {large / fast} increase during fruit ripening ; <u>pH</u> 3. idea of no change in pH during first part of fruit development ; 4. idea of increase in pH during latter stage of fruit development ; 5. {linear / eq} increase in pH during fruit ripening ;	**max (3)**

Question Number	Answer	Mark
8(c)	1. idea that a number of apples needed at various stages (through development and ripeness) ; 2. apples need to be of the same variety /eq ; 3. testing should be done on fresh fruits /eq ; 4. reference to sucrose as the standard reference sugar ; 5. at a range of concentrations (of sucrose) ; 6. reference to the need to rinse out mouth with water between tasting ; 7. reference to the need for the same person to do the tasting ;	**max (4)**

Question Number	Answer	Mark
9(a)(i)	1. correct readings (38 / 39 and 9/10) ; 2. correct subtraction multiplied by 100 ; 3. divided by lower reading to give correct answer ;	**(3)**

Question Number	Answer	Mark
9(a)(ii)	1. men with high body fat level more likely to have high blood cholesterol /eq ; 2. idea that high fat diet likely to have more cholesterol / eq ; 3. (men doing {little / no} exercise) likely to have a high body fat / eq ; 4. idea that calorie intake is greater than calorie use ;	**max (3)**

Question Number	Answer	Mark
9(b)	1. {grasp /pinch / eq} skin ; 2. reference to use of (skinfold) callipers ; 3. idea of measuring thickness of fold (from callipers) ; 4. name two suitable sites e.g. waist / front upper arm / back upper arm / below shoulder blade ; 5. reference to taking more than one reading from each site ; 6. compare to tables of data / eq ;	**max (3)**

Unit 4 (6104/03) Human health and fitness

Question Number	Answer	Mark
6	1. increases; 2. decreases; 3. increases; 4. increases;	**(4)**

Question Number	Answer	Mark
7(a)	1. {surfactants / eq} – to reduce surface tension / prevent collapse ; 2. {thin walls / flattened cells / thin endothelium / eq} – {reduces diffusion distance / speeds up {gas exchange / diffusion} } ; 3. large surface area – {more / faster} {gas exchange / diffusion} ; 4. moist – allows gases to dissolve (and move across) ;	**max (3)**

Question Number	Answer	Mark
7(b)	1. stimulus e.g. {carbon dioxide / pH levels / H^+} in the blood ; 2. reference to stretch receptors / chemo receptors ; 3. reference to medulla (oblongata) ; 4. reference to inspiratory centres / expiratory centres ; 5. reference to change in frequency of nerve impulses ; 6. down the phrenic nerve / intercostal nerves; 7. to the { diaphragm / intercostal muscles } ;	**max (3)**

Question Number	Answer	Mark
8(a)	1. reference to increase in aortic pressure ; 2. reference to baroreceptors ; 3. in the aortic arch / eq ; 4. results in decrease in cardiac output / rate of heart beat ; 5. due to suppression of SAN / eq ; 6. (and due to) delay at AVN / eq ; 7. reference to {release of acetylcholine / vagus nerve parasympathetic nerve} ;	**max (4)**

Question Number	Answer	Mark
8(b)(i)	1. both increase / eq ; 2. linearly / eq ; 3. systolic pressure increases more than diastolic pressure / converse ; 4. diastolic pressure never rises above systolic pressure / converse ; 5. manipulation of figures to compare the increases ;	**max (3)**

Question Number	Answer	Mark
8(b)(ii)	1. reference to a need to change heart rate to change cardiac output ; 2. idea that heart rate/cardiac output can be changed by exercise / eq ; 3. suitable example of {exercise/stimulus} named ; 4. reference to use of sphygmomanometer (to measure blood pressure) ; 5. reference to positioning cuff on upper arm ; 6. reference to recording both (the diastolic and systolic) pressures each time ; 7. idea that same individual needs to be used throughout ;	**max (4)**

Question Number	Answer	Mark
9(a)(i)	4. correct readings (38 / 39 and 9/10) ; 5. correct subtraction multiplied by 100 ; 6. divided by lower reading to give correct answer ;	**(3)**

Question Number	Answer	Mark
9(a)(ii)	1. men with high body fat level more likely to have high blood cholesterol /eq ; 2. idea that high fat diet likely to have more cholesterol / eq ; 3. (men doing {little / no} exercise) likely to have a high body fat / eq ; 4. idea that calorie intake is greater than calorie use ;	**max (3)**

Question Number	Answer	Mark
9(b)	7. {grasp /pinch / eq} skin ; 8. reference to use of (skinfold) callipers ; 9. idea of measuring thickness of fold (from callipers); 10. name two suitable sites e.g. waist / front upper arm / back upper arm / below shoulder blade ; 11. reference to taking more than one reading from each site ; 12. compare to tables of data / eq ;	**max (3)**

Unit 5B (6105/01) Genetics, evolution and biodiversity

Question Number	Answer	Mark
1(a)	1. 63 ; [**max 2 from the following three marking points**] 2. cannot form gametes /eq ; 3. (because) chromosome pairing not possible / eq ; 4. during {meiosis / eq} ;	**max (3)**

Question Number	Answer	Mark
1(b)	1. (isolating mechanisms) prevent interbreeding (between species / populations) / barrier to reproduction / eq ; 2. (postzygotic mechanisms) allow {mating / fertilisation / eq} / eq ; 3. but prevent production of {viable / fertile} offspring / prevent offspring developing / eq ;	**(3)**

Question Number	Answer	Mark
1(c)	1. idea that species is group of organisms that can interbreed to produce fertile offspring / eq ; 2. but mule {is sterile / cannot produce offspring} ;	**(2)**

Question Number	Answer	Mark
2(a)	1. lapwing ; 2. greatest increase when predators are removed ; 3. use of data (either for lapwing or comparing lapwing to other birds) ; **OR** 1. red grouse ; 2. greatest increase of population with time when predators removed ; 3. use of data ;	**(3)**

Question Number	Answer	Mark
2(b)	1. collect a sample of animals mark them release them; 2. qualified reference to nature of mark ; 3. leave for suitable time, collect a second sample ; 4. count the number of marked animals in the sample ; 5. equation for Lincoln Index given / explanation of how Index is used ;	**max (3)**

Question Number	Answer	Mark
3(a)	1. absorption spectrum shows wavelengths where light is absorbed by pigments / eq ; 2. action spectrum shows activity at different wavelengths / eq ; 3. reference to the link between peak absorption for a pigment and the photosynthetic rate ; 4. indicates that pigments are involved in {photosynthesis / eq} ; 5. correct comparison between graphs (using whole range of wavelengths) ;	**max (3)**

Question Number	Answer	Mark
3(b)	thylakoid (membrane) / granum / grana ;	**(1)**

Question Number	Answer	Mark
3(c)	1. use of {chromatography paper / (silica) gel plates / eq}; 2. using {solvent / named example} to {move / separate} pigments ; 3. left to run until solvent {reaches / near to} {top / other end} of {paper / plate} ; 4. origin and solvent front marked ; 5. reference to use of R_f values to identify pigments ;	**max (4)**

Question Number	Answer	Mark
3(d)	1. (magnesium) {component / used in formation / eq} of chlorophyll ; 2. less chlorophyll formed if magnesium deficient / eq; 3. {other pigments / carotenoids} still present / eq ;	**max (2)**

Question Number	Answer	Mark
4(a)	each structure correctly drawn ;;;;	**(4)**

Question Number	Answer	Mark
4(b)	1. (more nutrients) increases the numbers of {cyanobacteria / algae}, more food for {zooplankton /fish} so their numbers increase ; 2. cyanobacteria produce / {toxins / eq} that kill {animals / organisms} (in the water) ; 3. create algal bloom that shades other (aquatic) plants ; 4. increase in {bacteria / decomposers } {uses up oxygen / increase BOD} ; 5. therefore {zooplankton / fish} {die / decrease in numbers} ;	**max (3)**

Question Number	Answer	Mark
4(c)	1. could inhibit {cell/ nuclear} / division / mitosis ; 2. could act as enzyme inhibitors (any form of inhibition) ; 3. could interfere with metabolic pathways / specific example ; 4. any other appropriate correct reason ;	**max (2)**

Question Number	Answer	Mark
4(d)	{the chemical pesticides could kill other organisms, not just the cyanobacteria} / {the water could be used as a source of drinking water for {people / animals} and the chemicals could disrupt food chains / any other suitable reason ;	**(1)**

Question Number	Answer	Mark
5(a)(i)	artery ;	**(1)**

Question Number	Answer	Mark
5(a)(ii)	*Any two from the following <u>pairs</u>:* 1. thick {wall / layer} of (smooth) muscle / thick elastic {layer / wall} ; 2. allows artery to expand / withstand pressure from the pulse of blood / eq ; 3. collagen (fibres) ; 4. provides strength / eq ; 5. smooth lining ; 6. prevent resistance to blood flow / eq ; 7. small lumen / eq ; 8. to maintain high pressure / eq ;	**max (4)**

Question Number	Answer	Mark
5(b)	1. inhibits the enzyme (that catalyses the conversion) ; 2. by active site-directed inhibition / eq ; 3. inhibitor {is a similar shape to the substrate } / blocks active site ; 4. by non active site-directed inhibition ; 5. inhibitor attaches to enzyme at point other than active site / eq ; 6. (and) causes active site to change shape ;	**max (4)**

Question Number	Answer	Mark
6(a)	1. peptide {bond / link} ; 2. (formed by) condensation ; 3. between {carboxyl / COOH} and {amine / amino / NH_2} ;	**max (2)**

Question Number	Answer	Mark
6(b)	1. ionic ; 2. hydrogen ; 3. disulphide stronger than hydrogen and ionic / eq ;	**(3)**

Question Number	Answer	Mark
6(c)	glucose able to be absorbed in stomach / no need for digestion of glucose / any other suitable suggestions ;	**(1)**

Question Number	Answer	Mark
6(d)	1. disulphide links {cannot form} ; 2. reference to disulphide links form between cysteine molecules ; *3. {chains / chain A and chain B} cannot be linked correctly ;* *4. {molecule /insulin / polypeptide} has a different {shape / tertiary structure / 3D-structure eq} ;* 5. (therefore) insulin {has different properties / not formed / eq} ; 6. insulin receptor sites on {cell surface membrane / eq} ; 7. receptor sites do not accept this insulin / eq ; 8. blood glucose level would {continue to rise / not fall / take longer to decrease} ; 9. reference to decrease in uptake of glucose from blood into cells ; 10. reference to less {glucose to glycogen / glycogenesis} in {liver / muscles} / ref/ to excess glucose in urine ;	**max (6)**

Question Number	Answer	Mark
7(a)	1. loss of rod cells (in retinitis pigmentosa) reduces ability to{receive light / eq} ; 2. reference to rhodopsin as photosensitive pigment ; 3. light causes {change of shape (in retinal) / reference to cis- to trans- retinal; 4. causes rhodopsin to split into opsin and retinal ; 5. opsin decreases permeability of rod cell to sodium ions ; 6. reference to generator potential / hyperpolarisation ;	**max (4)**

Question Number	Answer	Mark
7(b)	1. parental genotype and possible gametes shown using acceptable symbols ; 2. correct cross shown on diagram to give child genotypes ; 3. statement that both parents are carriers of recessive allele / child receives recessive allele from each parent ; 4. child with disorder will be homozygous recessive ; [may be identified clearly in diagram] 5. {1 in 4 / 25% / 0.25} chance of each child having disorder ; 6. {1 in 2 / 50% / 0.5} chance of each child being a carrier ;	**max (5)**

Question Number	Answer	Mark
8	1. buoyancy ; 2. less dense than water ; 3. hormones ; 4. reference to steroids / named example ; 5. water-proofing / reducing evaporation ; 6. reference to {waxes / oils} / example / hydrophobic nature ; 7. thermal insulation ; 8. reference to suitable example such as blubber / subcutaneous fat ; 9. electrical insulation ; 10. reference to myelin sheath / Schwann cell / increased impulse propagation ; 11. energy store ; 12. reference to respiration release energy / compact molecule / energy for germination / reference to brown fat ; 13. cell membrane ; 14. phospholipids / polar nature / forms bi layer ; 15. metabolic water ; 16. reference to survival in desert animals ; 17. physical protection / shock absorber ; 18. around {organs / named example) ; 19. {source / store} of vitamins ; 20. named example such as A, D or E ;	**max (6)**

Unit 5H (6115/01) Genetics, human evolution and biodiversity

Question Number	Answer	Mark
1(a)	1. 63 ; [**max 2 from the following three marking points**] 2. cannot form gametes /eq ; 3. (because) chromosome pairing not possible / eq ; 4. during {meiosis / eq} ;	**max (3)**

Question Number	Answer	Mark
1(b)	1. (isolating mechanisms) prevent interbreeding (between species / populations) / barrier to reproduction / eq ; 2. (postzygotic mechanisms) allow {mating / fertilisation / eq} / eq ; 3. but prevent production of {viable / fertile} offspring / prevent offspring developing / eq ;	**(3)**

Question Number	Answer	Mark
1(c)	1. idea that species is group of organisms that can interbreed to produce fertile offspring / eq ; 2. but mule {is sterile / cannot produce offspring} ;	**(2)**

Question Number	Answer	Mark
2(a)	1. {antigens / proteins} in human serum ; 2. {promote / eq} production of antibodies (in rabbit) ; 3. antibodies produced by lymphocytes / in lymph nodes / reference to agglutination ;	**max (2)**

Question Number	Answer	Mark
2(b)	to check if antibody {present / active} / idea of giving a {100% standard / eq} ;	**(1)**

Question Number	Answer	Mark
2(c)	1. reference to the greater the precipitation, the closer the ancestry ; 2. because there are more common proteins (in serum) ; 3. (serum of) chimpanzees / gorillas precipitates more than gibbons / orang-utans ; 4. reference to 80% (relative) precipitation (gorilla and chimpanzee), 60% in orang-utan / 20% in gibbon ;	**max (3)**

Question Number	Answer	Mark
3(a)	1. age and sex structure (of a population) / eq ; 2. in form of a {histogram / bar graph} ;	**(2)**

Question Number	Answer	Mark
3(b)(i)	1. USA has greater life expectancy than Uganda ; 2. greater proportion of population in USA {in higher age groups / above 40-45 / eq} than in Uganda ; 3. reference to numbers in each age group in USA {more-or-less equal up to {45 – 49 / 50 – 54} / does not decrease much up to {45 – 49 / 50 – 54} } ; 4. (but) numbers in each age group in Uganda decrease rapidly in each older age group ; 5. majority of Uganda population is children but adults outnumber children in USA ; 6. {hardly anyone / eq} above 75 in Uganda but still {large / reasonable / eq} numbers above 75 in USA ; 7. largest age group in Uganda is 0 – 4, in USA it is 35 – 39 ;	**max (3)**

Question Number	Answer	Mark
3(b)(ii)	1. Uganda more disease / less medical care available / eq ; 2. Uganda poorer diet / less food / eq ; 3. Uganda poorer {housing / living conditions} ; 4. Uganda poorer sanitation / eq ; 5. Uganda may have more wars / eq ; 6. Uganda less provision for care of elderly ; 7. Uganda has poorer {water supply / quality} ;	**max (2)**

Question Number	Answer	Mark
3(c)	1. both populations have increased ; 2. Uganda still shows short life expectancy compared with USA ; 3. increased proportion of children in Ugandan population / little change in population figures above 40 ; 4. USA has more people living to {older ages / above 45} than in 2000 / proportion of children in population decreased ; 5. population above 80 increases in USA but still hardly anyone above 80 in Uganda ;	**max (3)**

Question Number	Answer	Mark
4(a)	each structure correctly drawn ;;;;	**(4)**

Question Number	Answer	Mark
4(b)	1. (more nutrients) increases the numbers of {cyanobacteria / algae}, more food for {zooplankton /fish} so their numbers increase ; 2. cyanobacteria produce / {toxins / eq} that kill {animals / organisms} (in the water) ; 3. create algal bloom that shades other (aquatic) plants ; 4. increase in {bacteria / decomposers } {uses up oxygen / increase BOD} ; 5. therefore {zooplankton / fish} {die / decrease in numbers} ;	**max (3)**

Question Number	Answer	Mark
4(c)	1. could inhibit {cell/ nuclear} / division / mitosis ; 2. could act as enzyme inhibitors (any form of inhibition) ; 3. could interfere with metabolic pathways / specific example ; 4. any other appropriate correct reason ;	**max (2)**

Question Number	Answer	Mark
4(d)	{the chemical pesticides could kill other organisms, not just the cyanobacteria} / {the water could be used as a source of drinking water for {people / animals} and the chemicals could disrupt food chains / any other suitable reason ;	**(1)**

Question Number	Answer	Mark
5(a)(i)	artery ;	**(1)**

Question Number	Answer	Mark
5(a)(ii)	*Any two from the following <u>pairs</u>:* 1. thick {wall / layer} of (smooth) muscle / thick elastic {layer / wall} ; 2. allows artery to expand / withstand pressure from the pulse of blood / eq ; 3. collagen (fibres) ; 4. provides strength / eq ; 5. smooth lining ; 6. prevent resistance to blood flow / eq ; 7. small lumen / eq ; 8. to maintain high pressure / eq ;	**max (4)**

Question Number	Answer	Mark
5(b)	1. inhibits the enzyme (that catalyses the conversion) ; 2. by active site-directed inhibition / eq ; 3. inhibitor {is a similar shape to the substrate } / blocks the active active site ; 4. by non active site-directed inhibition ; 5. inhibitor attaches to enzyme at point other than active site / eq ; 6. (and) causes active site to change shape ;	**max (4)**

Question Number	Answer	Mark
6(a)	1. peptide {bond / link} ; 2. (formed by) condensation ; 3. between {carboxyl / COOH} and {amine / amino / NH_2} ;	**max (2)**

Question Number	Answer	Mark
6(b)	1. ionic ; 2. hydrogen ; 3. disulphide stronger than hydrogen and ionic / eq ;	**(3)**

Question Number	Answer	Mark
6(c)	glucose able to be absorbed in stomach / no need for digestion of glucose / any other suitable suggestions ;	**(1)**

Question Number	Answer	Mark
6(d)	1. disulphide links {cannot form} ; 2. reference to disulphide links form between cysteine molecules ; *3. {chains / chain A and chain B} cannot be linked correctly ;* *4. {molecule /insulin / polypeptide} has a different {shape / tertiary structure / 3D-structure eq} ;* 5. (therefore) insulin {has different properties / not formed / eq} ; 6. insulin receptor sites on {cell surface membrane / eq} ; 7. receptor sites do not accept this insulin / eq ; 8. blood glucose level would {continue to rise / not fall / take longer to decrease} ; 9. reference to decrease in uptake of glucose from blood into cells ; 10. reference to less {glucose to glycogen / glycogenesis} in {liver / muscles} / ref/ to excess glucose in urine ;	**max (6)**

Question Number	Answer	Mark
7(a)	1. loss of rod cells (in retinitis pigmentosa) reduces ability to{receive light / eq} ; 2. reference to rhodopsin as photosensitive pigment ; 3. light causes {change of shape (in retinal) / reference to cis- to trans- retinal; 4. causes rhodopsin to split into opsin and retinal ; 5. opsin decreases permeability of rod cell to sodium ions ; 6. reference to generator potential / hyperpolarisation ;	**max (4)**

Question Number	Answer	Mark
7(b)	1. parental genotype and possible gametes shown using acceptable symbols ; 2. correct cross shown on diagram to give child genotypes ; 3. statement that both parents are carriers of recessive allele / child receives recessive allele from each parent ; 4. child with disorder will be homozygous recessive ; [may be identified clearly in diagram] 5. {1 in 4 / 25% / 0.25} chance of each child having disorder ; 6. {1 in 2 / 50% / 0.5} chance of each child being a carrier ;	**max (5)**

Question Number	Answer	Mark
8	1. hormones ; 2. reference to steroids / named example ; 3. water-proofing / eq ; 4. reference to {oils / named example / hydrophobic nature} ; 5. thermal insulation ; 6. reference to suitable example such as blubber / subcutaneous fat ; 7. electrical insulation ; 8. reference to {release of energy by respiration / compact molecule / brown fat ; 9. energy store ; 10. reference to respiration release energy / compact molecule / energy for germination / reference to brown fat ; 11. cell membrane ; 12. phospholipids / polar nature / forms bi layer ; 13. physical protection / shock absorber ; 14. around {organs / named example) ; 15. {source / store} of vitamins ; 16. named example ;	**max (6)**

Unit 6 (6106/02) Written alternative to coursework

Question Number	Answer	Mark
1(a)		**(3)**

	Opening angle / degrees	
Stalk number	**Lightly shaded habitat**	**Heavily shaded habitat**
1	70.75	75.75
2	65.33	80.50
3	68.50	68.17
4	52.00	82.33
5	72.25	69.25
6	66.50	74.00
7	71.75	79.00
8	66.67	78.50
9	75.17	81.75
10	58.25	73.33
Mean	66.72	76.26

1. table of values with correct headings and units ;
2. correct calculations of degrees ;
3. correct overall means calculated from those in each habitat ;

OR (using ranked data)

	Opening angle / degrees	
Stalk number	**Lightly shaded habitat**	**Heavily shaded habitat**
1	52.00	68.17
2	58.25	69.25
3	65.33	73.33
4	66.50	74.00
5	66.67	75.75
6	68.50	78.50
7	70.75	79.00
8	71.75	80.50
9	72.25	81.75
10	75.17	82.33
Mean	66.72	76.26

Question Number	Answer	Mark
1(b)	**A** axes correct orientation and scale with units and labels ; **F** bar chart with key and points plotted correctly ;	**(2)**

Question Number	Answer	Mark
1(c)	there is no <u>significant</u> difference between the opening angle of leaves in lightly and heavily shaded habitats ;	**(1)**

Question Number	Answer	Mark
1(d)	1. calculated value (3.62) is greater than the critical value at 5% level 2.10) ; 2. (therefore) there is a <u>significant</u> difference between the opening angle of the leaflets in lightly and heavily shaded habitats ;	**(2)**

Question Number	Answer	Mark
1(e)	1. difficult to read the angle of special protractor against the standard (protractor) ; 2. likely that protractor will cause displacement of leaflet ; 3. not all leaflets will be measured at exactly 20 minutes / eq ; 4. reference to any suitable difference between leaflets on same stalk ; 5. effect may be different in lab conditions compared to field ;	**max (3)**

Question Number	Answer	Mark
2(a)	1. use one site ; 2. two equal areas ; 3. one stated method of standardising ploughing (e.g. depth, time) ; 4. at least <u>two</u> named abiotic variables considered ; 5. sample(s) of earthworms / casts collected <u>before</u> ploughing /eq ; 6. stated time for sampling after ploughing (minimum of 1 day) ; 7. suitable method of randomising sampling ; 8. number of samples (minimum 10) in each area ; 9. technique of collecting casts or earthworms ; 10. in stated area ; 11. dry mass of casts determined ; 12. collect specimen material {in the same season / at same time of year / at same time of day} ; 13. repeat investigation a minimum of three times ; **SPG** Account is concise and well-organised, there is good use of technical vocabulary and almost no spelling errors – **2 marks** There is some lack of organisation, limited vocabulary and a number of spelling errors – **1 mark** The account lacks organisation, there is little or no technical vocabulary and many spelling errors – **0 marks**	**max (8)** **up to (2)** **Total (10)**

Question Number	Answer	Mark
2(b)	1. table of raw data (to match the method) with accurately labelled rows and columns <u>with units</u> ; 2. reference to calculation of means ; 3. suitable graphical format that matches table and allows comparison ; 4. correctly labelled and orientated axes with units ; 5. reference to suitable type of statistical test ; 6. use of <u>stated</u> null hypothesis ;	**max (6)**

Question Number	Answer	Mark
2(c)	**Limitations:** 1. hard to collect all {earthworms / casts} (at each site) ; 2. difficult to ensure same abiotic conditions for all collections / before and after ploughing / eq ; 3. not all earthworms produce worm casts / can be extracted ; 4. different types / species of earthworm in different parts of the field; 5. birds / other predators may remove earthworms ; **Further work:** 6. investigate numbers of earthworms in two sites {in different seasons / over a number of years / eq} ; 7. investigate numbers of earthworms with no ploughing ; 8. {numbers / proportion} of juveniles (to assess future populations) ; 9. survival of {types /species} of earthworm to (two) ploughing techniques ; 10. investigate earthworm numbers / populations with another named human intervention (e.g. direct drilling, land with and without animal dung);	**up to (4)** **up to (4)** **max (5)**

Unit 6 (6106/03) Synoptic Paper

Question Number	Answer	Mark
1(a)	methane **and** carbon dioxide / formulae ;	**(1)**

Question Number	Answer	Mark
1(b)(i)	1. (pH) decreases from day 0 to day 10 ; 2. increases from day 10 to day 30 ; 3. rate of decrease greater than rate of increase / eq ; 4. credit a manipulated quantitative comment ;	**max (2)**

Question Number	Answer	Mark
1(b)(ii)	**Day 0 to day 10**: 1. ref to the production of carbon dioxide / CO_2 ; 2. reference to production of organic acids / named examples ; **Day 10 to day 30**: 3. {organic acids / named example} converted to {methane / non-acidic compounds} ; 4. reference to activity of microorganisms ;	**max (3)**

Question Number	Answer	Mark
1(c)	1. (ions of heavy metals) are enzyme inhibitors / eq ; 2. credit further detail of inhibitors e.g. (non) active site-directed or active site-directed ; 3. may {be toxic / eq} to microorganisms /eq ; 4. {reduces / stops} production of biogas / eq ;	**max (2)**

Question Number	Answer	Mark
2(a)(i)	1. (one of) {alternative / different} forms of a gene / eq ; 2. reference to responsible for determining different varieties of one characteristic ; 3. idea of each allele has unique sequence of bases ; 4. (allele)situated at a (gene) <u>locus</u> / eq ;	**max (2)**

Question Number	Answer	Mark
2(a)(ii)	1. appearance / characteristics (of an organism) / eq ; 2. depends on genotype **and** environment ;	**(2)**

Question Number	Answer	Mark
2(b)	1. gametes shown correctly ; 2. genotypes of offspring ; 3. probability = 0.33 / ⅓ / 33% ;	**(3)**

Question Number	Answer	Mark
2(c)	1. idea that ears etc., have a lower temperature (than the rest of body) ; 2. (therefore) enzyme is {active / not denatured / eq} ; 3. pigment produced / eq ; 4. no pigment produced in other parts because enzyme is {inactive / denatured} / eq ;	**max (3)**

Question Number	Answer	Mark
2(d)(i)	1. a {sequence / series / chain / eq} of reactions ; 2. each catalysed by an enzyme / eq ; 3. product of one reaction forms substrate for the next / eq ;	**max (2)**

Question Number	Answer	Mark
2(d)(ii)	1. reference to point mutation as a change in a base / eq ; 2. reference to point mutation resulting in a change in the amino acid (sequence of tyrosinase) ; 3. may change shape of {enzyme / active site} ; 4. {substrate / tyrosine} no longer fits into active site / no enzyme substrate complexes formed / eq ; 5. tyrosine not converted to DOPA / eq ; 6. no {melanin / pigment} produced ;	**max (3)**

Quick guide to the scientific content mark

AS content	A2 content	S mark
No relevant or accurate content at all		0
Very few correct facts		1
Some correct facts	Little or no relevant A2 content	3
Generally accurate AS content	Some A2 content, but lacks depth and accurate details	5
Generally accurate AS content	Average A2 content	7
Accurate and relevant AS content **must be present**	Good A2 content	9
Accurate and relevant AS content **must be present**	Excellent A2 content	11

AS content ONLY	**S = 3 max**
A2 content ONLY	**S = 7 max**

ESSAY MARK SCHEME

Outline scheme for marking essay questions 3, 4B and 5H

11 available for Scientific content (S)
2 available for Balance (B)
2 available for Coherence (C) **Total maximum mark available: 15**

Scientific content (S)

Scientific content (S)	Description
11 (good)	The essay demonstrates a sound understanding of the topic and contains a significant amount of material from most areas of the mark scheme, **including A2 content**. Suitable examples are included and the candidate has clearly and coherently linked together information from different parts of the specification.
9 (above average)	An above average essay, with accurate content. The essay includes a good balance of material from several areas of the mark scheme, **including A2 content**, and examples where appropriate. There may be some minor factual errors.
7 (average)	The essay includes relevant information from some areas of the mark scheme, **including A2 content**. The candidate links together some facts and principles. Some examples are included. There may be some minor factual errors.
5 (below average)	The essay includes some generally factually accurate and relevant material, and there is some attempt to link material from more than one area of the mark scheme. **The A2 content, in particular, lacks depth and accurate details**.
3 (poor)	There are some correct facts, but the essay lacks depth and accuracy. The essay contains **little or no relevant information from the A2 content**.
1 (poor)	There are very few correct facts. The essay is generally superficial and inaccurate.
0 (poor)	No correct or relevant material is included.

Note: If a **scientific content** mark of **0**, **1**, or **3** is awarded, it is very **unlikely** that a **balance** mark of more than **1** is appropriate.

An essay containing **AS** content **only** can be awarded a **max of 3** for scientific content.

An essay containing **A2** content **only** can be awarded a **max of 7** for scientific content.

S = 11 marks

Balance (B)

2 Most of the main topic areas outlined are covered
Some discussion of each of the areas chosen, illustrated with suitable examples where appropriate
Material included is all relevant to the topic and the candidate has linked information from more than one area of the specification.
Few, if any, errors

1 Some of the main topic areas outlined are covered.
Some discussion of each of the areas chosen.
Some irrelevant material included.
There are some examples which link together different areas of the specification. Some errors.

0 Very limited account, possibly only one aspect chosen
Material mostly irrelevant
No examples of the candidate linking information from different areas
Large number of errors

B = 2 marks

Coherence (C)

2 Material logically presented, with little or no repetition
Essay has coherence, ideas are developed well; continuous prose used throughout
Essay has an introduction and a conclusion, summing up the main points
Technical terms have been used correctly
Spelling, punctuation and grammar are sound

1 Material is presented in an orderly way and some ideas developed
Continuous prose used throughout
The introduction and conclusion may be present, but brief
Technical terms are used and generally in the correct context
Spelling, punctuation and grammar are generally sound

0 Essay style not used
Material in note form or numbered points
Very poor standard of spelling, punctuation and grammar

C = 2 marks

Question Number	Answer	Mark
3	*Energy flow and succession in ecosystems* introduction could include references to producers and consumers, food chains and food webs, succession as changes in community structure over time –	
AS	outline of autotrophic nutrition – roles of producers and consumers – food chains and food webs – how energy is transferred through food chains and food webs – why energy is lost between trophic levels –	
A2	**ecosystems are dynamic and subject to change –** **example of succession (grassland or abandoned farmland to woodland) –** **seral stages –** **plagio and climatic climax communities –** **Scientific content 11 marks** **Balance 2 marks** **Coherence 2 marks**	**(15)**

Question Number	Answer	Mark
4B	*Sexual reproduction in flowering plants and genetic variation* introduction could include reference to sexual reproduction involving the fusion of gametes, leading to genetic variation **AS** structure and functions of the principal parts of a flower – pollination – adaptations to insect pollination – adaptations to wind pollination – events leading to fertilisation – mechanisms for ensuring cross-pollination – **A2** **continuous and discontinuous variation -** **meiosis as a source of genetic variation –** **random fertilisation –** **mutations –** **Scientific content 11 marks** **Balance 2 marks** **Coherence 2 marks**	**(15)**

Question Number	Answer	Mark
5H	*The structure of proteins, and how proteins provide evidence for human evolution* introduction could include an outline of protein structure, references to using protein structure to investigate phylogenetic relationships –	
AS	structure of an amino acid – formation of peptide bond – formation of polypeptides - primary, secondary, tertiary and quaternary structure – roles of ionic, hydrogen and disulphide bonds in protein structure – reference to globular and fibrous proteins –	
A2	**use of proteins for investigating phylogenetic relationships –** **immunological studies of blood sera –** **amino acid sequences -** **references to cytochromes, haemoglobin amino acid sequences –** **Scientific content 11 marks** **Balance 2 marks** **Coherence 2 marks**	**(15)**

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