GradeMax



Mark Scheme (Results)

January 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	Additional guidance	Mark
1(a)(i)	An answer that includes two of the following points: • pain / hurts / tender / aches / throbbing / dolor • redness / red / rubor • warmth / heat / hot / increased temperature / calor • loss of function	All 3 correct = 2 marks 1 or 2 correct = 1 mark **IGNORE** itching **IGNORE** rash **IGNORE** fever	**(2)**

Question number	Answer	Additional guidance	Mark
1(a)(ii)	An answer that includes two of the following points: • pain alerts the person that there is an injury (1) • warmth speeds up {chemical reactions / skin cell division / phagocytosis / increases rate of enzyme activity (of person) / defence mechanisms} (1) • swelling results in more {blood / white blood cells / platelets / phagocytes / antibodies/ tissue fluid} (to the wound) (1) • redness results in more {blood / white blood cells / platelets / phagocytes / antibodies} (to the wound) (1)	**NB CE from (i)** **ACCEPT** to avoid {contact with area / using the injured part} **ACCEPT** reduce activity of bacterial enzymes / reduce growth of bacteria * two different ideas must be given to award 2 marks	**(2)**

Question number	Answer	Additional guidance	Mark
1(b)(i)	An answer that includes the similarity and two of the three differences: Similarities: • (overall) both treatments decrease inflammation (1) Differences: • curcumin is more effective than drug A (throughout) (1) • maximum decrease for drug A is less than that for curcumin (1) • credit a comparison at specific days (1)	**DO NOT PIECE TOGETHER** but accept in adjacent sentences **ACCEPT** converse where appropriate turmeric for curcumin **IGNORE** references to rate e.g. inflammation increases {2 / 4} days after operation with drug A but increases after day 3 with curcumin extract (1)	**(3)**

Question number	Answer	Additional guidance	Mark
1(b)(ii)	The correct answer is C 33.3 (g) ***A*** *is incorrect because 0.03g contains 0.009g curcumin* ***B*** *is incorrect because 3.33g contains 0.1g of curcumin* ***D*** *is incorrect because 33.3 recurring has been rounded incorrectly*		**(1)**

Question number	Answer	Additional guidance	Mark
2(a)	An explanation that includes two of the following points: • antibiotics used to treat impetigo and whooping cough because they are caused by bacteria (1) • antibiotics not always used to treat middle ear infections or sinus infections as they {can be caused by viruses / as they are not always caused by bacteria} (1) • antibiotics not used to treat multiple sclerosis or rheumatoid arthritis as they are not caused by bacteria (1)	**NB Do not accept if clear confusion with antibodies** **ACCEPT** because some of the bacteria are resistant to antibiotics **IGNORE** any ref to cause **ACCEPT** antibiotics used for bacterial infections if no other marks awarded	**(2)**

Question number	Answer	Mark
2(b)	The only correct answer is **B**. ***A*** *is incorrect because bactericidal antibiotics decrease the number of bacteria* ***C*** *is incorrect because antibiotics do not increase the number of bacteria* ***D*** *is incorrect because antibiotics do not increase the number of bacteria*	**(1)**

Question number	Answer	Additional guidance	Mark
2(c)(i)	An explanation that includes the following points: • to compete with (pathogenic) bacteria for {nutrients / named nutrient / space} (1) • so they {reduce / destroy / prevent the growth of} (pathogenic) bacteria (1)	 **IGNORE** food **ACCEPT** produce {toxins / chemicals} **ACCEPT** so that they do not increase in number and cause disease	 **(2)**

Question number	Answer	Additional guidance	Mark
2(c)(ii)	An explanation that includes the following points: • (because gut flora contain) bacteria (1) • and antibiotics are not (generally) specific to one type of bacteria (1)	 **ACCEPT** antibiotics {can affect different types of bacteria / can be broad spectrum}	 **(2)**

Question number	Answer	Additional guidance	Mark
2(c)(iii)	• accept a value between 9×10^6 and 1.2×10^7		**(1)**

Question number	Answer	Additional guidance	Mark
2(c)(iv)	An answer that includes the following points: • antibiotic P kills all but three types (1) • antibiotic Q only kills two types (1) • antibiotic R has no effect (on gut flora / types A and B) (1)	**ACCEPT** descriptions in terms of resistance and susceptibility but not immunity throughout **ACCEPT** correct references to bactericidal and bacteriostatic **ACCEPT** kills 4 types / kills type A but has limited effect on type B **ACCEPT** results in the presence of a new type / reduces the number of type A and type B	**(3)**

Question number	Answer	Additional guidance	Mark
3(a)	A description that includes four of the following points: • vaccine contains an {inactive / attenuated} form of the {pathogen / virus / bacteria / microorganism} (1) • macrophages engulf and display antigen on cell surface (1) • macrophages will present the antigen to T helper cells (1) • T helper cells will activate {B / T killer} cells (1) • (T / B) memory cells produced (1)	**ACCEPT** antigen (found on the pathogen) / weakened pathogen **DO NOT ACCEPT** dead {virus / antigen} **ACCEPT** macrophages become antigen-presenting cells + description to T helper cells **ACCEPT** description e.g. T helper cells release cytokines that cause B cell proliferation	**(4)**

Question number	Answer	Additional guidance	Mark
3(b)(i)	A description that includes the following points: • conclusion relating trust in scientists to income (1) • conclusion relating trust in scientists to vaccine safety (1) • conclusion relating income to vaccine safety (1)	e.g. trust goes down (slightly) with increase in income e.g. people who agree that vaccines are safe trust the scientists the most e.g. at all incomes, there are people who agree, neither agree nor disagree and disagree that vaccines are safe	**(3)**

Question number	Answer	Additional guidance	Mark
3(b)(ii)	education / (influence of) {media / family / friends / internet} / religious beliefs	previous experiences with {vaccines / medications} ethical beliefs fear of needles lack of trust in testing process allergies side effects more money for {treatment / healthcare} medical insurance	**(1)**

Question number	Answer	Additional guidance	Mark
3(c)	An answer that includes two of the following points: • vaccinated people will {not / be less likely to} develop the disease / vaccinated people will be immune (1) • fewer infected people to infect people who are not immune (1) • protect people who cannot become immune (1)	**IGNORE** less likely to be infected **ACCEPT** herd immunity e.g. allergic to vaccines, immunodeficient, immunosuppressed	**(2)**

Question number	Answer	Mark
4(a)(i)	The only correct answer is **B**. ***A*** *is incorrect because oxygen is not a greenhouse gas* ***C*** *is incorrect because oxygen is not a greenhouse gas* ***D*** *is incorrect because oxygen is not a greenhouse gas*	**(1)**

Question number	Answer	Additional guidance	Mark
4(a)(ii)	An answer that includes the following points: • (anthropogenic) caused by the effects of humans (1) • (climate change) changes to (mean) {temperature / rain fall} (1)	**IGNORE** named activities **ACCEPT** long-term (mean) change in weather patterns **IGNORE** weather unqualified / global warming / results of global warming / climate	**(2)**

Question number	Answer	Additional guidance	Mark
4(b)	An explanation that includes the following points: • species distributed more towards the North (1) • this distribution related to a described change in climate (1) • the effect of this change explained (1)	 **ACCEPT** move away from the equator (northwards) / move towards the (North) pole **IGNORE** upwards e.g. because the temperatures have become too hot, move to a cooler area, areas have become drier, areas have become wetter, drought e.g. so the enzymes do not work effectively enough (to sustain that species), their prey have migrated (North), they would become dehydrated, plants they feed on die, lack of food	**(3)**

Question number	Answer	Additional guidance	Mark
4(c)(i)	A description that includes the following points: • temperature (that a beetle was kept at) affects males more than females (1) • the optimum temperature (for keeping both beetles) is 35°C (1)	 **ACCEPT** temperatures higher than 35°C causes a greater decrease in offspring in males than females **ACCEPT** males at 35°C and females at 38°C / optimum is between 35°C and 38°C	**(2)**

Question number	Answer	Additional guidance	Mark
4(c)(ii)	An explanation that includes three of the following points: • there are fewer (successful) fertilisations by males / (successful) fertilisations are not (as) affected in females (1) • the sperm are damaged by higher temperatures / egg cells are not (so) affected by higher temperature (1) • higher temperatures decrease sperm {viability / motility} (1) • (higher) temperatures could affect {the acrosome reaction / sperm enzymes / male enzymes} / (higher) temperatures do not (really) affect {egg cell / female} enzymes (1)	**ACCEPT** offspring for fertilisation **ACCEPT** higher temperatures make the egg cell easier to penetrate **ACCEPT** enzymes of females have a higher optimum temperature than the enzymes of {sperm / males} **NB** If no other marks awarded, credit a correct description of the effect of temperature on enzyme activity	**(3)**

Question number	Answer	Additional guidance	Mark
5(a)(i)	An explanation that includes three of the following points: • because ATP is the source of energy for {plants / all living organisms} (1) • because light energy cannot be used (directly) (1) • ATP is needed in the {light-independent reactions/ Calvin cycle} to convert GP into GALP (1)	**ACCEPT** ATP is the {usable source of energy / energy currency}	**(2)**

Question number	Answer	Additional guidance	Mark
5(a)(ii)	An answer that includes the following points: • (ADP / adenosine diphosphate) and (inorganic) {Pi / phosphate / PO_4^{3-} (ion)} (1) • hydrolysis (1)	**ACCEPT** adp **DO NOT ACCEPT** P / phosphorus **ACCEPT** dephosphorylation	**(2)**

Question number	Answer	Additional guidance	Mark
5(a)(iii)	An explanation that includes three of the following points: • to {release / excite} electrons (from chlorophyll) (1) • so that electrons can be used in {chemiosmosis / (photo)phosphorylation} (1) • photolysis to {replace electrons lost by chlorophyll / provide protons for formation of reduced NADP (1) • to produce ATP and reduced NADP for the {light-independent reactions / Calvin Cycle} (1)		**(3)**

Question number	Answer	Mark
5(b)(i)	The only correct answer is **D**. ***A*** *is incorrect because ATP is not available to light-dependent reactions in cyclic photophosphorylation* ***B*** *is incorrect because ATP is not available to light-dependent reactions in cyclic photophosphorylation* ***C*** *is incorrect because oxidised NADP is not produced*	**(1)**

Question number	Answer	Additional guidance	Mark
5(b)(ii)	An answer that includes the following points: • C and O from carbon dioxide (1) • H from water (1)	 **ACCEPT** CO_2 **ACCEPT** H_2O **DO NOT ACCEPT** O from water	 **(2)**

Question number	Answer	Mark
5(b)(iii)		**(3)**

New biological molecule	Nitrates	Phosphates	Both nitrates and phosphates	Neither phosphates nor nitrates
protein	**X**			
RNA			**X**	
triglyceride				**X**

Question number	Answer	Additional guidance	Mark
6(a)(i)	An explanation that includes the following points: • mutation (in the DNA) causing allele for resistance to the new chemical (1) • (new) chemical acts as a selection pressure (1) • resistant flies survive and pass this {(new) gene / allele} onto their offspring (1)	**ACCEPT** forming a (new) gene for resistance **DO NOT ACCEPT** immune for resistant selection pressure causes mutation **DO NOT ACCEPT** immune for resistant	**(3)**

Question number	Answer	Additional guidance	Mark
6(a)(ii)	flies have a short life cycle / high mutation rate in flies / flies produce many offspring / chemical is a strong selection pressure	**DO NOT ACCEPT** selection pressure causes mutation	**(1)**

Question number	Answer	Additional guidance	Mark
*6(b)	Indicative content: **Graph:** • black stripes reduce number of biting flies on body and legs (D) • 128 down to 111 / by 17 / by 13% (D) • this may not be significant as error bars overlap (D) • black and white stripes reduce number of biting flies on body and legs (D) • 128 down to {57/58} / by {70/71} / by 55% (D) • probably significant as error bars do not overlap (D) • black and white stripes reduce the number of biting flies on body and legs more than just black stripes (C) • 111 down to {57/58} / by {53/54} / by {48/49}% (C) • probably significant as error bars do not overlap between the two groups of painted cattle (C) • error bar for black stripes is 17% and 17% for black and white stripes (C) **Table 1:** • black stripes reduce number of biting flies on legs but not on body (D) • 1309 down to 1030 / by 279 / by 21% (D) • black and white stripes reduce number of biting flies on body and legs (D) (body) 662 down to 231 / by 431 / by 65% (D) (legs) 1309 down to 710 / by 599 / by 46% (D) • black and white stripes reduce the number of biting flies on body and legs more than just black stripes (C) • (body) 677 down to 231 / by 446 / by 66% (C) • (legs) 1030 down to 710 / by 320 / by 31% (C) **Table 2:** • black stripes have no effect on {flicking tail / stamping feet / twitching} (D) • black and white stripes have very little effect on {flicking tail / stamping feet} (D) • black and white stripes have small increase on skin twitching (D) • 5 up to 8 / by 3 / by 60% (D)		

	Level 1 1 mark : description of data from one source 2 marks : description of data from two sources **Level 2** 3 marks : comparison made between black stripes only and black and white stripes, from one source of data 4 marks : two comparisons made between black stripes only and black and white stripes, from two sources of data **Level 3** 5 marks : two comparisons made between black stripes only and black and white stripes, from two sources of data **+** level 2 maths calculation OR a comparison of the error bars between black stripes only and black and white stripes 6 marks : two comparisons made between black stripes only and black and white stripes, from two sources of data **+** level 2 maths calculation AND a comparison of the error bars between black stripes only and black and white stripes		**(6)**

Question number	Answer	Mark
7(a)(i)	The only correct answer is **C**. ***A*** *is incorrect because DNA polymerase is used to synthesis DNA* ***B*** *is incorrect because integrase inserts DNA into other DNA* ***D*** *is incorrect because reverse transcriptase synthesises DNA using a RNA template*	**(1)**

Question number	Answer	Additional guidance	Mark
7(a)(ii)	An explanation that includes three the following points: • because restriction enzymes recognise specific (base) sequences (1) • because these recognition sites are not equally spaced along the DNA (1) • the enzyme hydrolyses the phosphodiester bonds (1) • therefore different sized fragments move different distances through the gel (1)	**IGNORE** incorrectly named enzyme from part (i) **ACCEPT** different enzymes cut at different sites **ACCEPT** different cutting sites will result in different length fragments **ACCEPT** breaks **ACCEPT** different speeds	**(3)**

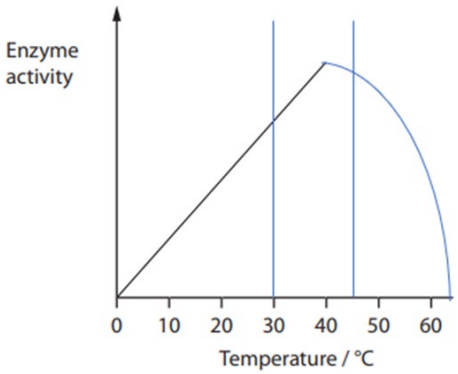
Question number	Answer	Additional guidance	Mark
7(b)(i)	• 0.2 (1) • 794 / 871 / 873 / 1000 (1)		(2)

Question number	Answer	Additional guidance	Mark
7(b)(ii)	indication of spot positioned between the origin and the 10 000 spot	**DO NOT ACCEPT** if clearly overlapping **CE** from 7(b)(i) i.e. if answer in 7(b)(i) is greater than 0.25, the spot would be below the 10 000 spot	(1)

Question number	Answer	Additional guidance	Mark
7(c)	{more molecules / more bonds / smaller spaces / fewer spaces} so higher {resistance / friction}	**ACCEPT** harder to move for higher resistance	(1)

Question number	Answer	Additional guidance	Mark
7(d)(i)	An answer that includes two of the following points: • bacterial {genome / chromosome} / (bacterial) nucleoid (1) • plasmid (1) • in mitochondria / mitochondrial DNA / mtDNA (1) • in chloroplasts / chloroplast DNA / cpDNA (1)	**IGNORE** loops of DNA in bacteria **IGNORE** mitochondria / chloroplasts unqualified **ACCEPT** cccDNA (formed by some viruses inside cell nuclei) viral DNA inserted into cell {ecc / extrachromosomal circular} DNA **DO NOT ACCEPT** ribosomes / in cytoplasm / in viruses	**(2)**

Question number	Answer	Additional guidance	Mark
7(d)(ii)	An answer that includes two of the following points: • linear DNA has (3' and 5') ends but circular DNA does not (1) • linear DNA is associated with (more) {proteins / histones} than circular DNA (1) • linear DNA will have (unbound) {phosphate / deoxyribose} but circular DNA will not (1) • linear DNA will have (one) fewer phosphodiester bond than circular DNA (with the same number of mononucleotides) (1)	**ACCEPT** converse **ACCEPT** circular DNA is supercoiled but linear DNA is not **ACCEPT** converse	**(2)**

Question number	Answer	Additional guidance	Mark
8(a)(i)	An answer that includes the following points: • linear line that increases with temperature and then decreases (1) • optimum temperature shown at (about) 40 °C (1)	**ACCEPT** carefully hand-drawn line sloping up to optimum **NB** line does not have to start at the origin **NB** optimum must be above 30°C and below 45°C  	**(2)**

Question number	Answer	Additional guidance	Mark
8(a)(ii)	• values at 30 °C and 40 °C chosen (1)	50 and 32.5 and 50 and 22.5	
	• rate calculated per minute for each (1)	(50-32.5) ÷ 5 / 17.5 ÷ 5 / 3.5 and (50-22.5) ÷ 5 / 27.5 ÷ 5 / 5.5 CE from reasonable values read from graph	
	• numbers substituted into equation (1)	5.5 ÷ 3.5 / 1.5714 CE if added 10 to a correct rate from mp 2	
	• correct answer to 2 / 3 sig figs with no units (1)	1.6 / 1.57 **ACCEPT** correctly rounded value for mp 3	
	OR	**OR**	
	• values at 40 °C and 50 °C chosen	50 and 22.5 and 50 and 47.5	
	• rate calculated per minute for each (1)	(50-22.5) ÷ 5 / 27.5 ÷ 5 / 5.5 and (50-47.5) ÷ 2.5 / 2.5 ÷ 5 / 0.5 CE from reasonable values read from graph	
	• numbers substituted into equation (1)	0.5 ÷5.5 / 0.090909 CE if added 10 to a correct rate from mp 2	
	• correct answer to 2 / 3 sig figs with no units (1)	0.091 / 0.0909 **ACCEPT** correctly rounded value for mp 3	**(4)**

<table>
<tr><th>Question number</th><th>Answer</th><th>Additional guidance</th><th>Mark</th></tr>
<tr><td>8(b)(i)</td><td>

mass of monosaccharides calculated to be 1361.3 / correct ratios expressed with more than one dp (1)
ratios shown correctly as either (all) whole numbers or both disaccharide and tetrasaccharide values correctly rounded to one dp (1)

</td><td>
NB check working out in space and first table for values
eg 164.012, 6.868, 1, 1.145

disaccharide 6.9 and tetrasaccharide 1.1
<table>
<tr><th>Type of carbohydrate</th><th>Ratio</th></tr>
<tr><td>monosaccharide</td><td>164</td></tr>
<tr><td>disaccharide</td><td>7</td></tr>
<tr><td>trisaccharide</td><td>1</td></tr>
<tr><td>tetrasaccharide</td><td>1</td></tr>
</table>
</td><td>(2)</td></tr>
</table>

Question number	Answer	Mark
8(b)(ii)	The only correct answer is **D**. ***A*** *is incorrect because inositol and raffinose have the modal concentration* ***B*** *is incorrect because inositol and raffinose have the modal concentration* ***C*** *is incorrect because inositol and raffinose have the modal concentration*	**(1)**

Question number	Answer	Additional guidance	Mark
*8(b)(iii)	**General description** • bacteria and fungi are decomposers • decomposers release enzymes for decomposition • digested molecules are absorbed into the decomposer • release carbon dioxide **Details of decomposition of carbohydrates** • carbohydrases are needed to breakdown carbohydrates • hydrolysis of glycosidic bonds • to form monosaccharides • monosaccharides taken up by diffusion • glucose used in respiration • carbon dioxide produced by respiration of glucose **Specific detail relating to carbohydrates in the table** • one glycosidic bond broken in disaccharides, two in trisaccharides, three in tetrasaccharides	**IGNORE** references to starch and amylase	

	• using one / two / three water molecules • e.g. sucrose broken down into glucose and fructose • monosaccharides do not need breaking down **Level 1 : general description of decomposition** 1 mark : one point made 2 marks : three points made **Level 2 : details about decomposition of carbohydrates** 3 marks : two points made 4 marks : three points made **Level 3 : specific details relating to carbohydrates in the table + mention of respiration releasing carbon dioxide** 5 marks : specific detail given for either di / tri / tetra saccharides 6 marks : specific detail given for two of the three types of saccharides		**(6)**

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