GradeMax



Mark Scheme (Results)

January 2022

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

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General Marking Guidance

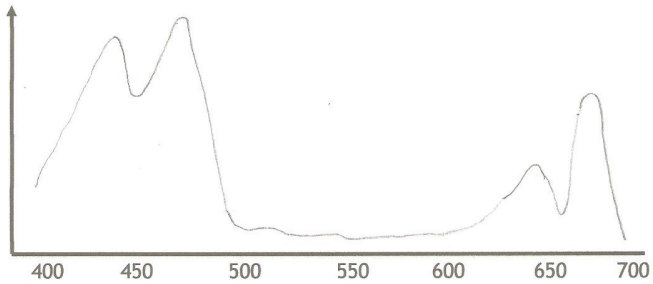
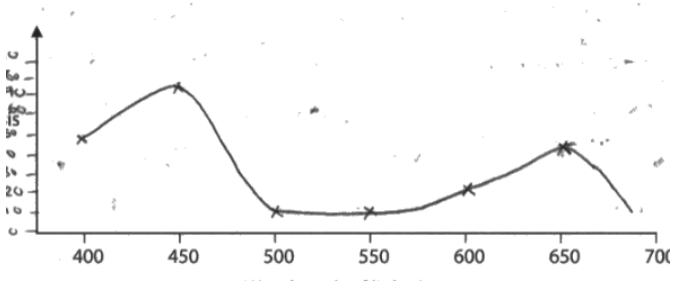
- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should 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

	Answer	Mark
1(a)	The only correct answer is **D**. **A** *is incorrect because thick coat is anatomical, sitting on ice is behavioural and producing metabolic water is physiological* ***B*** *is incorrect because thick coat is anatomical, sitting on ice is behavioural and producing metabolic water is physiological* ***C*** *is incorrect because thick coat is anatomical, sitting on ice is behavioural and producing metabolic water is physiological*	**(1)**

	Answer	Mark
1(b)	The only correct answer is **C**. **A** *is incorrect because its niche is its role not something it can produce* ***B*** *is incorrect because its niche is its role not its habitat* ***D*** *is incorrect because its niche is its role not its structure*	**(1)**

Question number	Answer	Additional guidance	Mark
1(c)	An explanation that includes the following points: • because there is a lack of (fresh) water (1) • because the sea water is salty (1)	**ACCEPT** (fresh) water is frozen cannot consume the snow / ice	**(2)**

Question number	Answer	Additional guidance	Mark
1(d)	An explanation that includes the following points: • (genetic diversity) decreases • because the gene flow reduced (1) • as a result of inbreeding (1)	**IGNORE** refs to mutations increasing diversity **ACCEPT** description e.g. fewer allele combinations passed on	**(3)**

Question number	Answer	Additional guidance	Mark
2(a)(i)	An answer that includes the following points: • a line that roughly follows the contours of the absorption spectrum lines and does not drop to zero (1) • {left hand peak (if one) / peak at about 460 (if two)} is higher than a right hand {peak / peaks} (1)	  **IGNORE** extrapolation back to y axis but if it hits zero then this would negate mp 1	**(2)**

Question number	Answer	Additional guidance	Mark
2(a)(ii)	• 1.2 / 1.23 / 1.24 / 1.25		**(1)**

Question number	Answer	Additional guidance	Mark
2(a)(iii)	An explanation that includes the following points: • so that light can be <u>absorbed</u> at {each / different} wavelength of light (1) • so that the rate of photosynthesis will be maximised (1)	**IGNORE** colours of light **ACCEPT** faster / more	**(2)**

	Answer	Mark
2(b)(i)	The only correct answer is **A** **B** *is incorrect because the peptide bond forms between the amino group and the carboxyl group* ***C*** *is incorrect because its a peptide bond that forms* ***D*** *is incorrect because it's a peptide bond that forms between the amino group and the carboxyl group*	**(1)**

Question number	Answer	Additional guidance	Mark
2(b)(ii)	A description that includes the following points: • use {GALP / glucose} (to incorporate into amino acids) (1) • use nitrates (taken up from the soil) (1)	 **DO NOT ACCEPT** wrong sugars **ACCEPT** nitrogen from nitrates **IGNORE** nitrogen / sulphates **DO NOT ACCEPT** wrong ions e.g. magnesium ions	 **(2)**

Question number	Answer	Additional guidance	Mark
3(a)	An explanation that includes the following points: • because it {destroys / weakens} the immune system (1) • by {destroying / decreasing the number of} T helper cells (1) • so {B cells / T killer cells} cannot be activated (1) • credit a consequence of this (1)	**ACCEPT** immunity **ACCEPT** CD4 cells **ACCEPT** {humoral / cell-mediated} immunity cannot be initiated e.g fewer antibodies produced (by plasma cells), less opsonisation, fewer infected host cells destroyed **IGNORE** phagocytosis unless description of opsonisation **DO NOT ACCEPT** viruses killed **NB** max 3 marks if no context	**(4)**

Question number	Answer	Additional guidance	Mark
3(b)(i)	An explanation that includes the following points: • because if reverse transcriptase is inhibited, a DNA copy of the (viral) RNA cannot be made (1) • because if integrase is inhibited, this DNA cannot be incorporated into the host cell DNA (1)	**ACCEPT (**viral) DNA cannot be made (viral) RNA cannot be transcribed <u>into DNA</u> **DO NOT ACCEPT** RNA cannot be made into DNA **ACCEPT** provirus cannot be formed **NB both reasons given but not linked to each enzyme = 1 mark**	**(2)**

Question number	Answer	Additional guidance	Mark
3(b)(ii)	An answer that includes the following points: • to increase the likelihood of the drugs {being effective / destroying the virus} (1) • credit an example of why they may not be effective on their own (1) • maybe used to treat other (viral) infections (1)	**ACCEPT** a description of how this could happen e.g.targetting another site (on the virus) **DO NOT ACCEPT** kill the virus **e.g.** one type of inhibitor may not penetrate all the cells virus may have mutated and become resistant other drugs might prevent the attachment of HIV to {host cells / T helper cells / CD4}	**(2)**

Question number	Answer	Additional guidance	Mark
3(b)(iii)	An answer that includes the following points: • because the drug treatment does not completely remove the virus (1) • therefore {viral replication can occur / activation of provirus} (1) • new viral particles burst out of {host / T helper} cells (1)	**ACCEPT** enter the lytic cycle **DO NOT ACCEPT** if linked to incorporation of DNA into host DNA	**(2)**

Question number	Answer	Mark
4(a)	The only correct answer is **D**. **B** *is incorrect because all three statements are true* ***C*** *is incorrect because all three statements are true* ***D*** *is incorrect because all three statements are true*	**(1)**

Question number	Answer	Additional guidance	Mark
4(b)	An explanation that includes the following points: • attaches to the {maltoporin / *E. coli* / bacteria} (1) • so that the {DNA / genetic material / core} can penetrate into the (bacterial) cell (1)	 **IGNORE** host cell **DO NOT ACCEPT** RNA **IGNORE** ref to virus entering cell	 **(2)**

Question number	Answer	Additional guidance	Mark
4(c)(i)	• to respire / to make ATP / as an energy source (1)	**ACCEPT** regulation of gene expression formation of peptidoglycan **DO NOT ACCEPT** to make energy **NB** there may be other correct answers that will need checking	**(1)**

Question number	Answer	Additional guidance	Mark
4(c)(ii)	**Points relating to the bacterial cell:** • mutation in the {lamß gene / gene coding for maltoprotein} • changing the structure of the maltoprotein • so that the J protein can no longer {bind / bind as well} • mutation resulting in the production of a (new) enzyme • that can cleave the J protein off the maltoprotein • preventing E. coli from being {infected / destroyed} • bacteria that survive will divide (asexually) • forming a clone of resistant bacteria • presence of virus acting as a selection pressure • but the maltoprotein would need to remain functional • otherwise no sugars for respiration **Points relating to the λ phage:** • without being able to attach to the bacteria, the virus will not persist • as it needs a host cell to replicate • being able to bind is the selection pressure • mutation in the viral DNA coding for the J protein • that would result in a J protein capable of binding to the altered maltoprotein • that would result in a J protein that could bind more strongly to the maltoprotein • that would result in binding to another attachment site • viruses that can bind will result in production of viruses that can also	**Level 1:** **1 mark =** 1 relevant comment made **2 marks =** 3 points made **Level 2:** **3 marks =** 4 points made that include both virus and bacteria **4 marks =** 5 points made that include both virus and bacteria **Level 3:** **5 marks =** 6 points made that include both virus and bacteria **6 marks =** 6 points which include **Either** the need for the maltoprotein to remain functional **Or** how mutations are passed on to next generation of viruses and bacteria **NB** limited to max 3 marks if no reference made to either J protein or maltoproteins	**(6)**

	bind • as their genetic material will be cloned inside the host cell		

Question number	Answer	Additional guidance	Mark
5(a)	An answer that includes two of the following points: • nuclear DNA is linear and mtDNA is circular (1) • nuclear DNA has unbound {phosphate group / sugar} whereas mtDNA does not (1) • mtDNA has (far)fewer {phosphodiester bonds / base pairs} (1)	**DO NOT PIECE TOGETHER** **IGNORE** straight / strands double helix **IGNORE** shorter / smaller **ACCEPT** other <u>structural</u> difference e.g. nuclear DNA organised around histones whereas mtDNA {is not / organised into nucleoids} nuclear DNA has 3' and 5' ends but mtDNA does not	**(2)**

Question number	Answer	Additional guidance	Mark
5(b)(i)	Any two from • (DNA) primers (1) • (DNA) (mono)nucleotides (1) • {taq / DNA} polymerase (1) • buffer (1)	**NB** Three correct = 2 marks, one or two correct = 1 mark **ACCEPT** all 4 listed **IGNORE** bases **DO NOT ACCEPT** RNA nucleotides **ACCEPT** taq enzyme **DO NOT ACCEPT** RNA polymerase	**(2)**

Question number	Answer	Additional guidance	Mark
5(b)(ii)	• length of time calculated for the 35 cycles (1) • 1.38 (hours) (1)	4950 (seconds) / 82.5 (minutes) / 1.375 (hours) ecf if a given value in {seconds / minutes} is correctly converted into hours with 2 dps Bald answer of 1.38 = 2 marks Bald answer of 4950 (seconds) / 82.5 (minutes) / 1.375 (hours) = 1 mark	**(2)**

Question number	Answer	Additional guidance	Mark
5(b)(iii)	An explanation that includes the following points: • {(high) temperature / 94°C} to {break the H bonds (between the strands) / separate the strands} (1) • {temperature lowered / 54°C} so that primers can attach (1) • {temperature raised (slightly) / 72°C} new (mono)nucleotides can {align / join} to bases (to form two molecules) (1) • {35 / many} cycles so that {several molecules / enough DNA} is made (1)	**ACCEPT** temperature lowered if no mention of primers **ACCEPT** appropriate temperature for (DNA) polymerase **IGNORE** bases / strands **IGNORE** strands **NB** Max 2 marks if no ref to change or quoted temperature from our diagram, provided the steps are in the correct order	**(3)**

Question number	Answer	Additional guidance	Mark
5(c)	An explanation that includes the following points: • by DNA profiling (1) • so that banding patterns (in each crow can be produce) and compared (1) • the more similar the profiles the more closely-related the crows (1) **OR** • by DNA profiling (1) • so that base sequences (in each crow can be determined) and compared (1) • the more similar the (base) sequences the more closely-related the crows (1)	ACCEPT (gel) electrophoresis / description of the process DNA fingerprint **IGNORE** common ancestor ACCEPT bioinformatics	**(3)**

	Answer	Mark
6(a)(i)	The only correct answer is **B**. **A** *is incorrect because* ***P*** *is a ribosome* ***C*** *is incorrect because* ***R*** *is a thylakoid* ***D*** *is incorrect because* ***S*** *is a starch grain*	**(1)**

	Answer	Mark
6(a)(ii)	The only correct answer is **C**. **A** *is incorrect because starch is stored in* **S** ***B*** *is incorrect because starch is stored in* **S** ***D*** *is incorrect because starch is stored in* **S**	**(1)**

	Answer	Mark
6(a)(iii)	The only correct answer is **B**. **A** *is incorrect because* ***C*** *is incorrect because* ***D*** *is incorrect because*	**(1)**

	Answer	Mark
6(a)(iv)	The only correct answer is **A**. **B** *is incorrect because* ***P*** *is 0.02µm,* ***R*** *is 0.435 µm and* ***S*** *is 1 to 35 µm* ***C*** *is incorrect because* ***P*** *is 0.02µm,* ***R*** *is 0.435 µm and* ***S*** *is 1 to 35 µm* ***D*** *is incorrect because* ***P*** *is 0.02µm,* ***R*** *is 0.435 µm and* ***S*** *is 1 to 35 µm*	**(1)**

	Answer	Mark
6(b)(i)	The only correct answer is **C**. **A** *is incorrect because* CO_2 is used ***B*** *is incorrect because* CO_2 is used ***D*** *is incorrect because area is* mm^{-2} *and time is* hr^{-1}	**(1)**

Question number	Answer	Additional guidance	Mark
6(b)(ii)	An answer that includes the following points: **Similarities:** • both have a rise and fall (in rate of photosynthesis with an increase in temperature) (1) • both have the same rate of photosynthesis at 16.5°C (1) **Differences:** • *Spartina* has {an optimum temperature of / highest rate at} 35°C whereas *Leucopoa* has {an optimum temperature of / highest rate at} 23°C (1) • *Leucopoa* has a higher rate below 16.5°C and *Spartina* has a higher rate above 16.5°C (1)	**DO NOT PIECE TOGETHER** **ACCEPT** 16.4°C **ACCEPT** values between 34 and 36, 21 and 24 a stated value difference provided it can be obtained from these values **ACCEPT** converse	**(3)**

Question number	Answer	Additional guidance	Mark
6(b)(iii)	A description that includes the following points: • read off the rate of photosynthesis at two temperatures 10°C apart (1) • divide the rate for the higher temperature by that for the lower temperature (1)	**ACCEPT** two stated temperatures e.g. 10°C and 20°C values for two rates at appropriate temperatures quoted {calculate / get} rate **ACCEPT** from an equation if t and t+10 have been described	**(2)**

Question number	Answer	Additional guidance	Mark
6(b)(iv)	An explanation that includes the following points: • Wheatland (1) • because Wheatland has the higher temperatures (throughout the whole year) (1) • therefore enzymes will be more active (at these higher temperatures) (1)	**ACCEPT** from a description appropriate named enzyme e.g. RUBISCO	**(3)**

Question number	Answer	Additional guidance	Mark
7(a)(i)	• {the number of / all} humans in the world (1)	**ACCEPT** amount people / *Homo sapiens* Earth / this planet / globally	**(1)**

Question number	Answer	Additional guidance	Mark
7(a)(ii)	• producing enough <u>food</u> / producing <u>food</u> without damaging the environment (1)	**ACCEPT** without running out minimises carbon footprint so food can be made in the future	**(1)**

Question number	Answer	Additional guidance	Mark
7(b)(i)	An explanation that includes the following points: • reason for release of carbon dioxide into the atmosphere by land clearance (1) • reason for release of carbon dioxide into the atmosphere by farming (1) • reason for less carbon dioxide being removed from the atmosphere (1) • reason for release of methane into the atmosphere (1) • credit details of how green house gases cause global warming (1)	e.g. burning of forests, burning of (fossil) fuels by vehicles, decomposition of dead remains by bacteria e.g. burning of (fossil) fuels by {tractors, transport of food products, factories} **IGNORE** by respiration e.g. trees absorbed more carbon dioxide than crops, animals do not remove carbon dioxide from the atmosphere e.g. paddy fields, cattle, decomposition of dead remains by bacteria e.g. trap heat energy	**(3)**

Question number	Answer	Additional guidance	Mark
7(b)(ii)	• 71% of 149 million calculated (1) • farmed area calculated (1) • 5.29×10^7 / 5.3×10^7 (km^2) (1)	e.g. of calculation 105 790 000 (105 790 000 ÷ 2 =) 52 895 000 ecf incorrect answer or 105 790 000 expressed in standard form to 1 or 2 dps correctly Bald answer of 5.29×10^7 / 5.3×10^7 (km^2) = 3 marks Bald answer of 52 895 000 or incorrect standard form for this value = 2 marks Bald answer of 1.06×10^8 = 2 marks Bald answer of 105 790 000 = 1 mark	**(3)**

Question number	Answer	Additional guidance	Mark
7(b)(iii)	• values in range of 1 : 0.06 to 1 : 0.1 (with a max of 2 decimal places) **or** 1 : 11 to 1 : 15 (1)	**ACCEPT** ratio expressed either way around	**(1)**

Question number	Answer	Additional guidance	Mark
*7(c)	• recycling of plant material (D) • to add nutrients to ground • so that artificial fertiliser use is reduced • which will cause less harm to the environment • genetic engineering to produce more {insect / drought} resistant crops (D) • to grow higher yield crops • so that more food is produced from the land • and fewer habitats have to be destroyed • reduce air miles to transport food (D) • use biofuels to fuel machinery used in farming (D) • use waste crop materials to make biofuels (D) • so that less carbon dioxide is released into the air • raise fewer animals and grow more crops (D) • because animals release carbon dioxide into atmosphere • which contribute to greenhouse effect • plants absorb more carbon dioxide from atmosphere • use solar / wind power for energy need in farming (D) • as these are sustainable • and do not produce carbon dioxide • encourage population to eat more plant-based foods (D) • as more mass of food can be produced from the land • because fewer trophic levels therefore less energy lost from the food chain • credit examples given from the diagram • reduce the quantity of plastic in packaging of food (D) • because it is not biodegradable • because it can harm animals	**Level 1:** 1 mark = one aspect described 2 marks = one aspect described with a simple explanation **Level 2:** 3 marks = one aspect described with an extended explanation OR two aspects described each with a simple explanation 4 marks = two aspects described each with an extended explanation OR three aspects described each with a simple explanation **Level 3:** 5 marks = three aspects described, all with extended explanation 6 marks = three aspects described, all with extended explanation that includes energy loss from a food chain	**(6)**

Question number	Answer	Additional guidance	Mark
8(a)(i)	An explanation that includes the following points: • explanation of why another method is not accurate (1) • explanation of why entomology is accurate (1)	**e.g.** drop in body temperature is dependent on ambient temperature **e.g.** knowing life cycles and timings insects {colonise dead body in specific order / show succession}	**(2)**

Question number	Answer	Additional guidance	Mark
8(a)(ii)	An explanation that includes the following points: • some {insects /species} only found in certain habitats (1) • therefore if non-native species found on the body, it has been moved (1)		**(2)**

Question number	Answer	Additional guidance	Mark
8(b)(i)	An answer that includes the following points: • to prevent animals from {eating / moving} it (1)	**ACCEPT** scavengers / carnivores appropriate named animal e.g. vulture, wolf **IGNORE** predators	**(1)**

Question number	Answer	Additional guidance	Mark
8(b)(ii)	• values read from the graph at 5 and 15 days / a value divided by 240 (1) • 0.08 (1)	e.g. of calculation 21 to 22 and 3 / in the range of 0.075 to 0.079166 Bald answer of 0.08 = 2 marks Bald answer between 0.075 and 0.079167 rounded up to more than 2 dps = 1 mark	**(2)**

Question number	Answer	Additional guidance	Mark
8(b)(iii)	An explanation that includes four of the following points: • {very little / no} change at start because {body not colonised by insects / only insect eggs present} (1) • {small decrease at /end of bloated stage / 3.5 days} due to wild animals eating flesh (1) • {large decrease in mass / at beginning of active stage / 5 days} as holes in flesh allow gases to escape (1) • {decrease in mass / during active and advanced stages} as insects eat the flesh (1) • some mass remains because bones cannot be {eaten / digested} (1)	**ACCEPT** very few microorganisms present decomposition has not started **ACCEPT** decomposition by microorganisms small volume of gas released some insects have started to eat loss of water **ACCEPT** mass remains constant because bones remain remains cannot be digested **NB** If no marks are awarded allow 1 mark for a description of decomposition	**(4)**

Question number	Answer	Additional guidance	Mark
8(b)(iv)	• to identify the <u>species</u> (that laid the eggs) / to determine time until hatching to find out when they were laid (1)		**(1)**

Question number	Answer	Additional guidance	Mark
8(b)(v)	An explanation that includes the following points: • succession means that the species of insects (found on the decomposing mammal) will {change with time / change with stage (of decomposition) / appear in a specific sequence} (1) • *Lucilia* appears on the body first (1) • then {*Cochliomyia / Chrysomya}* appear on the body and *Lucilia* {numbers decrease / is out competed} (1) • then *Ophyra* arrives and {*Cochliomyia / Chrysomya}* {decrease in number / are out competed} (1)	**ACCEPT** pioneer species	**(3)**

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