



Mark Scheme (Results)

Summer 2013

GCE Biology (6BI04)

Paper 01

Unit 4: The Natural Environment and Species Survival

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General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

Question Number	Answer	Additional Guidance	Mark
1(a)	C;		(1)

Question Number	Answer	Additional Guidance	Mark
1(b)	1. reference to mitosis ; 2. (followed by) cytokinesis / {cells divide into 2 cells / eq}; 3. reference to repeated (many times) ;	Not meiosis Ignore binary fission, asexual reproduction	(2)

Question Number	Answer	Additional Guidance	Mark
1(c)(i)	1. idea that each (small) square represents 1% ; 2. {count / determine} number of squares containing <i>Pleurococcus</i> ; 3. credit an indication of how the percentage was calculated ;		(2)

Question Number	Answer	Additional Guidance	Mark
1(c)(ii)	A ;		(1)

Question Number	Answer	Additional Guidance	Mark
1(c)(iii)	1. idea of obtaining more data (outside) ; 2. reference to processing the data eg plotting a (scatter) graph, correlation test ; 3. credit correct reference to interpretation of {test / graph}; 4. reference to an extended study eg laboratory experiments ; 5. idea that the extended study would be repeated ; 6. idea of looking at results of previous studies ;	Do not credit ref to collecting data at different times of day Accept Spearman's rank, Pearson's correlation eg draw a line of best fit	(3)

Question Number	Answer	Additional Guidance	Mark								
1(c)(iv)	1. suitable named factor ; 2. description of the possible effect on {numbers / distribution} ;	Ignore predators <table border="1" data-bbox="1126 1007 1832 1329"> <tr> <td data-bbox="1126 1007 1464 1114">snails / grazers /herbivores / primary consumers</td> <td data-bbox="1469 1007 1832 1114">less as being eaten</td> </tr> <tr> <td data-bbox="1126 1114 1464 1155">disease on trees</td> <td data-bbox="1469 1114 1832 1155">less as smaller habitat</td> </tr> <tr> <td data-bbox="1126 1155 1464 1225">disease in <i>Pleurococcus</i></td> <td data-bbox="1469 1155 1832 1225">less as being destroyed</td> </tr> <tr> <td data-bbox="1126 1225 1464 1329">competition (from other organisms)</td> <td data-bbox="1469 1225 1832 1329">less due to lack of resources eg light, space</td> </tr> </table>	snails / grazers /herbivores / primary consumers	less as being eaten	disease on trees	less as smaller habitat	disease in <i>Pleurococcus</i>	less as being destroyed	competition (from other organisms)	less due to lack of resources eg light, space	(2)
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competition (from other organisms)	less due to lack of resources eg light, space										

Question Number	Answer	Additional Guidance	Mark
2(a)(i)	1. idea of {fast / maximum} {gas exchange / uptake of carbon dioxide / eq}; 2. idea of penetration of light ; 3. idea that carbon dioxide is used in the {light-independent stage / Calvin cycle / formation of GP}; OR idea that light is used in {light-dependent stage / photolysis / photophosphorylation / eq } ;	Accept CO ₂ but ignore incorrect formula	(2)

Question Number	Answer	Additional Guidance	Mark
2(a)(ii)	1. transport (in xylem) of water (to the leaves) / eq ; 2. transport (in phloem) of {sucrose / sugar / carbohydrates } (away from the leaves) / eq; 3. (water) for {light-dependent reaction / photolysis / source of hydrogen (ions)}; OR idea of (transporting sugar) to make more room for more carbohydrate synthesis ;	Accept H ₂ O but ignore incorrect formula Accept phosphates but ignore mineral ions Not glucose or any other name sugars Accept reducing power, NADPH Accept (phosphates) for ATP synthesis	(2)

Question Number	Answer	Additional Guidance	Mark												
2(b)(i)	<table border="1"> <thead> <tr> <th>Reaction</th> <th>Details</th> <th>Structure</th> </tr> </thead> <tbody> <tr> <td></td> <td></td> <td>{ thylakoid (membrane) / grana / granum} ;</td> </tr> <tr> <td></td> <td></td> <td>stroma ;</td> </tr> <tr> <td></td> <td></td> <td>stroma ;</td> </tr> </tbody> </table>	Reaction	Details	Structure			{ thylakoid (membrane) / grana / granum} ;			stroma ;			stroma ;	<p>Not thylakoid space Ignore electron transport chain</p> <p>Not stoma / stomata</p> <p>Not stoma / stomata</p>	(3)
Reaction	Details	Structure													
		{ thylakoid (membrane) / grana / granum} ;													
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Question Number	Answer	Additional Guidance	Mark
2(b)(ii)	C ;		(1)

Question Number	Answer	Additional Guidance	Mark
2(b)(iii)	C ;		(1)

Question Number	Answer	Additional Guidance	Mark
2(b)(iv)	<ol style="list-style-type: none"> 1. reference to conversion (of GALP) to glucose / eq; 2. (which is) β glucose ; 3. reference to formation of glycosidic bonds ; 4. between C₁ and C₄ / these bonds are 1-4 (glycosidic bonds) ; 5. by condensation ; 6. reference to {straight / unbranched} (chains of glucose) ; 7. reference to cellulose as a {polysaccharide / polymer of glucose / eq} ; 	<p>NB this is a question about the formation of cellulose, not its structure</p> <p>NB a reference to these bonds being formed must be made</p>	(4)

Question Number	Answer	Additional Guidance	Mark
3(a)	A ;		(1)

Question Number	Answer	Additional Guidance	Mark
3* (b)	<p>QWC – Spelling of technical terms must be correct and the answer must be organised in a logical sequence</p> <ol style="list-style-type: none"> 1. idea that biofuel production may (overall) results in more carbon dioxide in the atmosphere ; <p style="text-align: center;">OR</p> <p>idea that carbon neutral means that the carbon dioxide produced equals the carbon dioxide used ;</p> <ol style="list-style-type: none"> 2. idea of forests as carbon {sinks / eq} ; 3. idea that {clearing land / deforestation} results in (net) increase in carbon dioxide (in atmosphere) ; 4. (less plants means) less carbon dioxide {removed / used / eq} by photosynthesis ; 5. {burning / eq} trees produces carbon dioxide ; 6. idea that (increased) decomposition produces carbon dioxide; 7. idea of using {(fossil) fuels / petrol / diesel} by {lorries / machinery / eq} produces carbon dioxide ; 8. {burning /eq} of biofuels produces carbon dioxide ; 	<p>QWC emphasis is clarity of expression</p> <p>Accept stores / sumps</p>	(5)

Question Number	Answer	Additional Guidance	Mark
3(c)	1. reference to production of {greenhouse gases / named greenhouse gas} ; 2. idea that these gases {build up/ remain / form a layer} in (upper) atmosphere; 3. which {absorb / trap / eq} {heat energy / infra-red / IR / eq} ; 4. reflected from earth's surface ; 5. idea that increased levels of these gases increase the greenhouse effect ; 6. idea that (mean) temperature of earth's {surface / atmosphere} is increasing ;	Accept carbon dioxide, water vapour, sulphur dioxide, oxides of nitrogen Not methane Accept long wavelength light	(4)

Question Number	Answer	Additional Guidance	Mark
4(a)(i)	NPP = 4680 ; R = 5720 ;	NB If there are no answers in the box, look for answers in the space below question If answers are the wrong way round, award 1 mark If both answers are wrong, accept R = 10168.9 / 10169	(2)

Question Number	Answer	Additional Guidance	Mark
4(a)(ii)	1. $NPP = GPP - R$ / eq; 2. 55% (GPP energy) is lost / eq ; 3. energy lost as heat / eq ; 4. to provide energy for { active transport / any other named energy-requiring process} ; 5. NPP is {(stored) energy / energy available for next trophic level / eq} ;	<p>Accept correct description in words</p> <p>eg movement (opening of flowers, turning of leaves), glycolysis</p> <p>Ignore idea that energy is used for respiration unqualified</p> <p>Accept biomass</p>	(3)

Question Number	Answer	Additional Guidance	Mark
4(b)	1. cattle {are primary consumers / herbivores / eat grass / eat plants / eq} ; 2. (therefore) gain energy (available as NPP) ; 3. idea of grazing capacity of the grassland ; 4. idea of affect on yield of {meat / milk / eq} ; 5. idea of changing to a more {efficient / NPP yielding} crop ;	<p>Accept idea that farmer is ensuring that there is enough NPP available for his cattle</p> <p>Accept growth rate</p>	(3)

Question Number	Answer	Additional Guidance	Mark
4(c)	<ol style="list-style-type: none"> idea of variation over short periods of time; idea that whole year gives an {average / overall / eq} value ; idea that biomass includes {all / undigestible / inedible / eq} organic material ; idea that rate of productivity may influence how much grazing is possible ; 	eg more NPP on a sunny day, seasonal	(2)

Question Number	Answer	Additional Guidance	Mark
5(a)	<p>A = adenine C = cytosine G = guanine T = thymine ;</p>	<p>Accept reasonable phonetic spellings Not: adenosine cysteine glycine thiamine, thyosine, tyrosine</p>	(1)

Question Number	Answer	Additional Guidance	Mark
5(b)(i)	<ol style="list-style-type: none"> idea that each amino acid is coded for by three {nucleotides / bases} ; credit quoted example / idea that 12 {nucleotides / bases} code for 4 amino acids ; 	<p>Accept in context of RNA</p> <p>AAT / AAC = leucine, CAG = valine, TTT = lysine</p>	(2)

Question Number	Answer	Additional Guidance	Mark
5(b)(ii)	<ol style="list-style-type: none"> idea that each {triplet is discrete / each base is only used once in a triplet / eq} ; idea that AAT + AAC + CAG + TTT gives 4 (distinct) { triplets / codes} ; 	<p>Accept a specific example eg the first T can only be used in code for first leucine</p> <p>Accept a description of how the code could be read if overlapping</p>	(2)

Question Number	Answer	Additional Guidance	Mark
5(b)(iii)	<ol style="list-style-type: none"> idea that more than one code can be used for a {particular amino acid/ stop code} ; AAT and AAC code for leucine ; 	Accept more codes than are needed to code for all the amino acids (and stop code)	(2)

Question Number	Answer	Additional Guidance	Mark
5(c)	B ;		(1)

Question Number	Answer	Additional Guidance	Mark
5* (d)	<p>QWC – Spelling of technical terms must be correct and the answer must be organised in a logical sequence</p> <ol style="list-style-type: none"> 1. reference to mRNA with sequence UUA UUG GUC AAA ; 2. idea that ribosome is involved ; 3. idea that each tRNA molecules is attached to one (specific) amino acid ; 4. credit example of tRNA anticodon with specific amino acid 5. reference to anticodons on tRNA {bind / link to / line up against / eq} codons on mRNA ; 6. credit a specific example (from this DNA) ; 7. idea of hydrogen bonds between bases (of tRNA and mRNA) ; 8. reference to formation of peptide {bonds / links} between (adjacent) amino acids ; 	<p>QWC emphasis is logical sequence NB The mps do not have to be given in this order necessarily</p> <p>Not tRNA carries amino acids</p> <p>AAU /AAC = leucine, CAG = valine, UUU = lysine</p> <p>Ignore complementary</p> <p>eg UUA codon and AAU anticodon</p> <p>Accept between codon and anticodon</p>	(5)

Question Number	Answer	Additional Guidance	Mark
6(a)	<ol style="list-style-type: none"> 1. bacteria have DNA, viruses have DNA or RNA ; 2. idea that bacteria have {circular / eq} genetic material, viruses have {linear / straight} ; 3. bacterial DNA is double-stranded, viral {DNA / RNA} is single (or double) stranded / eq; 4. bacteria (may) have plasmids, viruses do not have plasmids / eq; 	<p>NB piece answers together throughout</p> <p>Do not accept in context of plasmid</p>	(2)

Question Number	Answer	Additional Guidance	Mark
6(b)(i)	<ol style="list-style-type: none"> 1. reference to {phagocytosis /endocytosis / engulfing} ; 2. credit details of phagocytosis ; 3. reference to bacterium inside a {vacuole / vesicle / phagolysosome} ; 	<p>eg formation of {pseudopodia / membrane extensions around bacteria} / cytoplasmic streaming / binding to bacteria</p> <p>Not phagolysosome</p>	(2)

Question Number	Answer	Additional Guidance	Mark
6(b)(ii)	<ol style="list-style-type: none"> 1. idea that bacteria need to be accessible to antibiotics ; 2. idea of bacteria inside macrophages ; 3. reference to waxy layer of (these) bacteria ; 4. idea that (bacteriostatic) antibiotics affect dividing bacteria; 5. reference to antibiotic resistance (of these bacteria) ; 	<p>Not bacteriocidal antibiotics</p>	<p>(2)</p>

Question Number	Answer	Additional Guidance	Mark
6(b)(iii)	<ol style="list-style-type: none"> 1. idea of { dead / attenuated / eq } { organisms / pathogen / bacterium / eq } put into person; 2. reference to (stimulation of) { specific / primary } (immune) response ; 3. credit details of T helper cell activation ; 4. credit details of B cell activation ; 5. credit details of T killer cell activation ; 6. reference to production of memory cells ; 	<p>NB not simply crediting ref to vaccination as in stem of question Accept antigen</p> <p>eg macrophages as APCs</p> <p>eg involvement of cytokines, B cells as APCs</p> <p>eg involvement of cytokines, infected cells as APCs</p>	<p>(3)</p>

Question Number	Answer	Additional Guidance	Mark
6(c)	<ol style="list-style-type: none">1. reference to {further lung damage / severe breathing problems / eq} ;2. idea that the <i>Mycobacterium</i> get into the {blood / lymph};3. idea that organ failure (leads to death) ;4. idea of {reduced / weakened} immune response (due to a loss of T cells) ;5. credit detail of role of T (helper) cells ;6. credit detail of effect of no T killer cells ;7. credit detail of effect of no B cells ;8. ref to {secondary / opportunistic / other} infections (causing death) ;	<p>eg cannot obtain enough oxygen</p> <p>eg production of cytokines</p> <p>eg infected cells will not be destroyed</p> <p>eg no antibody produced</p>	<p>(4)</p>

Question Number	Answer	Additional Guidance	Mark
7(a)(i)	<ol style="list-style-type: none"> {skin / epidermis} is a barrier / eq ; reference to keratin ; reference to lack of receptors (for the virus) ; 	<p>Accept prevents entry but not prevents infection</p> <p>NB keratin in skin forms a barrier = 2 marks</p> <p>Accept skin has different receptors</p>	(2)

Question Number	Answer	Additional Guidance	Mark
7(a)(ii)	<ol style="list-style-type: none"> idea that viruses only {infect / attach to / eq} {specific receptors / specific cells / host cells} ; idea that receptors not present on {blood cells / endothelial cells / eq} ; reference to {destruction / eq} of viruses by phagocytes ; 	<p>Accept white blood cells. neutrophils; PMN</p> <p>Ignore macrophages</p> <p>Not lymphocytes, T cells, plasma cells</p>	(2)

Question Number	Answer	Additional Guidance	Mark
7(b)	<ol style="list-style-type: none"> 1. reverse transcriptase (required) in HIV, no reverse transcriptase in cold virus ; 2. DNA formed (using RNA) in HIV, {no DNA formed / RNA used to make protein / translation} in cold virus ; 3. reference to {provirus / latency / delay in virus formation / eq} in HIV infection, {no provirus / lytic cycle / (immediate) formation of virus particles / eq} in cold virus ; 	<p>NB answers can be pieced together but candidates still have to state both parts of mark point</p>	(2)

Question Number	Answer	Additional Guidance	Mark
7(c)(i)	<ol style="list-style-type: none"> 1. to synthesise (common cold) RNA / eq ; 2. for amino acids to bind to tRNA / eq ; 3. to synthesise (common cold) protein (capsid) / eq ; 	<p>Accept translation</p>	(2)

Question Number	Answer	Additional Guidance	Mark
7(c)(ii)	<ol style="list-style-type: none"> idea of enzyme affecting {molecules in membrane / proteins / (phospho)lipids / cholesterol} ; enzyme breaks {bonds / named bonds / eq} ; reference to {(by) hydrolysis / hydrolytic enzymes} ; credit detail of enzyme action ; reference to enzyme U as {protease / lipase / cholesterase} ; 	<p>eg lowers activation energy, binding of active site to substrate (cannot credit reference to catalyst, as in stem of question)</p> <p>Ignore lysosyme</p>	(3)

Question Number	Answer	Additional Guidance	Mark
8(a)(i)	<ol style="list-style-type: none"> (successful interbreeding) produces offspring; (same species produce) fertile (offspring); credit reason why offspring of different species might be infertile ; 	<p>Accept converse throughout</p> <p>Ignore viable</p> <p>eg genetic incompatibility, different number of chromosomes, poor quality gametes , low number of gametes</p>	(3)

Question Number	Answer	Additional Guidance	Mark
8(a)(ii)	<ol style="list-style-type: none"> 1. reference to reproductive isolation ; 2. different breeding times; 3. do not recognise {courtship displays / songs / eq} ; 4. physically incompatible eg genitalia ; 		(3)
Question Number	Answer	Additional Guidance	Mark
8(b)	<ol style="list-style-type: none"> 1. idea that the two species share the same habitat ; 2. idea that the two species experience the same environmental conditions ; 3. (therefore) the same selection pressures ; 4. idea that they are both well-adapted (to their environment) ; 5. idea that no mutations have happened that {improve / change} their {phenotypes / survival}; 6. {no / few} changes in allele frequency / gene pool is stable ; 7. idea that there has been very little change in environment (over the years) ; 	<p>Accept similar</p> <p>NB this needs to be in the context of both species being subjected to the same selection pressures</p> <p>Accept similar</p>	(3)

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