Mark Scheme (Results)

October 2021

Pearson Edexcel International Advanced Level
In Biology (WBI14) Paper 01
Energy, Environment, Microbiology and Immunity

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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	Mark
1(a)(i)	The only correct answer is **D**. **A** *is incorrect because P is a ribosome (the smallest structure), Q is a starch grain (the largest structure)* ***B*** *is incorrect because P is a ribosome (the smallest structure), Q is a starch grain (the largest structure)* ***C*** *is incorrect because P is a ribosome (the smallest structure), Q is a starch grain (the largest structure)*	**(1)**

Question number	Answer	Mark
1(a)(ii)	The only correct answer is **B**. **A** *is incorrect because GALP is found in the stroma which is structure R* ***C*** *is incorrect because GALP is found in the stroma which is structure R* ***D*** *is incorrect because GALP is found in the stroma which is structure R*	**(1)**

Question number	Answer	Additional guidance	Mark
1(a)(iii)	• 14 267 / 14 270 / 14 300 / 14 400 / 14 000 (1)	**ACCEPT** in standard form e.g. 1.4267×10^4 **DO NOT ACCEPT** with units	**(1)**

Question number	Answer	Additional guidance	Mark
1(a)(iv)	An answer that includes at least one similarity and one difference: **Similarities:** • both have a phospholipid bilayer (1) **Differences:** • T has {chlorophyll / photosynthetic pigments / photosystems / PSI / PSII} in it but U does not (1) • T contains {ATP synthase / ATP ase} but U does not (1) • T contains electron carrier proteins but U does not (1)	**DO NOT PIECE TOGETHER** **ACCEPT** made of phospholipids **ACCEPT** electron carriers / ETC **NB** penalise once if refer to membranes or chloroplast as a cell	**(3)**

Question number	Answer	Additional guidance	Mark
1(b)	An answer that includes the following points: • light is needed for the replication (of chloroplast DNA) (1) • replication (of chloroplast DNA) is independent of {mitosis / cell cycle} (1)	**ACCEPT** replication of chloroplast DNA does not occur in the dark **IGNORE** DNA increases day / night	**(2)**

	Answer	Mark
2(a)(i)	The only correct answer is **A**. **B** *is incorrect because TMV does not have an envelope* ***C*** *is incorrect because λ phage does not have an envelope* ***D*** *is incorrect because TMV does not have an envelope*	**(1)**

Question number	Answer	Mark
2(a)(ii)	The only correct answer is **C**. ***A*** *is incorrect because Ebola has a helical structure* ***B*** *is incorrect because HIV has a polyhedral structure* ***D*** *is incorrect because TMV has a helical structure*	**(1)**

Question number	Answer	Mark
2(a)(iii)	The only correct answer is **C**. ***A*** *is incorrect because Ebola, HIV and TMV all have RNA and λ phage has DNA* ***B*** *is incorrect because Ebola, HIV and TMV all have RNA and λ phage has DNA* ***D*** *is incorrect because Ebola, HIV and TMV all have RNA and λ phage has DNA*	**(1)**

Question number	Answer	Additional guidance	Mark
2(b)(i)	**U G G U U C C G C** (1)		**(1)**

Question number	Answer	Additional guidance	Mark
2(b)(ii)	An explanation that includes two of the following points: • (because the positive strand) has the {codons / codes} for the {proteins / amino acids} (1) • because the positive strand has the <u>complementary</u> base sequence needed to make the negative strand (1)	**ACCEPT** used in translation / (viral) genes negative strand does not have the correct codons **DO NOT ACCEPT** transcription **IGNORE** refs to sense and antisense (strands)	**(2)**

Question number	Answer	Additional guidance	Mark
2(c)	An explanation that includes four of the following points: • because (during 18 days) new viruses are produced (1) • (new) viruses {burst out of / damage} (host) cells (1) • infecting more cells / causing the spread of the virus (1) • takes time for the immune system to be stimulated (1) • so {person may become ill / virus out of control} before immune system stimulated (1)	**IGNORE** refs to latency / description of retroviruses / replication of DNA **IGNORE** names of host cells **ACCEPT** description of event that take place **ACCEPT** description e.g. not enough antibodies present for opsonisation **ACCEPT** before {receiving antiviral drugs / drugs can take effect} **DO NOT ACCEPT** kill virus	**(4)**

<table>
<tr><th>Question number</th><th>Answer</th><th>Mark</th></tr>
<tr><td>3(a)</td><td>
<table>
<tr><th rowspan="2">Statement</th><th colspan="4">Type of artificial immunity</th></tr>
<tr><th>both active and passive</th><th>active only</th><th>passive only</th><th>neither active nor passive</th></tr>
<tr><td>Antibodies are injected into the person</td><td></td><td></td><td>X</td><td></td></tr>
<tr><td>B cells differentiate into plasma cells</td><td></td><td>X</td><td></td><td></td></tr>
<tr><td>Memory cells are formed</td><td></td><td>X</td><td></td><td></td></tr>
</table>
</td><td>(3)</td></tr>
</table>

Question number	Answer	Additional guidance	Mark
3(b)(i)	A description that includes the following points: • engulf the virus / phagocytosis of the virus (1) • digestion of the virus (1) • antigen presentation to {T helper / CD4} {cells / lymphocytes} (1)	**ACCEPT** pathogen, if in context of virus reference to a macrophage being a phagocyte, if in context of viruses **DO NOT ACCEPT** kills the virus **ACCEPT** macrophage is an {antigen presenting cell / APC} to T helper cells **DO NOT ACCEPT** to T killer cells	(3)

Question number	Answer	Additional guidance	Mark
3(b)(ii)	An explanation that includes four of the following points: • T helper cells {activate / stimulate} B cells (to divide) (1) • because antibody will be needed for opsonisation (1) • T helper cells {activate / stimulate} T killer cells (to divide) (1) • because T killer cells destroy (virus-infected) cells (1) • so that virus can be {engulfed / destroyed} by macrophages (1)	**ACCEPT** stimulate humoral response **ACCEPT** antibodies prevent viruses binding to host cells **ACCEPT** stimulate cell-mediated response **ACCEPT** a description **DO NOT ACCEPT** killed pathogen in context of bacteria	**(4)**

Question number	Answer	Additional guidance	Mark
4(a)(i)	• 1.27 / 1.33 (1)	**DO NOT ACCEPT** 1.33 recuring	**(1)**

Question number	Answer	Additional guidance	Mark
4(a)(ii)	• 21 / 21.3 / 21.26 / 24.8 / 24.81 / 25 (%) (1)	Allow ecf from (i)	**(1)**

Question number	Answer	Mark
4(b)(i)	The only correct answer is **B**. *A is incorrect because S is the oldest ring* *C is incorrect because P is the newest ring and S is the oldest ring* *D is incorrect because P is the newest ring and S is the oldest ring*	**(1)**

Question number	Answer	Additional guidance	Mark
4(b)(ii)	An explanation that includes three of the following points: • because each year a ring will be formed (1) • and the thickness of the rings will {be different for each year / depend on the conditions} (1) • the rings in each sample can be {matched / lined up} (1) • and only counting a ring once if it overlaps (1)	**ACCEPT** the number of rings is the age this tree is {68 to 76} years old quoted figures e.g. 69 rings = 69 years **ACCEPT** named condition e.g. temperature	**(3)**

Question number	Answer	Additional guidance	Mark
4(b)(iii)	A description that includes the following points: • measure the height (of the whole tree) (1) • height divided by the {(total) number of rings / age} (1)	 **ACCEPT** length for height measure {radius / diameter / total width of rings} at bottom (of tree) **ACCEPT** {radius / diameter} at bottom of tree divided by {number of rings / age} CE from mp 1	 **(2)**

Question number	Answer	Additional guidance	Mark
5(a)(i)	methods used to prevent contamination (of person / culture) (with other microorganisms) (1)	**ACCEPT** techniques / procedures / routines **ACCEPT** prevent {entry / exit / infection} **IGNORE** growth	**(1)**

Question number	Answer	Additional guidance	Mark
5(a)(ii)	A description that includes two of the following points: • carry out work beside {a bunsen burner / in a hood} (1) • use sterilised {equipment / media} / sterilise equipment after use (1) • credit named personal procedure (1) • minimise the time that cultures are exposed to the air / do not open cultures at the end (1)	**ACCEPT** description of how equipment could be sterilised e.g. media autoclaved, wash area with disinfectant **e.g.** wearing gloves, washing hands **e.g.** transfer bacteria quickly	**(2)**

Question number	Answer	Additional guidance	Mark
5(a)(iii)	An explanation that includes two of the following points: • to prevent entry of bacteria that may compete with the *E. coli* (1) • to prevent entry of bacteria that may grow in different {types / concentrations} of microbial substances (than *E. coli*) (1) • to prevent infection (of person) with bacteria in the culture that {is / maybe} pathogenic (1)	**ACCEPT** will not know if *E.coli* or the other bacteria is growing	**(2)**

Question number	Answer	Additional guidance	Mark
5(b)	An explanation that includes the following points: • explanation for temperature given (1) • explanation for time given (1)	 e.g. appropriate temperature needed for the enzymes to function temperature not too high so the enzymes do not denature **ACCEPT** proteins for enzymes temp won't be rate limiting for growth e.g. antimicrobial effect can be seen when bacteria are growing enough time has to be allowed for the bacterial growth to become visible enough time for antimicrobials to have an effect	**(2)**

Question number	Answer	Additional guidance	Mark
5(c)(i)	An explanation that includes the following points: • to show if the cultures were contaminated (1) • because the antimicrobial agent would not {kill / inhibit the growth of} other types of bacteria (1) **OR** • to check that the *E. coli* has not changed its {susceptibility / resistance} (1) • so that the results will apply to known *E. coli* (1)	**ACCEPT** a description e.g. to see if other bacteria are growing	**(2)**

Question number	Answer	Additional guidance	Mark
5(c)(ii)	An explanation that includes the following points: • to show that the *E.coli* were viable (1) • because if there was not any growth of bacteria you would not know if the bacteria were dead or the antimicrobial agents were (very) effective (1)	**ACCEPT** alive / can replicate / can grow **ACCEPT** to show that the antimicrobials were inhibiting growth **IGNORE** antimicrobials affecting growth	**(2)**

Question number	Answer	Additional guidance	Mark
5(c)(iii)	A description that includes the following points: • description of adding equal volumes of {antimicrobial substance / antimicrobials / substance / solution} and {water / media / broth / buffer} together (1) • description of this being repeated (a few times) using previous solution (1)	**ACCEPT** the idea of doing this process in the wells directly or separately **ACCEPT** stated volumes / 50% volumes / volumes in ratio 1 : 1 **IGNORE** amount **ACCEPT** a reference to serial dilutions	**(2)**

Question number	Answer	Additional guidance	Mark
5(c)(iv)	• MIC of E and G calculated (1) • {32 / 2^5} (1)	MIC of E = 1 in 8 and MIC of G = 1 in 256 Or MIC of E = 1 in 16 and MIC of G = 1 in 512 **ACCEPT** E is {32 / 2^5} times less effective **NB** correct answer gains 2 marks **ACCEPT** 2.25 for 1 mark	**(2)**

Question number	Answer	Additional guidance	Mark
6(a)	An answer that includes the following points: • number of (different) species (1) • genetic diversity within a species (1)	**ACCEPT** species richness amount **ACCEPT** variation in {genotypes / alleles}	**(2)**

Question number	Answer	Additional guidance	Mark
6(b)	An explanation that includes two of the following points: • <u>absorb</u> light energy so that electrons are {excited / released} (1) • to synthesise ATP and reduced NADP (1)	**ACCEPT** NADPH **IGNORE** $^{+}$ signs **ALLOW** to absorb light energy so that it can be converted into ATP energy = 1 mark	**(2)**

Question number	Answer	
*6(c)(i)	Indicative content: Comparisons: • propanone extracts more chlorophyll a from species P • propanone extracts more chlorophyll a from species R • DMSO extracts more chlorophyll a from species Q than propanone • propanone and DMSO extract similar concentrations of chlorophyll b from species S • propanone extracts more chlorophyll b from species P • propanone extracts more chlorophyll b from species Q • propanone extracts more total chlorophyll from species P Generalisations: • propanone is the most effective solvent at extracting chlorophyll • species P appears to contain the most chlorophyll when using propanone • DMSO is generally less effective than propanone except when extracting chlorophyll a from species Q **Implications in identifying species:** • some chlorophyll lost when extracted together as total is less than the sum of the components • other pigments extracted in some cases as total is more than individual components added together • the choice of solvent depends on the chlorophyll / species being extracted • because of difference in solubility (of pigments / membranes) / permeability of membranes • more than one solvent needs to be used if this method is to be used for identifying species • as different solvents extract different concentrations of different chlorophylls from different species • possibility of looking at extraction of other pigments • some sort of comparison table / calibration curve needed to match profile to extraction profiles • propanone better if only using one solvent as results the most varied • avoids need for DNA analysis • comparisons can be made in the field / with simple equipment • no indication of validity of data	**Level 1 :** 1 mark = 2 comparisons listed 2 marks = 4 comparisons listed **Level 2 :** 3 marks = 6 comparisons OR 1 generalisation + 3 comparisons OR 2 generalisations 4 marks = one implication discussed **Level 3 :** 5 marks = two implications discussed 6 marks = three implications discussed

Question number	Answer	Additional guidance	Mark
6(c)(ii)	An answer that includes two of the following points: • chlorophylls have different solubility in different solvents (1) • because the chlorophylls have different structures (1) • different solvents can {permeate / dissolve / disrupt} (cell / chloroplast) membranes differently (1)	**ACCEPT** more / less will dissolve **IGNORE** Rf values reacted with solvent	**(2)**

Question number	Answer	Additional guidance	Mark
7(a)(i)	7 (g) (1)		**(1)**

Question number	Answer	Additional guidance	Mark
7(a)(ii)	• value given in the range 0.005 to 0.0083 (1) • this value given to 1 or 2 sig figs {per day / day^{-1}} (1)	**ACCEPT** answers in correct standard form to 1 or 2 sig figs **ACCEPT** {0.02 / 0.017} {per day / day^{-1}} for 1 mark	**(2)**

Question number	Answer	Additional guidance	Mark
7(a)(iii)	An explanation that includes four of the following points: • decomposition (of tea) is {faster / greater} at 25°C (1) • because enzymes {work faster / move faster / have more kinetic energy} (at warmer temperatures) (1) • as there are more (frequent / energetic) enzyme-substrate collisions (1) • loss of mass is due to release of carbon dioxide (1) • by the respiration of the {decomposers / bacteria / fungi} (1)	**ACCEPT** converse throughout **ACCEPT** description e.g. breakdown of organic matter **ACCEPT** may be due to more bacteria	**(4)**

Question number	Answer	Additional guidance	Mark
7(a)(iv)	An answer that includes the following points: • because the teas maybe composed of different molecules (1) • that {cannot be broken down as easily / are less accessible to the enzymes} (in rooibos) (1) **OR** • because the pH (in the teabag) is different (1) • therefore enzymes (of the bacteria) are less active (in rooibos) (1) **OR** • because there are {inhibitors / antimicrobials / toxins} in rooibos (1) • that {inhibit the enzymes / kill the decomposers} (1)	**ACCEPT** converse throughout **ACCEPT** named difference e.g. surface area **IGNORE** different masses of organic matter **ACCEPT** which enzymes cannot breakdown **ACCEPT** higher concentrations	**(2)**

Question number	Answer	Additional guidance	Mark
7(b)(i)	• both the decomposition rate and {S / stabilisation factor / carbon stored} are mean values (1)	**ACCEPT** average for mean	**(1)**

Question number	Answer	Additional guidance	Mark
7(b)(ii)	An explanation that includes three of the following points: • {number 6 / loamy desert} (and 3 / birch / 5 / sandy desert) (1) • because it has the highest S value and the lowest decomposition rate (1) • therefore more carbon retained (in the soil) and less {carbon / carbon dioxide} released (1) • less carbon dioxide (in the atmosphere), the less global warming (1) **OR** • {number 6 / loamy desert} (and 3 / birch / 5 / sandy desert) (1) • because it has the highest S value therefore more carbon retained (in the soil) (1) • because it has the lowest decomposition rate and therefore less {carbon / carbon dioxide} released (1) • less carbon dioxide (in the atmosphere), the less global warming (1)	**DO NOT ACCEPT** carbon dioxide retained **ACCEPT** less greenhouse effect, description **DO NOT ACCEPT** carbon dioxide retained **ACCEPT** less greenhouse effect, description	**(3)**

Question number	Answer	Additional guidance	Mark
8(a)	• how much organic matter present in organisms (1)	**ACCEPT** amount / mass / content of / measure of dry mass / tissue containing carbon plant / animal / an organism / trophic level	**(1)**

Question number	Answer	Additional guidance	Mark
8(b)(i)	• total biomass of eukarya or all organisms calculated (1) • 85.84 / 85.8 / 86 (%) (1)	468 / 545.2	**(2)**

Question number	Answer	Additional guidance	Mark
8(b)(ii)	An answer that includes two of the following points: • cannot count all organisms as individuals (1) • organisms (within a group) are different {sizes / masses} (1)	**ACCEPT** take too long to count / too small to count **IGNORE** measure **ACCEPT** biomasses	**(2)**

Question number	Answer	Additional guidance	Mark
8(b)(iii)	An answer that includes three of the following points: Advantage: • very {visual / clear / easy} (way of presenting data / to understand) (1) • credit an example (1) Disadvantage: • cannot compare polygons with different shapes (but similar size) (1) • credit an example (1)	**e.g** easy to see the organisms with the highest biomass such as arthropods **ACCEPT** areas of polygons cannot be compared e.g. such as cnidarians and livestock	**(3)**

Question number	Answer	Additional guidance	Mark
*8(c)	**Indicative content:** **Voronoi diagram:** • most biomass found on land and least found in marine (D) • because land provides the most suitable conditions to sustain living organisms* • such as light (for plants and algae) / water **Plants:** • all plants found on land (D) • because need enough light for photosynthesis • not in marine (D) • as salt water not suitable • not found deep underground (D) • as no light for photosynthesis **Fungi:** • predominantly found on land (D) • because they need a solid place to feed • because they need (gaseous) oxygen for respiration • not found deep underground (D) • because barely any other organisms live there to provide organic matter to decompose **Protists:** • found on both land and in marine environment (D) • because enough light for those that photosynthesise • they are the producers for the marine food chains* • can feed on {phytoplankton / algae} in the sea • not found deep underground (D) • because no light for those that photosynthesise • because no food **Animals:** • found on land and in a marine environment (D) • because have adapted for {feeding / movement} in both of these environment • can feed on {plants / seaweeds / other animals} • not found deep underground (D) • because no {food / water / pressure too high / ground too hard}	**Level 1 :** 1 mark = 2 descriptions 2 marks = 4 descriptions **OR** 1 {organism / Voronoi diagram} explained **Level 2 :** 3 marks = 2 {organisms / Voronoi diagram} explained 4 marks = 3 {organisms / Voronoi diagram} explained **Level 3 :** 5 marks = 4 {organisms / Voronoi diagram} explained 6 marks = 4 organisms explained **AND** explanation of Voronoi diagram* **OR** realises that there must be a non-plant producer in the sea*	**(6)**

	Bacteria: • one of two groups to be found in all three environments (D) • because can obtain energy from decomposition on the {land / marine} • can use alternative sources of energy deep underground **Archaea:** • one of two groups to be found in all three environments (D) • because can obtain energy from decomposition on the {land / marine} • can use alternative sources of energy deep underground		

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