

# AS Level Biology A

## H020/02 Depth in biology

### Sample Question Paper

**Date – Morning/Afternoon**

Version 2.0

Time allowed: 1 hour 30 minutes

**You may use:**

- a scientific or graphical calculator

**First name****Last name****Centre  
number****Candidate  
number****INSTRUCTIONS**

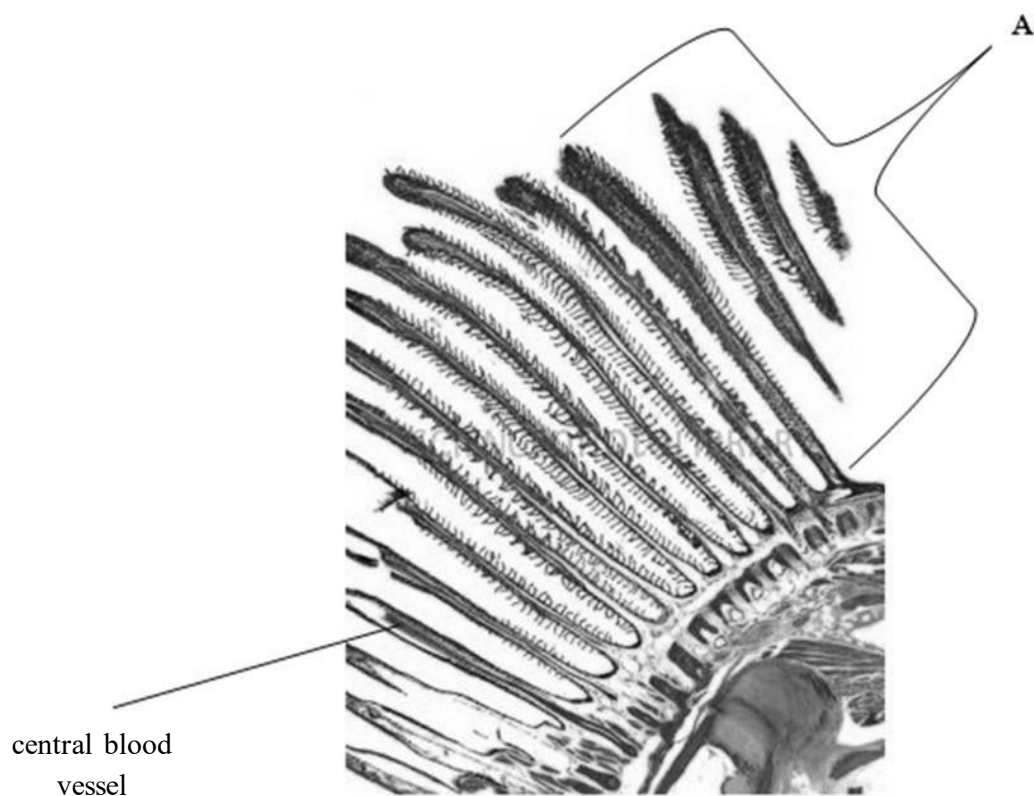
- Use black ink. You may use an HB pencil for graphs and diagrams.
- Complete the boxes above with your name, centre number and candidate number.
- Answer **all** the questions.
- Where appropriate, your answers should be supported with working. Marks may be given for a correct method even if the answer is incorrect.
- Write your answer to each question in the space provided.
- Additional paper may be used if required but you must clearly show your candidate number, centre number and question number(s).
- Do **not** write in the bar codes.

**INFORMATION**

- The total mark for this paper is **70**.
- The marks for each question are shown in brackets [ ].
- Quality of extended responses will be assessed in questions marked with an asterisk (\*).
- This document consists of **16** pages.

Answer **all** the questions.

- 1 **Fig. 1.1** shows a microscopic image of part of a fish gill.



**Fig. 1.1**

- (a) Name structure A.

..... [1]

- (b) Explain how **Fig. 1.1** shows that gills are adapted for efficient gas exchange.

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..... [4]

- (c) Each gill is supported by a gill arch made of bone. Bone tissue is made of living cells, collagen and an inorganic component.

Explain why bone is described as a tissue and gills are described as organs.

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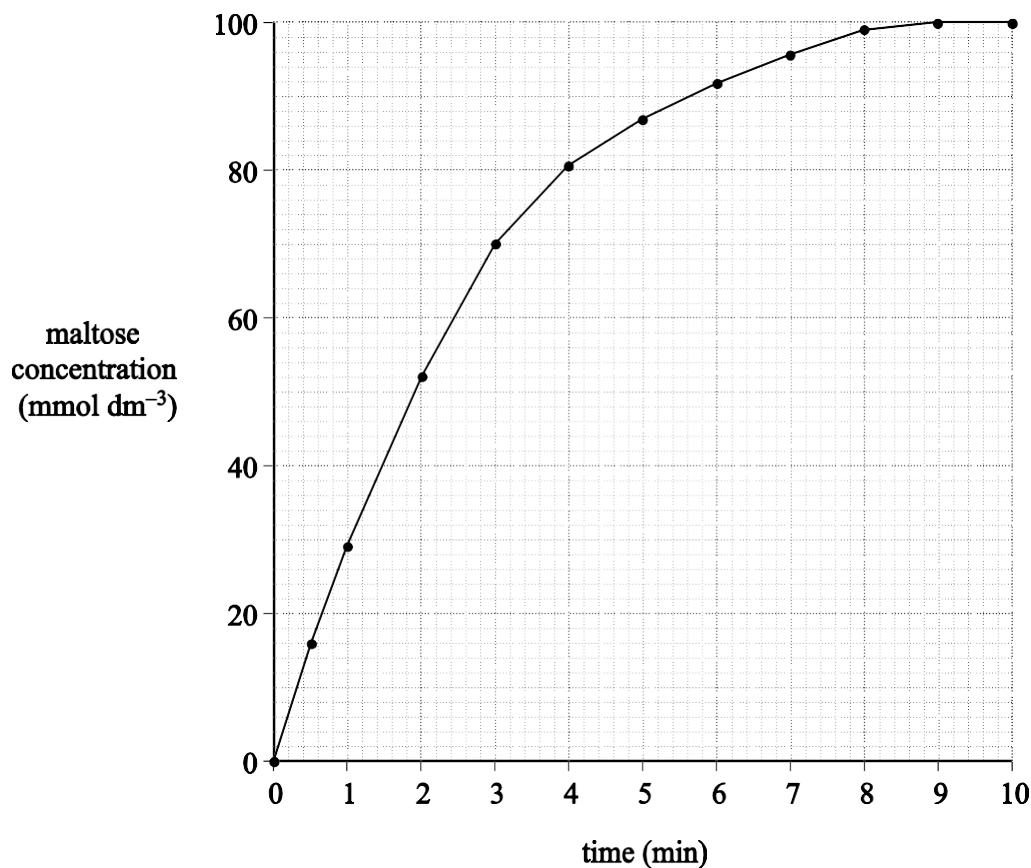
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[3]

2 Amylase is an enzyme that breaks down starch into maltose.

(a) A student investigated the breakdown of starch into maltose. The results are shown in **Fig. 2.1**.



**Fig. 2.1**

(i) Calculate the rate of maltose production over the first 30 s.

Use appropriate units.

Answer .....[2]

(ii) How would this calculated rate differ from the 'true' initial rate of reaction?  
Explain your answer.

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[3]

- (b) The student conducted a further investigation using the same enzyme and substrate.
- A range of substrate concentrations was used.
  - The investigation was repeated in the presence of an inhibitor of amylase activity extracted from kidney beans.

Fig. 2.2 shows a sketch of the student's results.

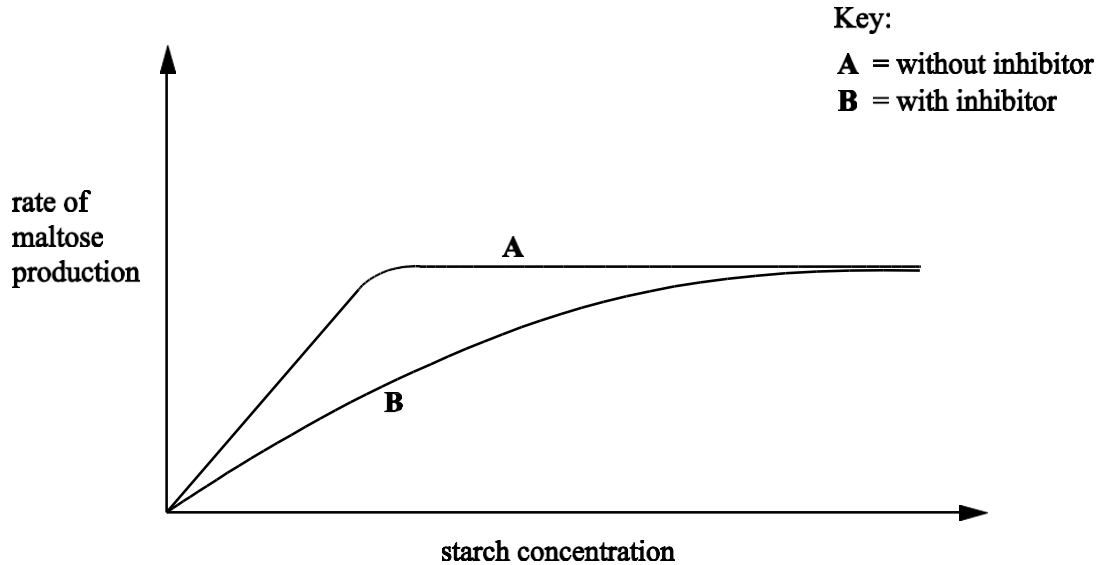


Fig. 2.2

- (i) Explain the mechanism by which the extract from the kidney bean inhibited the amylase.

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..... [3]

- (ii) What evidence from the graph supports your answer to part (i)?

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..... [1]

- (c) The student then investigated the effect of pH on the activity of the amylase.

This was the method used,

- Tubes containing starch and amylase were set up in a range of pH buffer solutions.
- The same concentration of starch and amylase were used each time.
- A small sample of the solution was removed and tested for the presence of starch at 20 s intervals.
- The procedure was repeated three times and a mean was calculated for each pH.

The student presented the results in **Table 2.1**.

pH	4	5	6	7	8	9
<b>Mean amylase activity (% of maximum)</b>	27	68	96	100	50	29

**Table 2.1**

- (i) Another student wanted to replicate the investigation.

Refine the method, by giving additional information, so that reproducible results would be obtained.

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..... [3]

- (ii) Explain, with reference to bonding, why amylase activity is low at pH 4.

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..... [4]

- (iii) The student concluded that the optimum pH for amylase was pH 7.

A teacher made the following statement:

*'The results in **Table 2.1** provide only weak support for the conclusion that the optimum pH for amylase is pH 7.0'*

Evaluate the statement **and** suggest an improvement to the student's procedure that would support the conclusion more strongly.

**Evaluation**

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**Improvement**

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[3]

- (d) Amylase activity is increased in the presence of chloride ions.

State the name given to any inorganic ion that increases the activity of an enzyme.

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[1]

**3** Vaccinations are effective in preventing the spread of a range of diseases.

**(a)** Explain why vaccinations are an example of active immunity.

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[2]

**(b)** Measles is a potentially fatal disease.

- Since 1988 children in the UK have been vaccinated against measles using the MMR vaccine.
- In 1998 a study was published which linked the MMR vaccine to the development of a condition known as autism. Some parents refused to have their children vaccinated with MMR.
- The study linking MMR to autism has since been discredited.

**Table 3.1** shows some data about the percentage of children vaccinated with MMR and the incidence of measles in England and Wales.

Year	Proportion of children vaccinated with MMR (%)	Confirmed cases of measles
1997	92	177
1998	91	56
1999	88	92
2000	88	110
2001	87	70
2002	84	319
2003	82	437
2004	80	188
2005	81	78
2006	84	740
2007	85	990
2008	85	1370
2009	85	1144
2010	88	380

**Table 3.1**



- (i) Between 1997 and 1999 the mean percentage of children vaccinated with MMR was 90.3.

Calculate the mean number of confirmed cases of measles between 1997 and 1999.

Give your answer to one decimal place.

Answer..... [1]

- (ii) In 2005, despite relatively low vaccination rates, the number of confirmed cases of measles was only 78.

Use your answer to part (i) to calculate the percentage change in the number of confirmed cases of measles from the mean value of 1997–1999 to 2005.

Give your answer to one decimal place.

Answer..... [2]

- (iii) In early 2006, a newspaper claimed that the drop in MMR vaccination rates had not led to the predicted increase in measles cases.

Evaluate the validity of the newspaper's claim. Use processed data to support your argument.

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 .....  
 .....  
 ..... [3]

- (c) The MMR injection is actually a combination of three different vaccines.

It protects children against measles, mumps and rubella pathogens.

Explain why it is not possible to protect against the different pathogens using only one vaccine.

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 .....  
 .....  
 ..... [3]

- 4 Haemoglobin is a protein that carries oxygen in the blood of all mammals. The structure of haemoglobin can vary slightly between species.

Fig. 4.1 shows a llama, a relative of the camel.



Fig. 4.1

- Llamas live at high altitudes and camels live at low altitudes.
- At high altitudes the partial pressure of oxygen is low.
- Llama and camel haemoglobin consists of 2  $\alpha$  subunits and 2  $\beta$  subunits.
- Each subunit contains a haem group and is able to bind to one molecule of oxygen.
- In the  $\beta$  subunits, one amino acid present in camel haemoglobin has been replaced by a different amino acid in llama haemoglobin.

Fig. 4.2 shows dissociation curves for llama haemoglobin and camel haemoglobin.

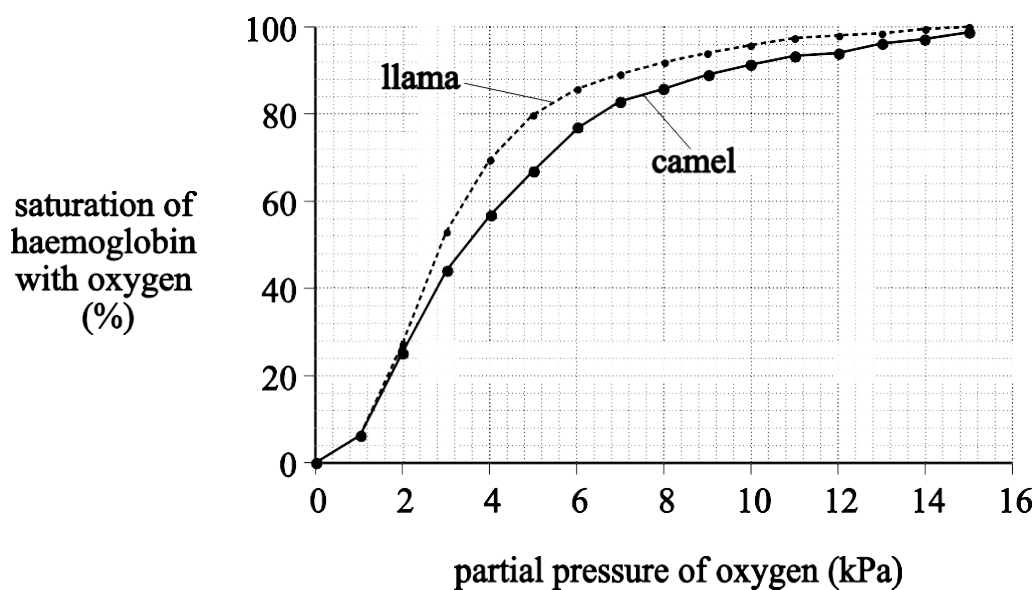


Fig. 4.2

- (a) (i) State the partial pressure of oxygen that results in a saturation of 50% in llama haemoglobin.

Answer..... [1]

- (ii) Explain why it is important for the survival of the llama that the llama haemoglobin dissociation curve is to the left of the camel haemoglobin dissociation curve.

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..... **[2]**

- (b)\*** Describe how the structure of llama haemoglobin is likely to be different from that of camel haemoglobin with reference to the four levels of protein structure.

[illegible]

Additional answer space if required.

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(c) Collagen is a fibrous protein.

State three **properties** of a fibrous protein that are different from those of a globular protein.

- 1.....
- 2.....
- 3.....

[3]

(d) A vet is concerned that a llama is unwell. The vet suspects there may be haemoglobin in the urine of the llama.

Explain how the vet could confirm this suspicion?

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[2]

- 5** Bats are the only mammals that have wings. Many species of bat hunt flying insects at night. Bats are able to use echolocation (sound waves) in order to help them find their prey in the dark.

**(a) (i)** Explain why bats and birds, despite not being closely related, have both evolved wings.

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..... **[3]**

**(ii)** Suggest why the vast majority of bird species have not evolved the ability to echolocate.

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..... **[1]**

Population	Mean body mass (g)	Mean wingspan (m)	Range of echolocation call (kHz)	Colour	Habitat
Common pipistrelle	5.5	0.22	52 – 60	medium to dark brown	woodland, hedgerows, grassland, farmland, suburban and urban
Soprano pipistrelle	5.5	0.21	42 – 47	medium to dark brown	wetland, woodland edge, tree lines, hedgerows, suburban gardens and parks

A researcher made the following claim:

Evaluate the researcher's claim by using the evidence in **Table 5.1** to support and to challenge the researcher's conclusion. [6]

[illegible]

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Additional answer space if required.

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- 6** DNA is arguably the most important molecule in the whole of biology.

When a cell divides an identical copy of its DNA is made in a process called DNA replication.

- (a)** Explain how pairing of nitrogenous bases allows identical copies of DNA to be made.

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..... **[3]**

- (b) (i)** Outline how the process of DNA replication is completed, following the pairing of nitrogenous bases.

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..... **[3]**

- (ii)** Why is DNA replication described as semi-conservative?

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..... **[1]**

**END OF QUESTION PAPER**



## Summary of updates

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Date	Version	Change
October 2020	2.0	Updated copyright acknowledgements.

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### Copyright Information:

Q1: picture of fish gills © Dr Keith Wheeler/Science photo library @ <http://www.sciencephoto.com/>

Q4: picture of Llama © Tim Graham / Alamy

Q5: Data adapted from [www.bats.org.uk](http://www.bats.org.uk) Reproduced with permission from the Bat Conservation Trust

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Oxford Cambridge and RSA

**...day June 20XX–Morning/Afternoon**

**AS Level Biology A**

**H020/02 Depth in biology**

**SAMPLE MARK SCHEME**

**Duration:** 1 hour 30 minutes

**MAXIMUM MARK 70**



**MARKING INSTRUCTIONS****PREPARATION FOR MARKING****SCORIS**

1. Make sure that you have accessed and completed the relevant training packages for on-screen marking: *scoris assessor Online Training*; *OCR Essential Guide to Marking*.
2. Make sure that you have read and understood the mark scheme and the question paper for this unit. These are posted on the RM Cambridge Assessment Support Portal <http://www.rm.com/support/ca>
3. Log-in to scoris and mark the **required number** of practice responses (“scripts”) and the **required number** of standardisation responses.

YOU MUST MARK 10 PRACTICE AND 10 STANDARDISATION RESPONSES BEFORE YOU CAN BE APPROVED TO MARK LIVE SCRIPTS.

**MARKING**

1. Mark strictly to the mark scheme.
2. Marks awarded must relate directly to the marking criteria.
3. The schedule of dates is very important. It is essential that you meet the scoris 50% and 100% (traditional 50% Batch 1 and 100% Batch 2) deadlines. If you experience problems, you must contact your Team Leader (Supervisor) without delay.
4. If you are in any doubt about applying the mark scheme, consult your Team Leader by telephone, email or via the scoris messaging system.

5. Work crossed out:
- where a candidate crosses out an answer and provides an alternative response, the crossed out response is not marked and gains no marks
  - if a candidate crosses out an answer to a whole question and makes no second attempt, and if the inclusion of the answer does not cause a rubric infringement, the assessor should attempt to mark the crossed out answer and award marks appropriately.
6. Always check the pages (and additional objects if present) at the end of the response in case any answers have been continued there. If the candidate has continued an answer there then add a tick to confirm that the work has been seen.
7. There is a NR (No Response) option. Award NR (No Response)
- if there is nothing written at all in the answer space
  - OR if there is a comment which does not in any way relate to the question (e.g. 'can't do', 'don't know')
  - OR if there is a mark (e.g. a dash, a question mark) which isn't an attempt at the question.
- Note: Award 0 marks – for an attempt that earns no credit (including copying out the question).
8. The scoris **comments box** is used by your Team Leader to explain the marking of the practice responses. Please refer to these comments when checking your practice responses. **Do not use the comments box for any other reason.**
- If you have any questions or comments for your Team Leader, use the phone, the scoris messaging system, or email.
9. Assistant Examiners will send a brief report on the performance of candidates to their Team Leader (Supervisor) via email by the end of the marking period. The report should contain notes on particular strengths displayed as well as common errors or weaknesses. Constructive criticism of the question paper/mark scheme is also appreciated.

10. For answers marked by levels of response:

- Read through the whole answer from start to finish.
- Decide the level that **best fits** the answer – match the quality of the answer to the closest level descriptor.
- To select a mark within the level, consider the following:

**Higher mark:** A good match to main point, including communication statement (in italics), award the higher mark in the level

**Lower mark:** Some aspects of level matches but key omissions in main point or communication statement (in italics), award lower mark in the level.

Level of response questions on this paper are **4(b)** and **5(b)**.



## 11. Annotations

Annotation	Meaning
<b>DO NOT ALLOW</b>	Answers which are not worthy of credit
<b>IGNORE</b>	Statements which are irrelevant
<b>ALLOW</b>	Answers that can be accepted
( )	Words which are not essential to gain credit
—	Underlined words must be present in answer to score a mark
<b>ECF</b>	Error carried forward
<b>AW</b>	Alternative wording
<b>ORA</b>	Or reverse argument

## 12. Subject-specific Marking Instructions

### INTRODUCTION

Your first task as an Examiner is to become thoroughly familiar with the material on which the examination depends. This material includes:

- the specification, especially the assessment objectives
- the question paper
- the mark scheme.

You should ensure that you have copies of these materials.

You should ensure also that you are familiar with the administrative procedures related to the marking process. These are set out in the OCR booklet **Instructions for Examiners**. If you are examining for the first time, please read carefully **Appendix 5 Introduction to Script Marking: Notes for New Examiners**.

Please ask for help or guidance whenever you need it. Your first point of contact is your Team Leader.



Question		Answer	Marks	Guidance
1	(a)	(gill) filament(s) ✓	1	<b>ALLOW</b> lamella(e)
	(b)	<i>three from</i> many / AW, lamellae / structure A, provide large surface area ✓ (presence of) secondary lamellae on main lamellae provide large surface area ✓ short distance between blood and, water / outside ✓ idea that blood maintains diffusion gradient ✓  <i>any of above linked to</i> faster diffusion (of oxygen, carbon dioxide) ✓	4	<b>ALLOW</b> only if linked to another marking point.  <b>IGNORE</b> refs to squamous cells as not visible on Fig. 1.1.
	(c)	<i>three from</i> tissue has, one / few, types of cell <b>and</b> performs, one / few, functions ✓  <i>idea that</i> bone has, one / few, types of cell <b>or</b> <i>idea that</i> bone performs, one / few, functions ✓  organs consist of several tissues ✓  gills contain two or more <b>named</b> tissues ✓	3	<b>ALLOW</b> bone, blood, epithelial, connective.
		<b>Total</b>	<b>8</b>	

Question			Answer	Marks	Guidance
2	(a)	(i)	32 ✓ mmol dm <sup>-3</sup> min <sup>-1</sup> ✓	2	<b>ALLOW</b> mmol dm <sup>-3</sup> / min' or 'mmol dm <sup>-3</sup> per , min / minute <b>ALLOW</b> 0.53 mmol dm <sup>-3</sup> / s
		(ii)	(initial rate likely to be) greater ✓  <i>because...</i> higher concentration of, substrate / amylose, molecules (at start) ✓ more chance of, substrate / AW, entering <u>active site</u> ✓	3	<b>ALLOW</b> 'starch'
	(b)	(i)	<i>three from</i> competes (with substrate) / competitive ✓ enters / fits in / binds to / blocks, active site ✓ prevents substrate from entering active site ✓ (binds to active site) temporarily ✓	3	
		(ii)	(at high substrate concentration) rate approaches rate in absence of inhibitor ✓	1	<b>IGNORE</b> idea that increased substrate concentration overcomes the inhibition as answer must refer to evidence from the graph.
	(c)	(i)	<i>three from</i> specify volume of starch and amylase to be added to the tubes ✓ specify volume (in ml) of the solution that should be removed for testing ✓ stir before taking the sample ✓ test with iodine ✓ all carried out at same temperature ✓	3	

Question			Answer	Marks	Guidance
		(ii)	<i>four from</i> ionic / hydrogen, bonds, disrupted / broken ✓ (by) high concentration of, hydrogen <u>ions</u> / H <sup>+</sup> ✓ tertiary structure / shape of active site, changed ✓ substrate no longer fits into active site ✓ (enzyme) denatured ✓	4	IGNORE active site denatured.
		(iii)	<i>Evaluation, two from</i> idea that optimum could be anywhere between pH 6 and pH 8 ✓ only one value between pH 6 and pH 8 tested ✓ idea that shape of data implies optimum less than pH 7 ✓  <i>Improvement</i> repeat at more pH values between 6 and 8 ✓	3	
	(d)		cofactor ✓	1	IGNORE coenzyme.
			Total	20	

Question			Answer	Marks	Guidance
3	(a)		two from antibodies produced (by person being vaccinated) ✓ activation of (named) lymphocytes (of person being vaccinated) ✓ (specific) memory cells remain (in person being vaccinated) ✓	2	
	(b)	(i)	108.3 ✓	1	<b>IGNORE</b> all other responses.
		(ii)	28.0 ✓✓	2	<b>ALLOW</b> 1 mark if correct answer given to incorrect number of decimal places. <i>If answer is incorrect</i> <b>ALLOW</b> 1 mark for any number divided by the candidate's answer to part (i). <i>If the candidates answer to part (i) is incorrect apply ecf.</i>
		(iii)	max two from: <i>idea that</i> lowest year has been cherry-picked ✓ <i>idea that</i> average of several years would have been a better indicator ✓ <i>idea that</i> level might fluctuate ✓  <i>plus:</i> use of processed data to support any of the above ✓	3	
	(c)		two from different pathogens have different <u>antigens</u> ✓ antigens have specific <u>shape</u> ✓ shape of antibody must be <u>complementary</u> to (specific) antigen ✓ <i>any of the above linked to</i> different antibody needed for each pathogen ✓	3	
			<b>Total</b>	<b>11</b>	

Question			Answer	Marks	Guidance
4	(a)	(i)	2.8 (kPa) ✓	1	<b>ALLOW</b> answer in the range of 2.8–3.0 kPa
		(ii)	(llama) haemoglobin needs higher affinity for oxygen ✓ (so) can pick up oxygen at lower partial pressure (of oxygen) ✓	2	
	(b)*		<p><b>Level 3 (5–6 marks)</b> Describes differences and similarities of llama and camel haemoglobin at all four levels of protein structure with correct reference to bonding.</p> <p><i>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</i></p> <p><b>Level 2 (3–4 marks)</b> Describes differences and similarities of llama and camel haemoglobin in some levels of protein structure with some reference to bonding.</p> <p><i>There is a line of reasoning presented with some structure. The information presented is in the most-part relevant and supported by some evidence.</i></p> <p><b>Level 1 (1–2 marks)</b> Describes a difference or similarity of llama and camel haemoglobin at a level of protein structure.</p> <p><i>There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.</i></p>	6	<p><b>Indicative scientific points include:</b></p> <ul style="list-style-type: none"> <li>• difference in primary structure</li> <li>• different amino acid / polypeptide sequence</li> <li>• one amino acid changed.</li> <li>• amino acid change could cause change to secondary structure</li> <li>• initial coiling or folding of polypeptide chain</li> <li>• α-helix</li> <li>• β-pleated sheet</li> <li>• hydrogen bonding.</li> <li>• amino acid change could cause change to tertiary structure</li> <li>• further coiling of secondary structure</li> <li>• ionic bonding</li> <li>• disulphide bonds</li> <li>• hydrophilic/hydrophobic bonds</li> <li>• 3D shape.</li> </ul>

Question			Answer	Marks	Guidance
			<b>0 marks</b> No response or no response worthy of credit.		<ul style="list-style-type: none"> <li>• amino acid change has not changed quaternary structure</li> <li>• alpha and beta subunits still able to form haemoglobin in both camel and llama.</li> </ul>
	(c)		insoluble ✓ strong / AW ✓ unreactive / AW ✓	<b>3</b>	<b>IGNORE</b> flexible.
	(d)		<i>two from</i> add biuret / NaOH and CuSO <sub>4</sub> , solution / reagent to urine ✓ observe colour change (from blue to purple) ✓ compare with, control / blank (urine containing no protein) ✓	<b>2</b>	<b>IGNORE</b> biuret test unqualified.
			<b>Total</b>	<b>14</b>	

Question			Answer	Marks	Guidance
5	(a)	(i)	<p><i>three from</i>  similar, niche / lifestyle / AW ✓  similar <u>selection pressure</u> ✓  <i>idea that</i> wings are advantage for survival in both bats and birds ✓  alleles for 'wings' more likely to be passed to next generation ✓</p>	3	<p><b>ALLOW</b> 'same'  <b>ALLOW</b> 'same'</p> <p><b>ALLOW</b> 'genes'</p>
		(ii)	<p><i>idea that</i> echolocation not needed for an animal active during the day where reduced visibility is not an issue ✓</p>	1	
	(b)*		<p><b>Level 3 (5–6 marks)</b>  Full and detailed evaluation of the claim using all of the data in Table 5.1. Learner demonstrates a holistic judgement of the data providing evidence for and against the claim.</p> <p><i>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</i></p> <p><b>Level 2 (3–4 marks)</b>  Detailed evaluation of the claim using most of the data in Table 5.1. Sound judgement is made on a range of aspects of the data.</p> <p><i>There is a line of reasoning presented with some structure. The information presented is in the most-part relevant and supported by some evidence.</i></p> <p><b>Level 1 (1–2 marks)</b>  An evaluation of the claim is attempted using some of the information in Table 5.1. Simple conclusions are drawn citing limited aspects of the data.</p>	6	<p><b>Indicative scientific points may include:</b></p> <p><b>Support for conclusion (that common and soprano pipistrelle are distinct species)</b></p> <ul style="list-style-type: none"> <li>• echolocation ranges do not overlap</li> <li>• genetic basis for echolocation suggests genetic difference between populations</li> <li>• idea that different species are likely to have genetic differences.</li> </ul> <p><b>Information that could be used in support or to challenge</b></p> <ul style="list-style-type: none"> <li>• Mean wing span is very similar</li> <li>• Could indicate difference, though not significant</li> <li>• Could be due to environmental factors, where the populations live.</li> <li>• Habitats overlap</li> <li>• Could indicate same species in different areas</li> <li>• Could be different species adapted to slightly different environments.</li> </ul>

Question			Answer	Marks	Guidance
			<p><i>There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.</i></p> <p><b>0 marks</b> No response or no response worthy of credit.</p>		<p><b>Challenge to conclusion</b></p> <ul style="list-style-type: none"> <li>• same mean body mass, could be same species</li> <li>• same colour, could be same species</li> <li>• potential environmental cause of body mass variation implies weak challenge to conclusion.</li> </ul> <p><b>ALLOW</b> a comment on whether the researcher's conclusion is supported.</p>
			<b>Total</b>	<b>10</b>	



Question			Answer	Marks	Guidance
6	(a)		<p><i>three from</i> adenine / A pairs with thymine / T <b>and</b> cytosine / C pairs with guanine / G ✓ (because of) hydrogen bonding ✓</p> <p><i>idea that</i> purine can only bind with pyrimidine because they are different sizes ✓</p> <p><i>idea that</i> if one base is known it can pair with only one other base ✓</p>	3	<b>ALLOW</b> 2 H bonds between A and T and 3 H bonds between C and G.
	(b)	(i)	<p>(involves) DNA polymerase ✓ sugar-phosphate backbone (re)forms/condensation reaction between phosphate and sugar ✓</p> <p>DNA winds into double helix ✓</p>	3	<b>ALLOW</b> higher level answers e.g. role of DNA ligase in joining sugar-phosphate backbone lagging strand filled in with Okazaki fragments.
		(ii)	(new molecule consists of) one old strand and one new strand ✓	1	
			<b>Total</b>	<b>7</b>	

## Summary of updates

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Date	Version	Change
January 2019	2.0	Minor accessibility changes to the paper: i) Additional answer lines linked to Level of Response questions ii) One addition to the rubric clarifying the general rule that working should be shown for any calculation questions