



Mark Scheme (Results)

January 2023

Pearson Edexcel International Advanced
Subsidiary Level In Biology (WBI14/01)
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	Additional guidance	Mark
1(a)	An answer that includes two of the following points: - sterilise equipment (1) - work beside a bunsen burner (1) - cover / minimise the length of time that cultures are open (1)	ACCEPT named methods of sterilisation and named equipment washing hands / gloves / wiping down surfaces with disinfectant ACCEPT selective media NB aseptic technique if no other marks awarded	(2)

Question number	Answer	Mark
1(b)	The only correct answer is C <i>A is incorrect because 10 µg is 0.01 mg, and 0.5 mg ÷ 0.01 = 50</i> <i>B is incorrect because 10 µg is 0.01 mg, and 0.5 mg ÷ 0.01 = 50</i> <i>D is incorrect because 10 µg is 0.01 mg, and 0.5 mg ÷ 0.01 = 50</i>	(1)

Question number	Answer	Additional guidance	Mark
1(c)	An explanation that includes three of the following points: - not A and D because {they have no effect / the bacteria are resistant to them / there is no zone of inhibition} (1) - B as it {is most effective / has the largest zone of inhibition} (1) - use {high mass / 200 µg} antibiotic C as lower masses are not effective (1) - use antibiotic B at 10 µg as higher masses are no more effective (1)	ACCEPT use antibiotics B, C and E as {they are effective / the bacteria are not resistant to them / they have a zone of inhibition} PIECE TOGETHER ACCEPT do not use {low mass / 20µg} of C as it is not effective	(3)

	Answer	Mark
2(a)(i)	The only correct answer is C <i>A is incorrect because P is a ribosome</i> <i>B is incorrect because Q is the cell wall</i> <i>D is incorrect because T is the membrane</i>	(1)

	Answer	Mark
2(a)(ii)	The only correct answer is C <i>A is incorrect because light-dependent reaction takes place on membranes and Q is the cell wall</i> <i>B is incorrect because light-dependent reaction takes place on membranes and S is the cytoplasm</i> <i>D is incorrect because light-dependent reaction takes place on membranes and U is the flagellum</i>	(1)

	Answer	Mark
2(a)(iii)	The only correct answer is B <i>A is incorrect because light-independent reaction takes place in the cytoplasm and Q is the cell wall</i> <i>C is incorrect because light-independent reaction takes place in the cytoplasm and T is the cell membrane</i> <i>D is incorrect because light-independent reaction takes place in the cytoplasm and U is a flagellum</i>	(1)

Question number	Answer	Additional guidance	Mark
2(b)	A description that includes two of the following points: • bacterial (pigments) can absorb (light) at a greater range of wavelengths (1) • bacterial (pigments) absorb more (light) at most wavelengths (1) • bacterial (pigments) absorb most (light) at 380 nm and 880 nm and plant pigments at 440 nm (1)	ACCEPT bacterial (pigments) absorb at the end of the spectrum as well but plants do not ACCEPT (overall) more absorption there are more peaks for bacterial (pigments) ACCEPT +/- 10	(2)

Question number	Answer	Additional guidance	Mark
2(c)	A description that includes the following points: - distance solvent moved (from the origin) measured (1) - distance {pigment / solute} moved from the origin (1) - equation {described / given} (1)	DO NOT ACCEPT at end of paper ACCEPT measure from {centre / leading edge} of pigment (1) $R_f = \text{distance moved by pigment} \div \text{distance moved by solvent}$	(3)

Question number	Answer	Mark
3(a)	The only correct answer is D <i>A is incorrect because TMV is an RNA virus</i> <i>B is incorrect because TMV is an RNA virus</i> <i>C is incorrect because TMV does not have an envelope</i>	(1)

Question number	Answer	Additional guidance	Mark
3(b)(i)	8.7% of the 8.3×10^{12} calculated (1) 7.6×10^{12} (1) OR - percentage recycled calculated (1) 7.6×10^{12} (1)	$0.7221 \times 10^{12} / 7.221 \times 10^{11}$ 91.3 Bald answer of $7.6 \times 10^{12} = 2$ marks Bald answer of $7.5779 \times 10^{12} / 76 \times 10^{11} / 0.7221 \times 10^{12} / 7.221 \times 10^{11} / 91.3 = 1$ mark	(2)

Question number	Answer	Additional guidance	Mark
3(b)(ii)	An explanation that includes the following points: - because they {produce / release} enzymes (1) - that can {break / hydrolyse} bonds within the plastic (1)		(2)

Question number	Answer	Additional guidance	Mark
3(b)(iii)	An explanation that includes the following points: - because breakdown products {taken up / absorbed} (by the bacteria) (1) - respiration produces carbon dioxide (1) (bacterial) {biomass / stored material} is {(other) organic molecules / converted breakdown products / glycogen / polysaccharide / protein / lipid} (1)	ACCEPT converting what is taken up into {another molecule / glucose / named (simple) molecule} DO NOT ACCEPT molecules not found in bacteria e.g. starch, chlorophyll	(3)

Question number	Answer	Additional guidance	Mark
4(a)	5 {million / $\times 10^6$} 5 000 000 4.8 / 4.9 {million / $\times 10^6$} 4 800 000 / 4 900 000 4.78 / 4.85 / 4.86 / 4.92 {million / $\times 10^6$} 4 780 000 / 4 850 000 / 4 860 000 / 4 920 000		(1)

Question number	Answer	Additional guidance	Mark
4(b)	A description that includes four of the following points: • GALP converted to glucose (1) • glucose converted to {fructose / sucrose} (1) • sucrose transported in phloem (1) • phosphates used / phosphorus needed (in component molecule / rubber) (1) • credit details of {phosphates / phosphorus} (1) • glucose respired for energy / enzymes used in the production of {component molecule / rubber} (1)	ACCEPT converted to component (rubber) molecules ACCEPT component (rubber) molecules transported in phloem DO NOT ACCEPT glucose e.g. phosphates taken up from the soil by {active transport / facilitated diffusion} / phosphates transported in xylem / breakdown product of ATP / ATP provides the phosphorus	(4)

Question number	Answer	Additional guidance	Mark
4(c)	An explanation that includes the following points: • {trunk / base of tree} sample removed (1) • rings counted (1) • because {one ring is made each year / number of rings equals age of tree} (1)	DO NOT ACCEPT chopping tree down / using branches	(3)

Question number	Answer	Additional guidance	Mark
5(a)(i)	An explanation that includes the following points: • because it is making predictions (1) • based on {knowledge / data} (1) • it is a visual representation (of what might happen) (1)	ACCEPT guess / an idea / estimation / what might happen ACCEPT statistics / what has happened NB award {extrapolation / correlation / trend} once in either context of mp 1 or mp 2	(2)

Question number	Answer	Additional guidance	Mark
5(a)(ii)	• 33 / 33.3 / 33.33 (%)		(1)

Question number	Answer	Mark
*5(b)	1 Aspect : Positive impact on local (human) population: • crops will provide food • forests will provide materials for {building / making fires} • {crops / forest} will provide {employment / income} • {crops / forests} encourage new animals that might provide food • credit effect of reduced global warming on people e.g. no extremes of temperature, no droughts 2 Aspect : Negative impact on local (human) population: • {crops / forests} may replace the crops they were growing already • {crops / forests} may {reduce / replace} the land they were using for animals • {crops / forests} may {reduce / replace} the land they were {living on / using for houses / factories} • crops use {pesticides / fertilisers} which is expensive for farmers 3 Aspect : Positive impact on global warming: • carbon dioxide will be removed from the atmosphere • decreasing the greenhouse effect • extremes of temperature should be reduced • extremes of precipitation should be reduced 4 Aspect : Negative impact on global warming: • planting crops may reduce carbon dioxide levels less than {forests / pre-existing crops} • machinery used in {planting {forests / crops} / harvesting crops} produces carbon dioxide • burning {plants / trees} produces carbon dioxide 5 Aspect : Positive impacts on biodiversity: • planting {crops / forests} may increase (new) habitat • plants may provide food • increase in herbivores may increase carnivores 6 Aspect : Negative impacts on biodiversity: • planting {crops / forest} could reduce (original) habitat • crops are monocultures and therefore reduce biodiversity • trees planted may not be suitable species • crops use pesticides that could harm food chains	(6)

			Additional guidance
Level 0	0	No awardable content	
Level 1	1-2	Demonstrates isolated elements of biological knowledge and understanding to the given context with generalised comments made. Vague statements related to consequences are made with limited linkage to a range of scientific ideas, processes, techniques and procedures. The discussion will contain basic information with some attempt made to link knowledge and understanding to the given context.	Simple links made between plants and their impact
Level 2	3-4	Demonstrates adequate knowledge and understanding by selecting and applying some relevant biological facts / concepts. Consequences are discussed which are occasionally supported through linkage to a range of scientific ideas, processes, techniques and procedures. The discussion shows some linkages and lines of scientific reasoning with some structure.	Extended links made between plants and their advantages or disadvantages
Level 3	5-6	Demonstrates comprehensive knowledge and understanding by selecting and applying relevant biological facts / concepts. Consequences are discussed which supported throughout by sustained linkage to a range of scientific ideas, processes, techniques and procedures. The discussion shows a well-developed and sustained line of scientific reasoning which is clear and logically structured.	Clear discussions on the types of plants and their advantages and disadvantages

Question number	Answer	Mark
6 (a)	The only correct answer is C <i>A is incorrect because enzymes are organic molecules that decrease activation energy</i> <i>B is incorrect because enzymes are organic molecules</i> <i>D is incorrect because enzymes increase activation energy</i>	(1)

Question number	Answer	Additional guidance	Mark
6(b)(i)	log / logarithmic / $\log_{10}$ / log to the base 10 (scale)	DO NOT ACCEPT $\ln$ / $\log_e$ / natural log	(1)

Question number	Answer	Mark
6(b)(ii)	The only correct answer is C <i>A is incorrect because both level of salt and wave action are abiotic</i> <i>B is incorrect because wave action is abiotic</i> <i>D is incorrect because level of salt is abiotic</i>	(1)

Question number	Answer	Additional guidance	Mark
6(b)(iii)	An explanation that includes three of the following points: - enzymes needed for the metabolism (of the fish) (1) - because enzyme activity is not sufficient at both higher and lower temperatures (than zone of tolerance) (1) - because at lower temperatures there will not be enough kinetic energy for {collisions / enzyme-substrate complexes to be formed} (1) - because at higher temperatures {the enzymes denature / active site changes shape} (1)	PIECE TOGETHER ACCEPT converse ACCEPT enzymes do not work fast enough / no enzyme activity / in zone of tolerance enzyme <u>activity</u> is at an optimum DO NOT ACCEPT start to denature	(3)

Question number	Answer	Additional guidance	Mark
6(c)(i)	- values for 20 °C and 30 °C read from the graph (1) - numbers substituted into the equation and evaluated (1) 1.5 / 1.6 / 1.56 / 1.62 with no units (1)	{2.6 / 2.7 / 2.8} and 4.2 $4.2 \div 2.6 = 1.615384615$ $4.2 \div 2.7 = 1.555555555556$ $4.2 \div 2.8 = 1.5$ answer to 1 or 2 decimal places Bald answer of 1.5 / 1.6 / 1.56 / 1.62 with no units = 3 marks Bald answer of 1.556 / 1.615 or more correctly rounded dps = 2 marks Bald answer of {2.6 / 2.7 / 2.8} and 4.2 = 1 mark	(3)

Question number	Answer	Additional guidance	Mark
6(c)(ii)	An explanation that includes three of the following points: - as storage time increases the {activity / optimum temperature (of the enzyme)} decreases (1) - the active site changes shape (due to storage time) (1) - because the bonds break (due to more energy) (1) - as more energy causes more vibration between the R groups (1) - the longer the active site is distorted the less likely it is to return to normal shape (1)	ACCEPT tolerance to temperature decreases ACCEPT enzyme {changes shape / changes structure / is denatured} DO NOT ACCEPT any named bond not found in an enzyme	(3)

Question number	Answer	Mark
7(a)(i)	The only correct answer is B <i>A is incorrect because Q is a hydrogen bond</i> <i>C is incorrect because R is a covalent bond</i> <i>D is incorrect because Q is a hydrogen bond</i>	(1)

Question number	Answer	Mark
7(a)(ii)	The only correct answer is C <i>A is incorrect because a deoxyribose does not have a negative charge</i> <i>B is incorrect because a covalent bond does not have a charge</i> <i>D is incorrect because the bases do not have a negative charge</i>	(1)

Question number	Answer	Additional guidance	Mark
7(b)(i)	{Maleo / this bird / it} is only found in {Indonesia / this country / forest}	DO NOT ACCEPT answer given in context of habitat	(1)

Question number	Answer	Additional guidance	Mark
7(b)(ii)	the newly hatched birds cannot fly to the forest / the birds cannot get to beach	ACCEPT not enough beach left to lay eggs / not enough forest left for {roosting / feeding} / humans damage {eggs / nests} / decrease gene flow / inbreeding	(1)
Question number	Answer	Additional guidance	Mark
7(b)(iii)	An explanation that includes the following points: - because laying eggs in the sand will {keep them warm / hide them from predators / protect from wave action} (1) - because if the adults leave the site {there will be no indication that there are eggs laid there / they can go and find food (for themselves) / can avoid predators / it is too hot on the beach} (1) - because if the young can fly (straightaway) they can {avoid predators / get food} (1)		(3)

Question number	Answer	Additional guidance	Mark
7(b)(iv)	An explanation that includes the following points: - primers needed so that (DNA / taq) polymerase can bind (to one strand) (1) - because one primer is needed for each strand (1) - because the DNA strands {are antiparallel / are complementary / have different base sequences at each end} (1)	ACCEPT one primer can bind to each end of the DNA molecule ACCEPT two primers each with a complementary sequence of bases are needed DO NOT ACCEPT one for 3' and one for 5' end	(2)

Question number	Answer	Additional guidance	Mark
7(b)(v)	An explanation that includes the following points: - this sample of eggs had more males than females so the {birds may not be monogamous / claim may not be true} (1) - the sample size is too small (1) - the number of chicks may not represent the number of adults (1)	ACCEPT fewer females than males any correct <u>manipulated</u> data that illustrates this, including not a 1:1 ACCEPT a suitable description of why e.g. more males die	(3)

Question number	Answer	Additional guidance	Mark
8(a)(i)	A description that includes the following points: • (viral) RNA interacts with (host cell) ribosomes (1) • credit detail of role of (host) tRNA (1) • peptide bonds form between the (adjacent host) amino acids (1)	ACCEPT two tRNAs bind to RNA (at any one time) each tRNA carries a specific amino acid tRNA anticodons bind to RNA codons tRNA binds to RNA with hydrogen bonds DO NOT ACCEPT polypeptide bond / dipeptide bond	(3)

Question number	Answer	Additional guidance	Mark
8(a)(ii)	An answer that includes three of the following points: - inhibitor binds to protease so that it cannot bind to {the (poly)protein / its substrate} (1) - therefore the (polyprotein peptide) bonds will not be broken (1) - therefore {no / fewer} {individual / smaller / component / named component} proteins will be made (1) - therefore the {components / named components} cannot be assembled (into individual viruses) (1)	ACCEPT inhibitor binds to (poly)protein / inhibitor stops protease binding to (poly)protein ACCEPT (individual) proteins will not be separated ACCEPT virus cannot be put together from (poly)protein	(3)

Question number	Answer	Additional guidance	Mark
8(b)	An explanation that includes four of the following points: • if number of platelets were higher blood would clot faster (1) • and this would help to reduce the bleeding (1) • more {white blood cells / appropriately named white blood cell} {to destroy the virus / increase immune response} (1) • credit a role of a named type of white blood cell in the immune response (1) • credit reason why {phagocytes / named phagocyte} can attach (more) viruses (1)	ACCEPT higher rate e.g. macrophages for antigen presentation to T helper cells T helper cells in activating {T killer cells / B cells} T killer cells to destroy host cells infected with virus B cells to differentiate into plasma cells plasma cells to produce antibody to the virus DO NOT ACCEPT B cells produce antibody antibodies destroy virus e.g. opsonisation agglutination antibodies bind macrophage to the virus viruses released from host cells so accessible to phagocytes	(4)

Question number	Answer	Additional guidance	Mark
8(c)	A description that includes two of the following points: • credit advantage of this method being effective (1) • credit advantage of bacteria being passed to future generations (1) • the mosquitoes are not removed from the food chain (1) • more ethical as mosquitoes not harmed (1)	e.g. decreases chance of epidemic fewer people will die less need for {drugs / vaccines} no side effects of drugs e.g. the prevention will spread as the number of mosquitoes infected with the bacteria increase not every {mosquito / mosquito egg} has to be treated saving {time / money} treatment has to be done only once ACCEPT description of a consequence e.g. food webs not disrupted	(2)

Question number	Answer	Additional guidance	Mark
9(a)	1 (children) : 2.7 (women) : 4.7 (men) OR 1 (children) : 3 (women) : 5 (men)	ACCEPT 0.4 : 1 : 1.8 0.2 : 0.6 : 1 ACCEPT values in different order if clearly shown which is which	(1)

Question number	Answer	Additional guidance	Mark
9(b)	An explanation that includes three of the following points: - because formation of {plaques / tubercles / granuloma} in (lungs / other organs) (1) - therefore insufficient oxygen for (aerobic) respiration (1) - causes (other) organ failure (1) - weakens immune system so (death from) {other infections / tumours} (1)	ACCEPT reduces {gas exchange / gas exchange surface} ACCEPT description e.g. less oxygen enters blood ACCEPT named organ (in a correct context) / heart attack ACCEPT opportunistic infections (other than {TB / HIV} with / without ref to weakened immune system)	(3)

Question number	Answer	Additional guidance	Mark
9(c)(i)	An explanation that includes the following points: - because the untreated macrophages did not release IL-1β (1) - and therefore any inhibition by infection could not be shown / to compare the effect of infection on IL-1β (1)	ACCEPT did not release much IL-1β ACCEPT so that the inhibition could be seen to show the effect of TB (on macrophages / IL-1β)	(2)

Question number	Answer	Additional guidance	Mark
9(c)(ii)	An answer that includes four of the following points: - the antibody attached to the plastic otherwise everything will be washed away (1) - antibodies used (stage 1 or 5) are specific to the IL-1B (1) - so that they are bound to the {antigen / IL-1B} (stage 1 or 5) (1) - a dye has to be attached to antibodies to make {reaction / antigen / complex} visible (1) - unattached {antibodies / antigen / molecules / dye} have to be washed away (so that only the antigen-antibody complexes remain) (1)	ACCEPT stain the {antigen / complex}	(4)

Question number	Answer	Additional guidance	Mark
9(c)(iii)	A description that includes four of the following points: • both types of bacteria cultured in the same culture conditions (1) • use {aseptic technique / description of a technique} (1) • credit {named / description of} equipment used (1) • {calibration / standard} curve used to determine concentration of bacteria (1) • credit {description of how growth rate would be determined / appropriate stats test named to compare growth rate} (1)	ACCEPT same concentration of bacteria named condition e.g. temperature, time e.g. light meter / light sensor / spectrophotometer / colorimeter / cross underneath the flask / shine a light through and measure {transmission / absorbance} ACCEPT description of how the light {absorbed / transmitted} is determined by the number of bacteria ecf if haemocytometer used ecf if haemocytometer used	(4)

Question number	Answer	Additional guidance	Mark
9(c)(iv)	• use in a vaccine (1)	ACCEPT used to develop an {inhibitor of / antibody to / enzyme to break down / chemical to breakdown} this protein used to develop a way of switching off the gene coding for the protein (in the bacteria)	(1)

