Mark Scheme (SAM)

Pearson Edexcel International Advanced Level in Biology

Unit 4: The Natural Environment and Species Survival

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.
- Mark schemes will indicate within the table where, and which strands of Quality of Written Communication, are being assessed. The strands are as follows:
    i. ensure that text is legible and that spelling, punctuation and grammar are accurate so that meaning is clear
    ii. select and use a form and style of writing appropriate to purpose and to complex subject matter
    iii. organise information clearly and coherently, using specialist vocabulary when appropriate.

Using the Mark Scheme

Examiners should NOT give credit for incorrect or inadequate answers, but allow candidates to be rewarded for answers showing correct application of principles and knowledge. Examiners should therefore read carefully and consider every response: even if it is not what is expected, it may still be creditworthy.

The mark scheme gives examiners:

- an idea of the types of response expected
- how individual marks are to be awarded
- the total mark for each question
- examples of responses that should NOT receive credit.

/	Means that the responses are alternatives and either answer should receive full credit.
()	Means that a phrase/word is not essential for the award of the mark, but helps the examiner to get the sense of the expected answer.
Bold	Phrases/words in **bold** indicate that the meaning of the phrase or the actual word is **essential** to the answer.
ecf/TE/cq	(error carried forward)(transfer error)(consequential) means that a wrong answer given in an earlier part of a question is used correctly in answer to a later part of the same question.

Candidates must make their meaning clear to the examiner to gain the mark. Do not give credit for correct words/phrases which are put together in a meaningless manner. Answers must be in the correct context.

Quality of Written Communication

Questions that involve the writing of continuous prose require candidates to:

- write legibly, with accurate use of spelling, grammar and punctuation in order to make the meaning clear
- select and use a form and style of writing appropriate to purpose and to complex subject matter
- organise information clearly and coherently, using specialist vocabulary when appropriate.

Full marks will be awarded if the candidate has demonstrated the above abilities. Questions where Quality of Written Communication is likely to be particularly important are indicated (Quality of Written Communication) in the mark scheme, but this does not preclude others.

Question Number	Answer	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	Mark
1(c)(i)	1. Idea that each (small) square represents 1% 2. {Count/determine} number of squares containing *Pleurococcus* 3. Credit an indication of how the percentage was calculated	(2)

Question Number	Answer	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, e.g. plotting a (scatter) graph, correlation test 3. Credit correct reference to interpretation of {test/graph 4. Reference to an extended study, e.g. laboratory experiments 5. Idea that the extended study would be repeated 6. Idea of looking at results of previous studies	Do NOT credit reference to collecting data at different times of day. ACCEPT Spearman's rank, Pearson's correlation. 2. For example, 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. snails/grazers /herbivores/primary consumers — less as being eaten disease on trees — less as smaller habitat disease in *Pleurococcus* — less as being destroyed competition (from other organisms) — less due to lack of resources,e.g. light, space	**(2)**

Total for Question 1 = 11 Marks

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_2O but IGNORE incorrect formula. IGNORE mineral ions. NOT glucose or any other name sugars. ACCEPT reducing power, NADPH.	**(2)**

Question Number	Answer	Additional Guidance	Mark
2(b)(i)	<table><tr><th>Reaction</th><th>Structure</th></tr><tr><td>R</td><td>{thylakoid (membrane)/grana/ granum}</td></tr><tr><td>S</td><td>stroma</td></tr><tr><td>T</td><td>stroma</td></tr></table>	NOT thylakoid space. IGNORE electron transport chain. NOT stoma/stomata. NOT stoma/stomata.	(3)

Question Number	Answer	Mark
2(b)(ii)	C	(1)

Question Number	Answer	Mark
2(b)(iii)	C	(1)

Question Number	Answer	Additional Guidance	Mark
2(b)(iv)	1. Reference to conversion (of GALP) to glucose/eq 2. (Which is) β glucose 3. Reference to formation of glycosidic bonds 4. Between C_1 and C_4/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}	N.B. this is a question about the **formation** of cellulose, not its structure. N.B. a reference to these bonds being formed must be made.	**(4)**

Total for Question 2 = 13 Marks

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

Question Number	Answer	Additional Guidance	Mark
*3(b) Quality of Written Communication	(Quality of Written Communication – the answer must be organised in a logical sequence.) 1. Idea that biofuel production may (overall) results in more carbon dioxide in the atmosphere OR Idea that carbon neutral means that the carbon dioxide produced equals the carbon dioxide used 2. Idea of forests as carbon {sinks/eq} 3. Idea that {clearing land/deforestation} results in (net) increase in carbon dioxide (in atmosphere) 4. (Fewer 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	ACCEPT stores.	(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 short wavelength light.	**(4)**

Total for Question 3 = 10 Marks

Question Number	Answer	Additional Guidance	Mark
4(a)(i)	NPP = 4680 R = 5720	N.B. if there are no answers in the box, look for answers in the space below question. 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}	ACCEPT correct description in words. For example, movement (opening of flowers, turning of leaves), glycolysis. IGNORE idea that energy is used for respiration unqualified. ACCEPT biomass.	**(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	ACCEPT idea that farmer is ensuring that there is enough NPP available for his cattle. ACCEPT growth rate.	**(3)**

Question Number	Answer	Additional Guidance	Mark
4(c)	1. Idea of variation over short periods of time 2. Idea that whole year gives an {average/overall/eq} value 3. Idea that biomass includes {all/undigestible/inedible/eq} organic material 4. Idea that rate of productivity may influence how much grazing is possible	For example, more NPP on a sunny day, seasonal.	**(2)**

Total for Question 4 = 10 Marks

Question Number	Answer	Additional Guidance	Mark
5(a)	A = adenine C = cytosine G = guanine T = thymine	ACCEPT reasonable phonetic spellings. NOT: Adenosine Cysteine Glycine Thiamine, thyosine, tyrosine.	**(1)**

Question Number	Answer	Additional Guidance	Mark
5(b)(i)	1. Idea that each amino acid is coded for by three {nucleotides/bases} 2. Credit quoted example/idea that 12 {nucleotides/bases} code for 4 amino acids	ACCEPT in context of RNA. AAT/AAC = leucine, CAG = valine, TTT = lysine.	**(2)**

Question Number	Answer	Additional Guidance	Mark
5(b)(ii)	1. Idea that each {triplet is discrete/each base is used only once in a triplet/eq} 2. Idea that AAT + AAC + CAG + TTT gives 4 (distinct) {triplets/codes}	ACCEPT a specific example such as the first T can only be used in code for first leucine. ACCEPT a description of how the code could be read if overlapping.	**(2)**

Question Number	Answer	Additional Guidance	Mark
5(b)(iii)	1. Idea that more than one code can be used for a {particular amino acid/stop code} 2. 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	Mark
5(c)	B	**(1)**

Question Number	Answer	Additional Guidance	Mark
***5(d) Quality of Written Communication**	(Quality of Written Communication – the answer must be organised in a logical sequence.) 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	N.B. The Mps do not have to be given in this order necessarily. NOT tRNA carries amino acids. AAU/AAC = leucine, CAG = valine, UUU = lysine. IGNORE complementary. For example, UUA codon and AAU anticodon. ACCEPT between codon and anticodon.	**(5)**

Total for Question 5 = 13 Marks

Question Number	Answer	Additional Guidance	Mark
6(a)	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	N.B. piece answers together throughout. Do NOT ACCEPT in context of plasmid.	**(2)**

Question Number	Answer	Additional Guidance	Mark
6(b)(i)	1. Reference to {phagocytosis/endocytosis/engulfing} 2. Credit details of phagocytosis 3. Reference to bacterium inside a {vacuole/vesicle/phagolysosome}	For example, formation of {pseudopodia/membrane extensions around bacteria}/cytoplasmic streaming/binding to bacteria NOT phagolysozyme.	**(2)**

Question Number	Answer	Additional Guidance	Mark
6(b)(ii)	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)	NOT bacteriocidal antibiotics.	**(2)**

Question Number	Answer	Additional Guidance	Mark
6(b)(iii)	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	N.B. not simply crediting ref to vaccination as in stem of question. ACCEPT antigen. For example, macrophages as APCs. For example, involvement of cytokines, B cells as APCs. For example, involvement of cytokines, infected cells as APCs.	**(3)**

Question Number	Answer	Additional Guidance	Mark
6(c)	1. Reference to {further lung damage/severe breathing problems/eq}	For example, cannot obtain enough oxygen.	**(4)**
	2. Idea that the *Mycobacterium* 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	For example, production of cytokines.	
	7. Credit detail of effect of no B cells	For example, infected cells will not be destroyed.	
	8. Ref to {secondary/opportunistic/other} infections (causing death)	For example, no antibody produced.	

Total for Question 6 = 13 Marks

Question Number	Answer	Additional Guidance	Mark
7(a)(i)	1. {Skin/epidermis} is a barrier/eq 2. Reference to keratin 3. Reference to lack of receptors (for the virus)	ACCEPT prevents entry but NOT prevents infection. N.B. keratin in skin forms a barrier = 2 marks. ACCEPT skin has different receptors.	**(2)**

Question Number	Answer	Additional Guidance	Mark
7(a)(ii)	1. Idea that viruses only {infect/attach to/eq} {specific receptors/specific cells/host cells} 2. Idea that receptors not present on {blood cells/endothelial cells/eq} 3. Reference to {destruction/eq} of viruses by phagocytes	ACCEPT white blood cells, neutrophils, PMN. IGNORE macrophages. NOT lymphocytes, T cells, B cells, plasma cells.	**(2)**

Question Number	Answer	Additional Guidance	Mark
7(b)	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	N.B. answers can be pieced together but candidates still have to state both parts of mark point.	**(2)**

Question Number	Answer	Additional Guidance	Mark
7(c)(i)	1. To synthesise (common cold) RNA/eq 2. For amino acids to bind to tRNA/eq 3. To synthesise (common cold) protein (capsid)/eq	 ACCEPT translation.	**(2)**

Question Number	Answer	Additional Guidance	Mark
7(c)(ii)	1. Idea of enzyme affecting {molecules in membrane/proteins/(phospho)lipids/cholesterol} 2. Enzyme breaks {bonds/named bonds/eq} 3. Reference to {(by) hydrolysis/hydrolytic enzymes} 4. Credit detail of enzyme action 5. Reference to enzyme U as {protease/lipase/cholesterase}	 For example, lowers activation energy, binding of active site to substrate (cannot credit reference to catalyst, as in stem of question). IGNORE lysosyme.	**(3)**

Total for Question 7 = 11 Marks

Question Number	Answer	Additional Guidance	Mark
8(a)(i)	1. (Successful interbreeding) produces offspring 2. (Same species produce) fertile (offspring) 3. Credit reason why offspring of different species might be infertile	ACCEPT converse throughout. IGNORE viable. For example, genetic incompatibility, different number of chromosomes, poor quality gametes, low number of gametes.	**(3)**

Question Number	Answer	Mark
8(a)(ii)	1. Reference to reproductive isolation 2. Different breeding times 3. Do not recognise {courtship displays/songs/eq} 4. Physically incompatible, e.g. genitalia	(3)

Question Number	Answer	Additional Guidance	Mark
8(b)	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)	ACCEPT similar. N.B. needs to be in the context of both species being subjected to the same selection pressures. ACCEPT similar.	(3)

Total for Question 8 = 9 Marks

Total for Paper = 90 Marks