



Mark Scheme (Results)

Summer 2023

Pearson Edexcel International Advanced
Subsidiary Level In Biology (WBI14)

Paper 01

Unit 4: Energy, Environment, Microbiology and
Immunity

Question number	Answer	Additional guidance	Mark
1(a)	An explanation that includes the following points: • (magnesium ions are) components of chlorophyll (1) • which <u>absorbs</u> {light / photons} (1)	Examiners will need to check other roles if seen	(2)

- component of (leaf) ribosomes
- necessary for translation

- cofactor / allosteric modulator
- enabling {carboxylases / phosphatases / protein kinases / RNA polymerase / ATP synthases} to function

One of these would give 1 mark only:

involved in {phloem loading / sucrose transport in phloem / improved root : shoot ratio / vigorous root growth}
 supports {transpiration rate / stomatal conductance / carbon dioxide fixation / non-cyclic photophosphorylation}
 stabilises DNA
 involved in ATP synthesis

Question number	Answer	Additional guidance	Mark
1(b)	An explanation that includes four of the following points: - uptake of magnesium ions levels off without oxygen but continues to increase with oxygen (1) - uptake of magnesium ions increases as the ions can be taken up against the concentration gradient (1) {ATP / energy} is needed for {this / active transport} (1) - and oxygen is used in aerobic respiration to produce this ATP (1) - if {active transport was not involved / uptake was passive} the rate would have been the same in both groups (1)	ACCEPT more magnesium ions are taken up in presence of oxygen rate of uptake is faster in presence of oxygen NB piece together PIECE TOGETHER	(4)

Question number	Answer	Additional guidance	Mark
2(a)(i)	- mass of large and small bears calculated (1) 88 / 88.1 / 88.13 (kg)	133.5294117647 and 45.4 88.1294117647058 Bald correct answer = 2 marks Bald masses = 1 mark Bald unrounded = 1 mark	(2)

Question number	Answer	Additional guidance	Mark
2(a)(ii)	An explanation that includes the following points: - because the food that Hank was {stealing / eating} was higher in {kilojoules / energy} (than ants and berries) (1) - Hank was storing energy as {biomass / fat} / hibernating bears were {losing biomass / losing weight / living off their reserves} (1)	ACCEPT calories / fats / carbohydrates eating food throughout the whole year was eating food in the winter when the hibernating bears were not diets of other bears had fewer calories DO NOT ACCEPT NPP	(2)

Question number	Answer	Mark
2(b)(i)	The only correct answer is D <i>A is incorrect because DNA could not be analysed using an electron microscope</i> <i>B is incorrect because DNA could not be analysed using an electron microscope</i> <i>C is incorrect because entomology studies insects</i>	(1)

Question number	Answer	Additional guidance	Mark
2(b)(ii)	A description that includes the following points: • {comparison / differences} of the (pattern /size / number / position) bands} (1) • bands specific to females found on two of the tests but not on Hank's (1) • all (three) bears will have different {banding patterns / (DNA) fingerprints} (1)	ACCEPT use {base sequencing / DNA profiling / genetic fingerprint / gel electrophoresis} DO NOT ACCEPT females will have the same bands ACCEPT there will be (some) differences in the bands for all (three) bears DO NOT ACCEPT all the bands will be different IGNORE they don't have similar bands	(3)

Question number	Answer	Additional guidance	Mark
3(a)	An answer that includes the following points: Similarity: - both target bacteria (1) Differences: {bacteriostatic antibiotics / tetracycline) prevent {cell division / growth} and {bactericidal / vancomycin} {kill / destroy} (bacteria) (1)	ACCEPT both affect bacteria both used to treat bacterial infections both bacteria even if qualification is wrong - this would negate mp 2 not mp 1 IGNORE description of mechanisms named antibiotics	(2)

Question number	Answer	Additional guidance	Mark
3(b)(i)	A description that includes three of the following points: - antibiotics dissolved in a solvent (1) (then) antibiotics loaded onto the {filter paper / origin} (1) - filter paper (then) dipped into solvent (below the origin) (1) - and (then) left to run until the leading edge is near end of filter paper) (1)	ACCEPT named solvent e.g.water, ethanol ACCEPT added to the filter paper / chromatogram / TLC plate / other appropriate medium IGNORE onto glass ACCEPT named solvent	(3)

Question number	Answer	Mark
3(b)(ii)	The only correct answer is B <i>A is incorrect because the tetracycline spot is about three-quarters of the way up so R_f value is approx. 0.75</i> <i>C is incorrect because the tetracycline spot is about three-quarters of the way up so R_f value is approx. 0.75</i> <i>D is incorrect because the tetracycline spot is about three-quarters of the way up so R_f value is approx. 0.75</i>	(1)

Question number	Answer	Additional guidance	Mark
3(b)(iii)	An explanation that includes two of the following points: • because different solvents were used (1) • difference in solubilities (1) • tetracycline is more soluble (in both solvents) / vancomycin is less soluble (in both solvents) / both antibiotics are more soluble in the solvent used in method 2 (1) • different solid phase used (1)	ACCEPT two named solvents ACCEPT the more soluble the further it will travel antibiotics bind to medium differently different charge / molecular mass IGNORE dissolve differently IGNORE size / mass / structure / properties ACCEPT converse for method 1	(2)

Question number	Answer	Mark
4(a)	The only correct answer is C <i>A is incorrect because cellulose is made of β glucose</i> <i>B is incorrect because cellulose is made of β glucose</i> <i>D is incorrect because cellulose is a straight chain polymer</i>	(1)

Question number	Answer	Mark																								
4(b)	<table><tr><th rowspan="2">Structure</th><th colspan="4">Microorganism</th></tr><tr><th>Bacteria only</th><th>Fungi only</th><th>both bacteria and fungi</th><th>neither bacteria nor fungi</th></tr><tr><td>mitochondria</td><td>[x]</td><td>[x]</td><td>[x]</td><td>[x]</td></tr><tr><td>nuclei</td><td>[x]</td><td>[x]</td><td>[x]</td><td>[x]</td></tr><tr><td>70S (small) ribosomes</td><td>[x]</td><td>[x]</td><td>[x]</td><td>[x]</td></tr></table>	Structure	Microorganism				Bacteria only	Fungi only	both bacteria and fungi	neither bacteria nor fungi	mitochondria	[x]	[x]	[x]	[x]	nuclei	[x]	[x]	[x]	[x]	70S (small) ribosomes	[x]	[x]	[x]	[x]	(3)
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Question number	Answer	Mark
4(c)(i)	The only correct answer is D <i>A is incorrect because relative abundance of Streptococcus is highest in cubs, Escherichia and Shigella highest in sub-adults and Clostridium highest in adults</i> <i>B is incorrect because relative abundance of Streptococcus is highest in cubs, Escherichia and Shigella highest in sub-adults and Clostridium highest in adults</i> <i>C is incorrect because relative abundance of Streptococcus is highest in cubs, Escherichia and Shigella highest in sub-adults and Clostridium highest in adults</i>	(1)

Question number	Answer	Additional guidance	Mark
4(c)(ii)	A description that includes four of the following points: • source of sample identified (1) • name of method of determining numbers (1) • credit appropriate detail of method (1) • method for {identifying / eliminating} bacteria (1) • description of how the relative abundance will be determined (1)	e.g. faeces, intestinal flush IGNORE other samples e.g. colony counts, dilution plating, colorimeter, spectrophotometer, turbidity, counting chamber, haemocytometer ACCEPT description of the method e.g. light passed through to measure transmission e.g. serial dilutions, shaking sample before counting, safety precautions, culture conditions, aseptic technique e.g. colour of colonies, use of antibiotics, use of antibodies, use of {selective / indicator} media e.g. number of each streptococcus in each sample from each age group of panda comparing light transmission for each age group percentage of streptococcus of total number of bacteria	(4)

Question number	Answer	Additional guidance	Mark
5(a)(i)	- tangent correctly drawn (1) - rate calculated (1) - rate value between 0.060 and 0.090 expressed to 3 dps max (1)	line touches the outside of the curve at 1 200 seconds e.g. $65 \div 880 = 0.073863636363$ $50 \div 720 = 0.069444444$ ECFs: $147 \div 1120 = 0.1386792$ $147.5 \div 1120 = 0.131696428571$ $148 \div 1120 = 0.13962$ $147 \div 1130 = 0.13725490$ $147.5 \div 1130 = 0.13053097$ $148 \div 1130 = 0.1383177$ Ecf values from mp 2 correctly rounded to a max of 3 dps Ecf value of 0.1225 / 0.122916 / 0.12333 correctly rounded to max 3 dps but do not accept recurring numbers	(3)

Question number	Answer	Additional guidance	Mark
5(a)(ii)	An explanation that includes three of the following points: - oxygen is produced by photolysis (1) - presence of PBF (on <i>C. pyrenoidosa</i>) produces {oxygen faster / more oxygen} (than <i>C. pyrenoidosa</i>) OR PBF (alone) produces {no / very little} oxygen (1) {no / very little} oxygen produced by PBF) as it is {only a molecule / cannot photosynthesise} (1) (more oxygen produced) because {more light absorbed / wider range of wavelengths absorbed / green light absorbed as well} by PBF (1)	ACCEPT presence of PBF means that light (intensity) is not rate limiting ACCEPT converse for algae alone producing less oxygen	(3)

Question number	Answer	Additional guidance	Mark
5(b)	An explanation that includes the following points: - because {faster light-dependent reaction / more ATP produced / more reduced NADP produced} (1) - more {GALP / glucose} produced {light-independent / Calvin cycle / carbon fixation} (by <i>C. pyrenoidosa</i>) with PBF) (1) - therefore (more) {large organic molecules / NPP / biomass} produced (1)	ACCEPT NADPH DO NOT ACCEPT NAD ACCEPT faster {light-independent / Calvin cycle / carbon fixation} to produce {GALP / glucose} (by <i>C. pyrenoidosa</i>) with PBF) ACCEPT named polymer e.g. starch, protein, cellulose	(3)

Question number	Answer	Additional guidance	Mark
6(a)	{presence / entry / invasion} of a pathogen inside {cells / tissues}	ACCEPT named pathogen e.g. bacteria / virus / viral genetic material / <i>Plasmodium</i> / sporozoites / merozoites named {cell / tissue} if correct IGNORE body	(1)

Question number	Answer	Mark
6(b)(i)	The only correct answer is B <i>A is incorrect because the rate = $229 \times 10^6 \div 4.09 \times 10^5 = 559.9 = 600$</i> <i>C is incorrect because the rate = $229 \times 10^6 \div 4.09 \times 10^5 = 559.9 = 600$</i> <i>D is incorrect because the rate = $229 \times 10^6 \div 4.09 \times 10^5 = 559.9 = 600$</i>	(1)

Question number	Answer	Mark
6(b)(ii)	The only correct answer is D <i>A is incorrect because $274\,000 : (409\,000 - 274\,000) = 274\,000 : 135\,000 = 2 : 1$</i> <i>B is incorrect because $274\,000 : (409\,000 - 274\,000) = 274\,000 : 135\,000 = 2 : 1$</i> <i>C is incorrect because $274\,000 : (409\,000 - 274\,000) = 274\,000 : 135\,000 = 2 : 1$</i>	(1)

Question number	Answer	Additional guidance	Mark
6(c)(i)	An explanation that includes three of the following points: • sporozoites more accessible to immune system (than other stages) (1) • because memory cells need to be generated (against the sporozoites) (1) • so that they will be destroyed by (secondary) immune response (1) • to prevent them {entering liver cells / damaging liver cells} (1)	ACCEPT converse idea for merozoites ACCEPT description of destruction by secondary immune response e.g. phagocytosis by macrophages BUT NOT IN THE CONTEXT OF THE PRIMARY RESPONSE DO NOT ACCEPT antibodies destroy ACCEPT before they can develop into merozoites	(3)

Question number	Answer	Additional guidance	Mark
6(c)(ii)	An explanation that includes three of the following points: - because {the immune response takes time to develop / phagocytes may not be able to engulf all the sporozoites} (1) - therefore a chemical needed to kill the sporozoites {in the vaccine / that get into the liver / so that they cannot produce merozoites} (1) - second chemical needed to kill the merozoites in case the first chemical does not kill all the sporozoites (1) - to avoid the risk of the person developing malaria (from the live sporozoites in the vaccine) (1)	ACCEPT the vaccine may be ineffective / the person may have a weakened immune system / the immune system may not destroy all the sporozoites ACCEPT weaken / reduce the number of IGNORE in case one chemical does not work	(3)

Question number	Answer	Additional guidance	Mark
6(c)(iii)	An explanation that includes three of the following points: - because the two strains of sporozoites had (some) same antigens (1) - and the vaccine stimulated {an immune response / memory cells / production of antibodies} (to these common antigens) (1) - because a secondary immune response took place (1) - and both types of sporozoites {were destroyed (by the immune system) / engulfed by macrophages} (1)	ACCEPT (surface) {molecules / proteins} ACCEPT (surface) {molecules / proteins}	(3)

Question number	Answer	Additional guidance	Mark
7(a)(i)	16.82 / 16.83 / 16.87 / 16.8 / 16.9 / 17 (1)		(1)

Question number	Answer	Additional guidance	Mark
7(a)(ii)	A description that includes two of the following points: - used to make {amino acids / proteins} needed for growth (1) - used to make enzymes for chemical reactions - used to make DNA {which contains the genetic code / when (plant) cells divide} (1) - used to make ATP needed {as a source of energy / named process} (1) - used to make {chlorophyll / named light absorbing pigment} to <u>absorb</u> light for {light-dependent stage / photolysis} (1)	ACCEPT used to make amino acids to make {proteins / enzymes} used to make membrane transport proteins ACCEPT named enzyme in named chemical reaction ACCEPT used to make {bases / named base} to make {DNA / RNA / nucleic acids} ACCEPT used to make adenine to make {ADP / ATP}	(2)

Question number	Answer	Additional guidance	Mark
7 (b)(i)	74 (%) (1)	DO NOT ACCEPT any other value	(1)

Question number	Answer	Additional guidance	Mark
7 (b)(ii)	$1.5 \times 10^{12} / 1.54 \times 10^{12}$ (kg) (1)		(1)

Question number	Answer	Mark
*7(b)(iii)	Indicative content: Aspect 1 : Phytoplankton • more phytoplankton results in more photosynthesis • absorbing more carbon dioxide from the air • therefore less greenhouse gases • so less infra red radiation trapped • reducing global warming • release of nutrients into oceans will increase number of phytoplankton • because they use the nitrate for growth and division Aspect 2 : Animals other than whales • so there will be more carbon dioxide released into the air • due to respiration • which would increase global warming • increase in phytoplankton will increase numbers of whales / other animals Aspect 3 : Whales • more whales more carbon dioxide from respiration • more whales more nitrates released • there would be a lot of carbon stored in the whale's body • as {carbohydrate / protein / fat} • whale acts as a carbon sink • dead {whales / organisms} decompose very slowly • as conditions unfavourable for {decomposers / decomposition} • therefore this carbon will not be released back into the atmosphere as carbon dioxide • helping to reduce global warming Aspect 4 : Decomposition of phytoplankton and other animals • increase in phytoplankton and other animals means more dead organisms • so more decomposition • releasing {methane / carbon dioxide} into the atmosphere • due to respiration by microorganisms • increasing global warming	(6)

		Additional guidance
Level 0	No awardable content	
Level 1	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.	1 mark = one simple comment 2 marks = simple comments
Level 2	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.	3 marks = simple discussion of one aspect 4 marks = detailed discussion of one aspect AND simple discussion of one other aspect OR simple discussion of three aspects
Level 3	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.	5 marks = detailed discussion of one aspect AND simple discussion of two other aspects OR detailed discussion of two aspects 6 marks = detailed discussion of two aspects AND simple discussion of two other aspects OR detailed discussion of three aspects

Question number	Answer	Additional guidance	Mark
8(a)	An explanation that includes two of the following points: - because if existing trees are destroyed {carbon dioxide / carbon} will be released (back into the atmosphere) (1) - because they are {established / native} and therefore more resistant to {fires / storms / drought / disease / protect from soil erosion} (1) - because they are {homes / source of food} to other species (animals) (1)	ACCEPT existing forests are carbon sinks established trees are already removing (high levels of) carbon dioxide (from the atmosphere) new trees would remove less carbon dioxide (from the atmosphere) ACCEPT human dependent on them for {food / medicines}	(2)

Question number	Answer	Additional guidance	Mark
8(b)	An answer that includes two of the following points: • because the local people rely on the land (that is planned for reforestation) (1) • local people need to {understand the issues / be onside / feel that there livelihoods are safe / protect the trees} (1) • local people will understand {the area / climate / their land use / animals} better (1)	ACCEPT named land use organisations need to be aware of the needs of the local people IGNORE avoid conflicts	(2)

Question number	Answer	Additional guidance	Mark
8(c)	An explanation that includes the following points: - to avoid {destroying / disturbing / competition with} other ecosystems when planting trees (1) - as this would result in the {loss / decrease} of {other species / biodiversity} - to avoid destroying the {homes / farmland} of the local people by planting trees (1) - as this would cause {resentment / hunger / loss of income} (1) - to join together fragments of remaining forests / reduce isolation (of a particular) species by planting trees (1) - increase genetic diversity / prevent loss of genetic diversity (1) {conditions / named condition} at the site of original forest must be appropriate (for those trees) (1) - therefore reforestation will be {faster / more effective / more likely to be successful} (1)	NB max 3 for reasons without explanations (reasons = mp 1, 3, 5 and 7) e.g. soil type, rainfall, temperature, nutrient levels DO NOT ACCEPT when clearly written in the direct context of succession	(4)

Question number	Answer	Additional guidance	Mark
8(d)	An explanation that includes four of the following points: • (overall) to increase biodiversity (1) • native species because they are adapted for the conditions (1) • native species as they will support the indigenous wild life of the area OR native species to avoid the risk of non-native species outcompeting the native species (1) • endangered species to avoid {extinction / inbreeding / drop in genetic diversity} (1) • genetically-diverse species to expand the gene pool (1)	ACCEPT increase gene flow increase biodiversity within that species ACCEPT increase biodiversity within that species	(4)

Question number	Answer	Additional guidance	Mark
9(a)(i)	A description that includes the following points: • use the (liver / rectal / core) temperature (immediately) (1) • use the graph and this temperature to get the {number of hours after death / time (after death)} (1) • subtract this value from the time of finding the corpse (1)	NB be careful not to award time of death ACCEPT work backwards using the graph	(3)

Question number	Answer	Additional guidance	Mark
9(a)(ii)	An explanation that includes the following points: • {other factors / named factor} affects {heat loss / rate of heat loss / body temperature (after death)} (1) • credit an explanation for how a named factor affects {heat loss / temperature} (1)	e.g. several hours since death body may have been moved to a cooler area e.g. {clothing / fat} {acts as an insulator / limits heat loss} cooler ambient temperature cools body faster	(2)

Question number	Answer	Additional guidance	Mark
9(b)(i)	not ethical / dead person cannot give their permission / relatives may not agree / humans are genetically diverse	IGNORE more available similar tissues	(1)

Question number	Answer	Mark																												
*9(b)(ii)	<table><tr><th>Chemical tests</th><th>Discussion of usefulness</th></tr><tr><td>pH</td><td></td></tr><tr><td>Pigs</td><td>Useful because decrease with time Useful as there is an increase with time with {small error bars / very little overlap in error bars} so timings are quite accurate</td></tr><tr><td>Rats</td><td>Useful because decrease with time Useful as there is an increase with time but error bars overlap so would not give accurate timings</td></tr><tr><td>Ammonia</td><td></td></tr><tr><td>Pigs</td><td>Useful as there is an increase with time Useful as there is an increase with time with no overlap in error bars so timings will be accurate</td></tr><tr><td>Rats</td><td>Not very useful as {no clear patterns / no trend / data goes up and down} Not very useful because data goes up and down so one value will give two times Not useful as no ammonia after 48 hours Useful for determining that there was more than 48 hours since time of death as no ammonia present</td></tr><tr><td>Hypoxanthine</td><td></td></tr><tr><td>Pigs</td><td>Useful as there is an increase with time Useful as there is an increase with time with no overlap in error bars so timings will be accurate Very low levels between 0 and 6 hours with overlapping error bars so may not be useful {then / until after 6 hours} There is an anomaly (at 24 hours) so this would need further investigation to see if this affects accuracy</td></tr><tr><td>Rats</td><td>Not very useful as {no clear patterns / no trend / data goes up and down} Only useful up to {9 hours / 32 hours} Only useful up 6 hours otherwise one level could give two different timings</td></tr><tr><td>Lactate</td><td></td></tr><tr><td>Pigs</td><td>Not very useful as {no clear patterns / no trend / data goes up and down} Could be useful up to 9 / 24 hours as there is an increase in levels / not useful after 9 / 24 hours as levels fluctuate</td></tr><tr><td>Rats</td><td>Not very useful as {no clear patterns / no trend / data goes up and down} Could be useful up to 9 hours as there is an increase in levels / not useful after 9 hours as levels fluctuate</td></tr><tr><td>General</td><td>small sample size so questionable significance use more than one marker and combine results results indicate that the test are species specific overall pigs are more useful than rats</td></tr></table>	Chemical tests	Discussion of usefulness	pH		Pigs	Useful because decrease with time Useful as there is an increase with time with {small error bars / very little overlap in error bars} so timings are quite accurate	Rats	Useful because decrease with time Useful as there is an increase with time but error bars overlap so would not give accurate timings	Ammonia		Pigs	Useful as there is an increase with time Useful as there is an increase with time with no overlap in error bars so timings will be accurate	Rats	Not very useful as {no clear patterns / no trend / data goes up and down} Not very useful because data goes up and down so one value will give two times Not useful as no ammonia after 48 hours Useful for determining that there was more than 48 hours since time of death as no ammonia present	Hypoxanthine		Pigs	Useful as there is an increase with time Useful as there is an increase with time with no overlap in error bars so timings will be accurate Very low levels between 0 and 6 hours with overlapping error bars so may not be useful {then / until after 6 hours} There is an anomaly (at 24 hours) so this would need further investigation to see if this affects accuracy	Rats	Not very useful as {no clear patterns / no trend / data goes up and down} Only useful up to {9 hours / 32 hours} Only useful up 6 hours otherwise one level could give two different timings	Lactate		Pigs	Not very useful as {no clear patterns / no trend / data goes up and down} Could be useful up to 9 / 24 hours as there is an increase in levels / not useful after 9 / 24 hours as levels fluctuate	Rats	Not very useful as {no clear patterns / no trend / data goes up and down} Could be useful up to 9 hours as there is an increase in levels / not useful after 9 hours as levels fluctuate	General	small sample size so questionable significance use more than one marker and combine results results indicate that the test are species specific overall pigs are more useful than rats	(6)
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Level 1: Limited comments

1 mark = description of data for one chemical

2 marks = description of data for two chemicals

Level 2: Limited comments on usefulness

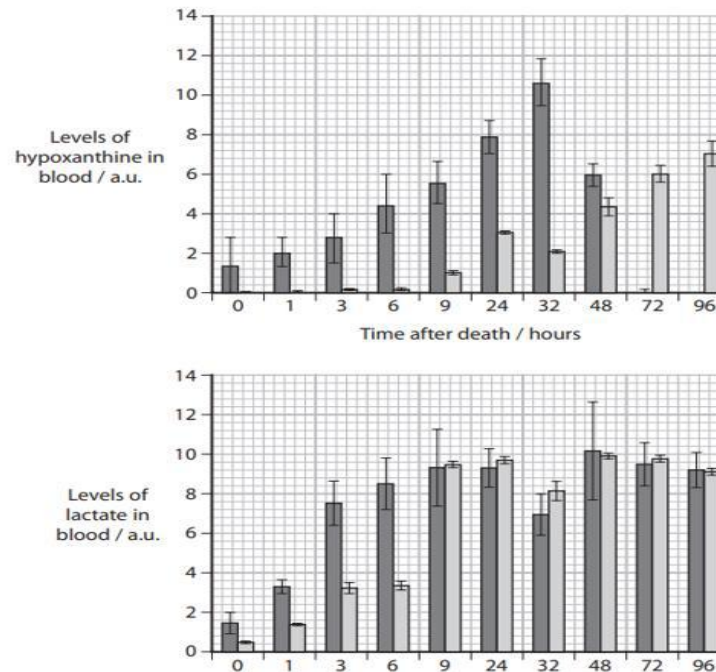
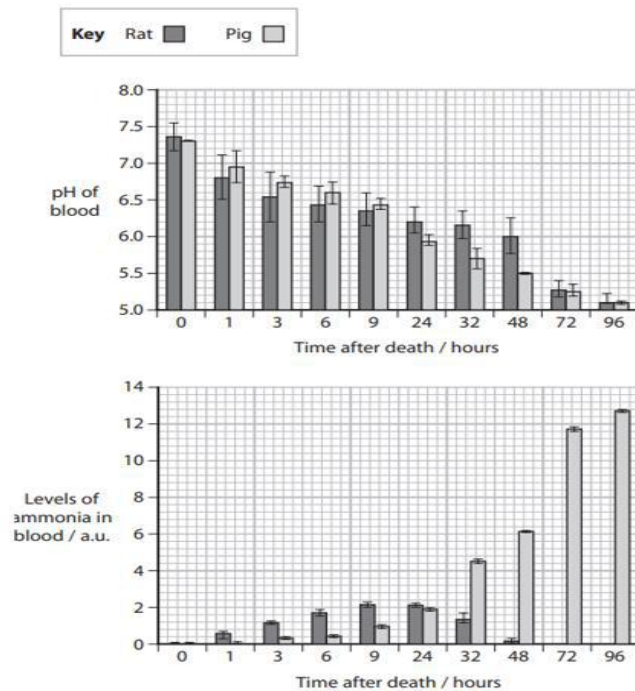
3 marks = usefulness of one chemical commented on **OR** one general comment

4 marks = usefulness of two chemicals commented on **OR** one chemical and one general comment

Level 3: Extended comments on usefulness

5 marks = usefulness of three chemicals commented on **OR** two chemicals and one general comment, **that includes at least one extended comment**

6 marks = usefulness four chemicals commented on **OR** three chemicals and one general comment, **that includes at least one extended comment**



Question number	Answer	Additional guidance	Mark
9(b)(iii)	An answer that includes three of the following points: • {pH / some chemicals} seem to have similar patterns so could be useful (in humans) (1) • some patterns seem to be species-specific so may not be useful (1) • therefore testing will need to be done (on humans) / but will the testing be {allowed / possible} (1) • credit suitable comment about {sample size / error bars} (1) • chemical tests will need to be used in conjunction with other methods (1)	ACCEPT pH decreases in both species so could be useful (in humans) ACCEPT are different in pigs and rats humans may be similar to {pigs / rats}	(3)