GradeMax



Mark Scheme (Results)

Summer 2025

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)	The only correct answer is **D** **A** *is incorrect because entomology is the study of insects* ***B*** *is incorrect because evolution is the changes to organisms not land* ***C*** *is incorrect because speciation is the formation of new species not characteristics of land*	**(1)**

Question number	Answer	Mark
1(b)	The only correct answer is **B** ***A*** *is incorrect because Archaea is a domain of organisms* ***C*** *is incorrect because epigenetic is changes to gene expression* ***D*** *is incorrect because sustainable means renewable*	**(1)**

Question number	Answer	Additional guidance	Mark
1(c)	An answer that includes two of the following points: • because the rats {killed the birds / ate the lizards / ate the eggs /destroyed the eggs} (1) • because the goats {ate the vegetation / trampled on the eggs} (1) • because there were no predators of the goats and rats (1)	**ACCEPT** eggs of {birds / lizards / animals} **ACCEPT** plants / grass / named small plants / grazed the land	**(2)**

Question number	Answer	Additional guidance	Mark
1(d)	A description that includes three of the following points: • {(counting) the number of / count the} (different) species (plants and animals) (1) • {(counting) the number / determining the abundance / determining the population of} each species (1) • {calculate / find / use} the (bio)diversity index / use the formula $\frac{N(N-1)}{\Sigma n(n-1)}$ (1) • biodiversity index would be higher (if the project successful) (1)	**IGNORE** sampling methods **ACCEPT** determine species richness plants and lizard species **ACCEPT** determine the heterozygosity index **ACCEPT** named index e.g. Shannon, Simpson **DO NOT ACCEPT** Hardy-Weinberg, other wrongly named tests, wrong formula **ACCEPT** both species richness and {genetic diversity / abundance} would be higher	**(3)**

Question number	Answer	Additional guidance	Mark
2(a)	• an organism that causes disease (1)	**ACCEPT** microorganism / bacteria <u>and</u> viruses (and fungi) causes an illness / infection / infects / to be sick / adverse effects to health	**(1)**

Question number	Answer	Additional guidance	Mark
2(b)	• {chemical / substance / drug / medicine} that (directly) {kills / destroys / inhibits the growth of} {bacteria / microorganisms / pathogens} (1)	**ACCEPT** a chemical that is {bacteriostatic / bactericidal} a chemical that inhibits reproduction (of bacteria)	**(1)**

Question number	Answer	Additional guidance	Mark
2(c)(i)	• (control) {does not alter / same / no change} (variety) **OR** increases A, decreases C and no effect on the proportion of E (1)		**(1)**

Question number	Answer	Additional guidance	Mark
2(c)(ii)	• whole number between 50 and 60 **OR** 80 and 90 (%) (1)	**ACCEPT** 0.5 to 0.6 **OR** 0.8 to 0.9 to max 2 decimal places	**(1)**

Question number	Answer	Additional guidance	Mark
2(c)(iii)	An explanation that includes two of the following points: • antibiotics do not discriminate between gut bacteria and pathogenic bacteria (1) • antibiotics affect types of gut bacteria differently (1) • changes in proportions due to {death / inhibition of growth / competition for space / nutrients} (1)	**ACCEPT** idea of broad or narrow spectrum not specific to pathogens / one type of bacteria **ACCEPT** a description e.g. A and E are susceptible and C is resistant	**(2)**

Question number	Answer	Mark
3(a)	The only correct answer is **B** **A** *is incorrect because dendrochronology studies tree rings* ***C*** *is incorrect because polymerase chain reaction increases number of DNA molecules* ***D*** *is incorrect because dendrochronology studies tree rings*	**(1)**

Question number	Answer	Additional guidance	Mark
3(b)(i)	• 79 – 32 / 47 (1) • 26.1 (1)	**DO NOT ACCEPT** 26.1 / 26.1	**(2)**

Question number	Answer	Additional guidance	Mark
3(b)(ii)	An explanation that includes the following points: • the line would be shallower / the gradient would be less (steep) (1) • because heat loss would be {less / slower} (1) • as fat is an (heat) insulator (1)	**ACCEPT** {temperature drop / cooling} is slower body stays warmer for longer less negative **ACCEPT** {diffusion / radiation} of heat out of body would be slower converse about retaining heat **ACCEPT** has low thermal conductivity	**(3)**

Question number	Answer	Additional guidance	Mark
3(b)(iii)	• intercept = 98.5 to 99.4 to max 1 decimal place (1) • gradient = {1.3 / 1.31/ 1.32 / 1.33 / 1.34 / 1.35 / 1.36 / $\frac{4}{3}$ } (negative value / positive value) (1) • negative gradient and intercept inserted correctly into equation (1)	e.g y = − 1.3 x + 98.5 y = − 1.32 x + 99	(3)

Question number	Answer	Additional guidance	Mark
4(a)(i)	• 74 / 74.2 / 74.19 (1)		(1)

Question number	Answer	Mark
4(a)(ii)	The only correct answer is **C** **A** *is incorrect because 3100 : (5574 – 3100) = 3100 : 2474 = 1.253 : 1* ***B*** *is incorrect because 3100 : (5574 – 3100) = 3100 : 2474 = 1.253 : 1* ***D*** *is incorrect because 3100 : (5574 – 3100) = 3100 : 2474 = 1.253 : 1*	**(1)**

Question number	Answer	Additional guidance	Mark
4(b)(i)	An answer that includes two of the following points: • (because the presence of tigers) would show that the {country was / mountains were / this habitat was} suitable for tigers to {live / survive / reproduce} in (1) • because if they were in the mountainous regions then they would be less likely to interfere with the people (1) • knowing where the tigers were would enable {these regions to be conserved / the tigers (health / numbers) to be monitored} (1) • to know that if a {non-native species / tigers} was introduced they would not harm the {ecosystem / biodiversity / food chains} (1)	**ACCEPT** idea that tigers were adapted for these regions **ACCEPT** converse idea for lowlands converse idea of people interfere with them less	**(2)**

Question number	Answer	Additional guidance	Mark
4(b)(ii)	An answer that includes four of the following points: • tigers from different countries would be able to {mix / mate} (1) • increasing the {gene pool / gene flow / allele combinations / (bio)diversity (of tigers)} (1) • and preventing inbreeding (1) • there would be {a healthier population / fewer illnesses in tigers} • (corridor) would increase places for tigers to live (1) • to prevent {extinction / further drop in numbers} of tigers (1)	**NB** Accept the converse argument for what would happen if no corridor **ACCEPT** {tigers / habitat} will not be fragmented there will be no geographical isolation allopatric speciation will be avoided **ACCEPT** becoming endangered	**(4)**

Question number	Answer	Mark
5(a)	The only correct answer is **A** ***B** is incorrect because only active immunities result in antibody production* ***C** is incorrect because only active immunities result in antibody production* ***D** is incorrect because only active immunities result in antibody production*	**(1)**

Question number	Answer	Additional guidance	Mark
5(b)(i)	An explanation that includes two of the following points: • because the <u>antigens</u> on the cancer cells are different to those on the T killer cells (1) • neither of the two antibodies could bind to both the cancer cells and T killer cells (1) • because antibodies are {specific / complementary} to one (type) <u>antigen</u> (1)	**ACCEPT** new antibody would have one **binding site** for cancer cell and one for T killer cell **ACCEPT** (naturally occurring) antibodies do not bind to two different <u>antigens</u>	**(2)**

Question number	Answer	Additional guidance	Mark
5(b)(ii)	An answer that includes three of the following points: • break the (covalent) bonds (1) • using {enzymes / chemical reaction} (to make / to break) (1) • join half of one antibody with half of another (with a covalent bond) (1) • {identifying / isolating} the hybrid antibodies (1)	**NB** ref to **genetic {engineering / modification}** = 1 mark if no other mps awarded **ACCEPT** hydrolyse for break **ACCEPT** condensation for join	**(3)**

Question number	Answer	Additional guidance	Mark
5(b)(iii)	An explanation that includes the following points: • T killer cells will **release** {chemicals / perforins / enzymes} to destroy cancer cells (1) • And {chemicals / perforins / enzymes} will be in a higher concentration (if the two cells are closer together) (1) • {opsonisation / agglutination} to enhance phagocytosis (1)	**ACCEPT** idea of closer proximity of perforins with cancer cells **ACCEPT** agglutination to prevent spread of cancer	**(2)**

Question number	Answer	Mark
6(a)(i)	The only correct answer is **C** ***A** is incorrect because DNA is not found in the membranes* ***B** is incorrect because matrix is in mitochondria not chloroplasts* ***D** is incorrect because the DNA is in the stroma and not the thylakoid space*	**(1)**

Question number	Answer	Mark
6(a)(ii)	The only correct answer is **B** ***A** is incorrect because amyloplasts do not contain DNA* ***C** is incorrect because vacuoles do not contain DNA* ***D** is incorrect because neither vacuoles nor amyloplasts contain DNA*	**(1)**

Question number	Answer	Mark
6(b)(i)	The only correct answer is **D** ***A** is incorrect because 150 000 ÷ 105 = 1429* **B** *is incorrect because 150 000 ÷ 105 = 1429* ***C** is incorrect because 150 000 ÷ 105 = 1429*	**(1)**

Question number	Answer	Additional guidance	Mark
6(b)(ii)	An answer that includes two of the following points: • non-coding regions (1) • promoter regions (1) • some genes code for non-proteins (1) • stop codons (1)	 **ACCEPT** introns / telomeres / centromeres / satellite DNA / tandem repeats idea that not all regions code for proteins **ACCEPT** enhancer regions / silencer regions / regulatory regions e.g. ncRNA, tRNA, rRNA, SiRNA (not mRNA) **ACCEPT** terminator regions	**(2)**

Question number	Answer	Additional guidance	Mark
6(b)(iii)	A description that includes the following points: • RNA polymerase is involved in the synthesis of RNA (1) • ribosomal proteins are involved in {translation / forming peptide bonds between amino acids} (1) • RUBISCO involved in carbon fixation (1) • ATP synthetase is involved in ATP synthesis from {ADP and phosphate / phosphorylation of ADP} (1)	**ACCEPT** transcription / formation of phosphodiester bonds between RNA nucleotides / lining up of RNA nucleotides along a DNA strand **ACCEPT** to hold mRNA and (two) tRNA in place **ACCEPT** reaction between carbon dioxide and RuBP **ACCEPT** P_i for phosphate protein channel involved in ATP synthesis hydrogen ions pass through releasing energy for ATP synthesis	**(4)**

Question number	Answer	Additional guidance	Mark
7(a)(i)	A description that includes three of the following points: • work {beside a Bunsen burner / in a sterile cabinet} (1) • use {(inoculating / wire) loop / wire} to {remove / transfer} {bacteria / colonies / cells} (into liquid culture) (1) • that has been sterilised (1) • swirl it in the broth / dislodge {bacteria / colonies / cells} in broth (1)	**ACCEPT** Q-tip, cotton bud, cotton swab, spatula idea that the loop is moved across the agar **ACCEPT** appropriate description of how the loop was sterilised e.g. passing through Bunsen burner, wiping with disinfectant, dipping in alcohol	**(3)**

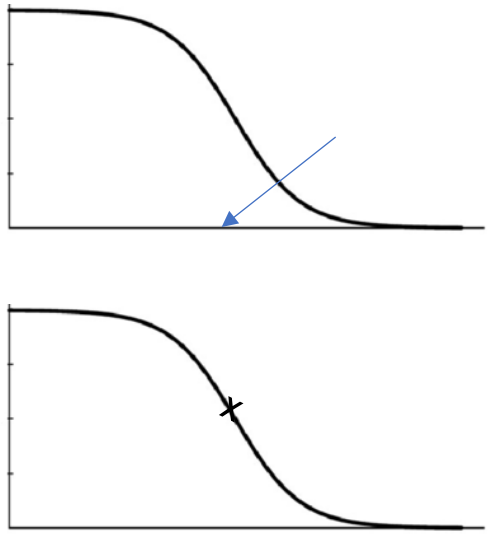
Question number	Answer	Additional guidance	Mark
7(a)(ii)	An answer that includes the following points: • to keep the {bacteria / *C. parietis*} {in suspension / (evenly) distributed} / to prevent the cells from settling (1) • so that they {have a supply of / mixed with} {oxygen / nutrients} (1) • to {**keep** the temperature constant / distribute the heat} (1)	**ACCEPT** evenly distribute / aerate / increasing dissolved oxygen	**(2)**

Question number	Answer	Mark
7(b)(i)	The only correct answer is **B** ***A** is incorrect because 45 ÷ 52 = 0.865384 = 0.87* ***C** is incorrect because 45 ÷ 52 = 0.865384 = 0.87* ***D** is incorrect because 45 ÷ 52 = 0.865384 = 0.87*	**(1)**

Question number	Answer	Additional guidance	Mark
7(b)(ii)	An explanation that includes two of the following points: • because beta-carotene is soluble (in the solvent used) (1) • beta-carotene has a (specific) RF value in that solvent (1) • beta-carotene is a pigment so can be seen (on the chromatogram) (1)	**ACCEPT** chromatography separates substances based on solubility **ACCEPT** moves a specific distance from the origin in that solvent the relative distance between the pigment and the solvent front is constant in that solvent **ACCEPT** comparing the Rf value to {data / information / standard / known values}	**(2)**

Question number	Answer	Additional guidance	Mark
7(c)	A description that includes the following points: • production of pigment reflects the growth of the bacteria (in both graphs) (1) • optimum pH for {pigment production / (growth of) bacteria} is 8 (1) • there is a (positive) correlation between temperature and {pigment production / growth of bacteria} (1)	**IGNORE** refs to more pigment than bacteria throughout explanations **ACCEPT** same {trends / patterns} (in both graphs) both increase **and decrease** together the production of pigment is (positively) correlated with the growth of bacteria (in both graphs) **ACCEPT** at pH 8 the {number of bacteria is highest / concentration of pigment is highest} **ACCEPT** description e.g. as temperature increases, concentration of pigment increases	**(3)**

Question number	Answer	Additional guidance	Mark
7(d)	An explanation that includes four of the following points: • no pigment (production) as the bacteria were adjusting to the new conditions (1) • no pigment (production) as the bacteria were synthesizing enzymes to make the pigment (1) • pigment {produced / increased} as the bacteria were {increasing in number / in the exponential phase} (1) • mass of pigment {levelled off / started to decrease / stopped increasing so rapidly} as {fewer bacteria were growing / more bacteria were dying / birth rate of bacteria equals death rate / in stationary phase} (1) • levels fell as the pigment was {breaking down / used by the bacteria} (1) • changes in pigment occurred after the changes in the number of bacteria as the number of bacteria determined how much pigment produced (1)	**ACCEPT** acclimatising, adapting, warming up, synthesising enzymes to digest nutrients **ACCEPT** it takes time to synthesise the pigment	**(4)**

Question number	Answer	Additional guidance	Mark
8(a)(i)	• indication of <u>temperature</u> at equivalent to 50 % on y axis (1)		(1)

Question number	Answer	Additional guidance	Mark
8(a)(ii)	A description that includes the following points: • turtles as temperature increases the percentage of males decreases / negative correlation **AND** tuatara as temperature increases the percentage of males increases / positive correlation (1) • credit a description of how the numbers change for either turtles or tuatara (1) • crocodiles as temperature increases the percentage of male crocodiles increases and then (as temperature increases further) the percentage of male crocodiles decrease (1)	**ACCEPT** in a description of how it changes **NB** piece together e.g. non-linear / S shaped / sigmoidal / (tuatara) increase and then level off at higher temperatures **ACCEPT** as temperature increases the percentage of male crocodiles increases, then stays the same and then decreases	**(3)**

Question number	Answer	Additional guidance	Mark
8(b)	An explanation that includes four of the following points: • temperature affects gene expression / sex of turtles is determined by environment and genotype (1) • due to epigenetic modification (1) • such as {DNA methylation / histone modification} (1) • at {lower / decreasing} temperatures DMRT1, Sox9 and AMH {genes expressed / (proteins) produced} (1) • at {higher / increasing} temperatures CIRP and aromatase {genes expressed / (proteins) produced} (1)	**ACCEPT** temperature switches genes on / off **ACCEPT** epigenetics **ACCEPT** other mechanisms but **IGNORE** post-transcriptional modification **ACCEPT** three **ACCEPT** two	**(4)**

Question number	Answer	Additional guidance	Mark
8(c)(i)	• named human activity that results in the sand warming (1) e.g. burning {(fossil) fuels / trees / plastics / biomass / biofuels} farming {animals / livestock} vehicle emissions farming rice / paddy fields / farming ruminants / farming named ruminant e.g. cattle landfill sites fossil fuel production / coal mining mismanagement of sewage draining of peat bogs deforestation building that shades the sand / removing trees that exposes the sand	**ACCEPT** burning {coal / oil / natural gas / peat} **IGNORE** {burning / combustion} unqualified	**(1)**

Question number	Answer
*8(c)(ii)	**Comments relating to graph:** • temperature of sand fluctuates • 30% microplastics has greater effects than 25% **Comments relating to table:** • microplastics have a similar / slightly higher mean temperature • with 30% being higher than 25% • difference do not look to be significant / SD overlap **General comments:** • as CIRP and aromatase {genes will be expressed / proteins will be produced} **OR** as DMRT1, Sox9 and AMH {genes will be silenced / protein will not be produced} • this may not be a concern as males can mate with more than one female • but this could reduce genetic variation • if temperature increases too much, only females will be born • there are not enough males to mate with females • consequences e.g.reducing reproduction rate and hence number of turtles born • microplastics may affect turtles in other ways e.g. poisoning them if consumed • the timing of the fluctuations could affect sex determination • scientists might be concerned as the microplastics could exacerbate effects of other temperature warming activities • decrease in numbers of turtles can disrupt food chain • SD overlap between **control** and microplastics so may not be significant **Comments relating to flatback turtles:** • slightly more females without influence of microplastics • as a mean of 30.047 for control is already higher than {Tpiv / 29.4} for flatback turtle • only a small increase is going to result in even more females being produced • SD for 30% microplastics indicate that all males or all females could be produced **Comments relating to green sea turtles:** • green sea turtles affected less as all three temperatures are close to their Tpiv • their numbers could remain stable as both males and females born in fairly equal proportions • their numbers could increase as less competition with flatbacks for food • no information that only males or females would be produced

			Additional guidance
Level 0	0	No awardable content	
Level 1	1-2	An explanation may be attempted but with limited interpretation or analysis of the scientific information and with a focus on mainly just one piece of scientific information. The explanation will contain basic information, with some attempt made to link knowledge and understanding to the given context.	**Level 1: Limited comments about the data** 1 mark = one comment from either graph or table 2 marks = one implication of microplastics in context of question
Level 2	3-4	An explanation will be given, with occasional evidence of analysis, interpretation and/or evaluation of both pieces of scientific information. The explanation shows some linkages and lines of scientific reasoning, with some structure.	**Level 2: Some discussion of effects of microplastics in the sand on turtles** 3 marks = two discussion points made 4 marks = three discussion points made
Level 3	5-6	An explanation is made that is supported throughout by sustained application of relevant evidence of analysis, interpretation and/or evaluation of both pieces of scientific information. The explanation shows a well-developed and sustained line of scientific reasoning, which is clear and logically structured.	**Level 3: Effect of microplastics on both species of turtle discussed with some reference to Tpiv** 5 marks = four discussion points that includes points made on both species 6 marks = five points made that includes points made on both species

Question number	Answer	Additional guidance	Mark
9(a)(i)	• 3.4×10^5 (tonnes) (1)		**(1)**

Question number	Answer	Additional guidance	Mark
9(a)(ii)	An explanation that includes the following points: • so that the infected plants can be {destroyed / pulled up / treated} **OR** so that {healthy / other} plants will not become infected • to reduce the loss (of harvest / plants) (1)	**ACCEPT** preventing spread to other plants **ACCEPT** idea of maximising food production	**(2)**

Question number	Answer	Additional guidance	Mark
9(b)(i)	• because this is (the range of) wavelengths in {sunlight / white light} (1)	**ACCEPT** wavelengths used in photosynthesis wavelengths absorbed by plants / chlorophylls / pigments / PS wavelengths from the sun **IGNORE** visible light	**(1)**

Question number	Answer	Additional guidance	Mark
9(b)(ii)	An explanation that includes two of the following points: • because (different) pigments {absorb / reflect} different {colours / wavelengths of} light (1) • because different pigments {absorb / reflect} different amounts of light (of the same wavelength of light) (1) • and the infected leaves have less {pigment / chlorophyll / green pigment} (than healthy leaves) (1)	**ACCEPT** {colours (of pigment) / streaks} idea that the streaks will {absorb / reflect} {colours / wavelengths of} light differently (to the healthy leaves) **ACCEPT** more {yellow / orange} pigment	**(2)**

Question number	Answer	Additional guidance	Mark
9(b)(iii)	An answer that includes three of the following points: • could be useful as there are some differences / infected leaves reflect (slightly) more light (1) • but they would need to be detectable in the {field / farm} (1) • being able to detect infection after 2 days would need to be soon enough for prevention of spread (1) • identification would be better if the {differences were greater / trends were different} / not so useful as differences are small (1) • no {error bars / SD / statistical analysis} to show if these differences are significant (1)	**ACCEPT** equipment may not be available / difficult to measure outside / other named abiotic factors may affect results e.g. mineral ion availability, light intensity / large numbers of plants would have to be monitored **ACCEPT** converse idea	**(3)**

Question number	Answer	Additional guidance	Mark
9(c)	An explanation that includes four of the following points: • rice from Africa could have alleles (coding) for resistance (1) • credit named mechanism (1) • because of a mutation (1) • which was positively selected for by the presence of the {virus / RYMV / viral disease} (1) • uninfected plants were able to {mature / survive / reproduce} and increase the allele frequency (in the gene pool) (1)	**ACCEPT** gene duplication converse for Asian rice e.g. tougher leaves (that the virus cannot penetrate) production of {chemicals / enzymes} (against viruses) change the binding site in the cell membrane **DO NOT ACCEPT** selection pressure causes the mutation **ACCEPT** (presence of) virus acted as a (positive) selection pressure	**(4)**

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