edexcel

INTERNATIONAL ADVANCED LEVEL

BIOLOGY

AS EXEMPLARS WITH COMMENTARIES

Pearson Edexcel International Advanced Subsidiary in Biology (XBI11)
First teaching September 2018
First examination from January 2019
First certification from August 2019

Pearson

Introduction

This booklet has been produced to support biology teachers delivering the new International Advanced Level Biology specification for first teaching in September 2018 and first assessment in January 2019.

This booklet looks at questions from the Sample Assessment Materials. It shows real student responses to these questions, and indicates how the examining team will follow the mark schemes to demonstrate how students would be awarded marks in these questions.

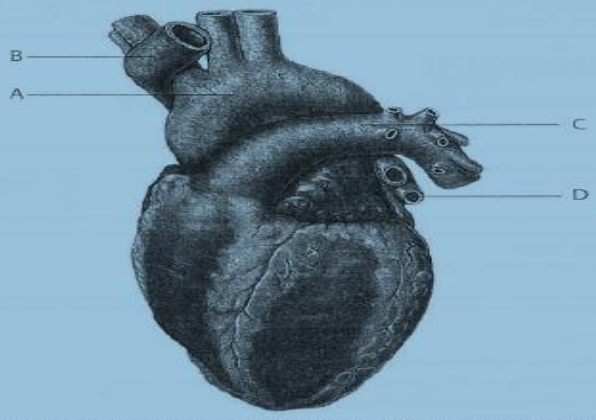
We have selected some responses to 6 questions, with mark schemes, from the sample assessment materials. A range of student responses with accompanying examiner commentaries on how the mark scheme has been applied then follow.

Other teaching and learning materials for this specification are available on the subject page here.

QUESTION 1 – Exemplar 1

1 Mammals have a heart that pumps blood through a network of blood vessels.

(a) The drawing shows a human heart.



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(i) Which blood vessel takes blood from the heart to the body?

(1)

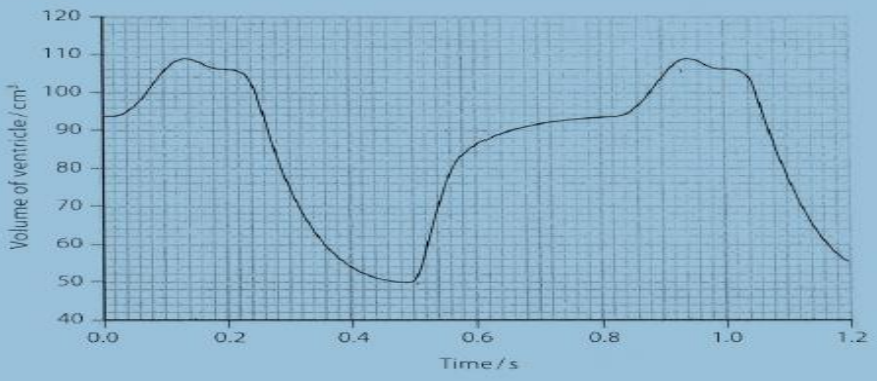
- [x] **A**
- [ ] **B**
- [ ] **C**
- [ ] **D**

(ii) Which blood vessel has semilunar valves and contains blood with the highest concentration of carbon dioxide?

(1)

- [ ] **A**
- [ ] **B**
- [x] **C**
- [ ] **D**

(b) The graph shows the change in volume of the left ventricle during the cardiac cycle.



(i) When is this heart in ventricular systole?

(1)

- [x] **A** at 0.1 seconds
- [x] **B** at 0.4 seconds
- [ ] **C** at 0.6 seconds
- [ ] **D** at 0.8 seconds

(ii) Calculate the volume of blood in dm^3 that will be pumped out of this heart by the left ventricle each minute.

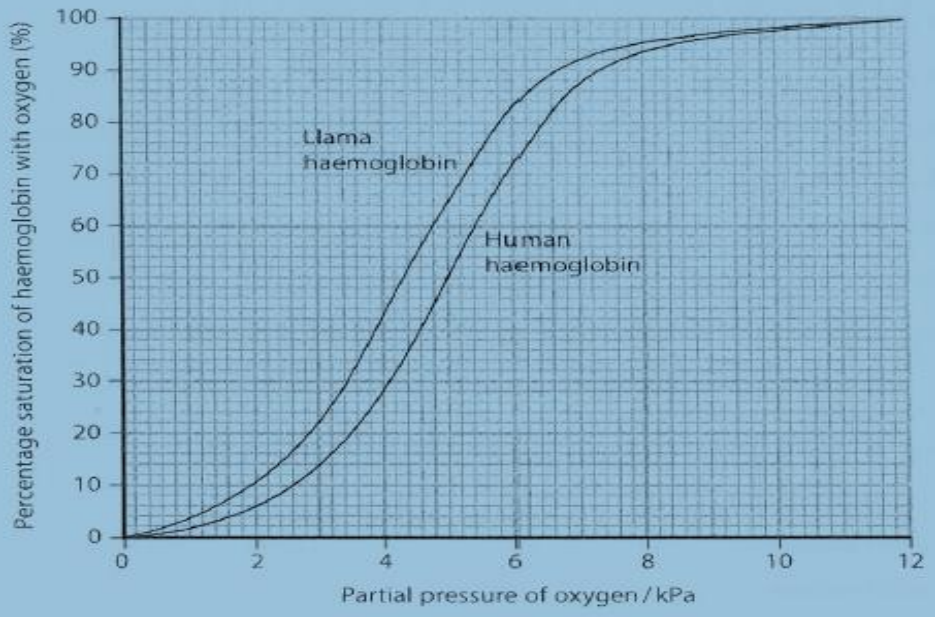
$60 : 0.8 \cdot 60 = 4500 : 1000 = 4,5$ (3)

Answer 4500 4,5 dm^3

(c) As altitude (height above sea level) increases, the partial pressure of oxygen in the air decreases.

Llamas are mammals that are adapted to living at high altitudes.

The graph shows the oxygen dissociation curves for llama haemoglobin and human haemoglobin.



Explain the differences between the dissociation curves. Use the information in the graph to support your answer.

(4)

- Llamas ~~same~~ same saturation with less pressure
- start & end at same point
- at 60 saturation humans need 0.6 kPa more

EXAMINER COMMENTARIES
Question 1, Exemplar 1

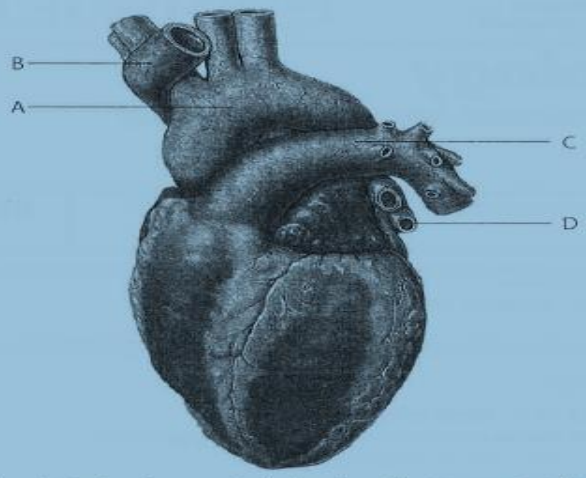
All three MCQs were correct.
The calculation was attempted and was awarded mp3 as a consequential error mark for the conversion.
Part (c) was attempted but did not score any of our mark points.
This is a new topic in the specification.

Q1ai (1)	1
Q1aii (1)	1
Q1bi (1)	1
Q1bii (3)	2
Q1c (4)	0

QUESTION 1 Exemplar 2

1 Mammals have a heart that pumps blood through a network of blood vessels.

(a) The drawing shows a human heart.



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(i) Which blood vessel takes blood from the heart to the body?

(1)

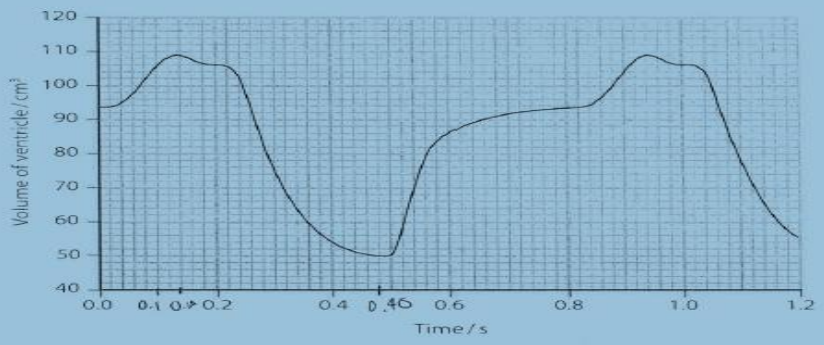
- ☐ A
- ☐ B
- ☒ C
- ☐ D

(ii) Which blood vessel has semilunar valves and contains blood with the highest concentration of carbon dioxide?

(1)

- ☒ A
- ☐ B
- ☐ C
- ☐ D

(b) The graph shows the change in volume of the left ventricle during the cardiac cycle.



(i) When is this heart in ventricular systole?

(1)

- ☐ A at 0.1 seconds
- ☒ B at 0.4 seconds
- ☐ C at 0.6 seconds
- ☐ D at 0.8 seconds

(ii) Calculate the volume of blood in dm^3 that will be pumped out of this heart by the left ventricle each minute.

(3)

$109\ cm^3 - 50\ cm^3 = 59\ cm^3$

$59\ cm^3 = 0.0059\ dm^3$

$0.0059\ dm^3 \Rightarrow 0.34\ s$

$1.041176\ dm^3 \Rightarrow 60\ s$

$0.48s - 0.14s = 0.34s$

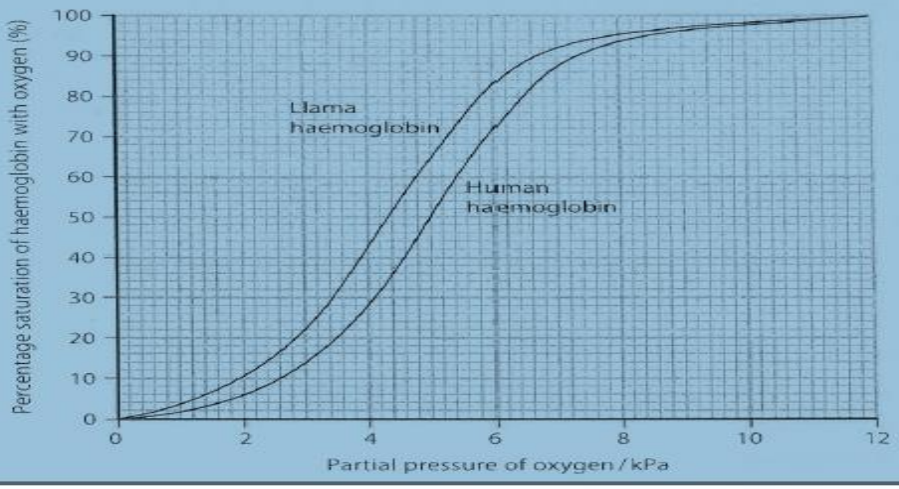
21 : 0.00566...

Answer 1.04 dm^3

(c) As altitude (height above sea level) increases, the partial pressure of oxygen in the air decreases.

Llamas are mammals that are adapted to living at high altitudes.

The graph shows the oxygen dissociation curves for llama haemoglobin and human haemoglobin.



Explain the differences between the dissociation curves. Use the information in the graph to support your answer.

[4]

Llamas always have a higher level of haemoglobin. This is a physiological adaptation of the llamas so that their blood can carry more oxygen to ~~their~~ all of their cells despite them living at a high altitude where the oxygen level in the air decreases. Humans ~~who~~ are not adapted to these conditions as there would be no advantage and simply a waste of resources. The llamas can however profit from this advantageous characteristic.

EXAMINER COMMENTARIES
Question 1 exemplar 2

1ai - This had the incorrect answer of 'C' and was awarded 0 marks.
1aii - This had the incorrect answer of 'A' and was awarded 0 marks.
1bi - This had the correct answer of 'B' and was awarded one mark.
1bii - In order to calculate the volume of blood that would be pumped out of the heart by the left ventricle each minute, students needed to calculate the volume of blood per beat from the graph and multiply it by the heart rate which had also been calculated from the graph. This then needed to be converted into dm^3. This student calculated the volume of blood to within +/- 1 of the correct volume and therefore gained mp1. They did not calculate a correct heart beat or perform a correct calculation for mp3.
1c - This response gained mp4 for a correct reference to less oxygen being available at higher altitudes.

Q1ai (1)	0
Q1aii (1)	0
Q1bi (1)	1
Q1bii (3)	1
Q1c (4)	1

Question 1 Mark scheme

Question number	Answer	Mark
1(a)(i)	A	(1)

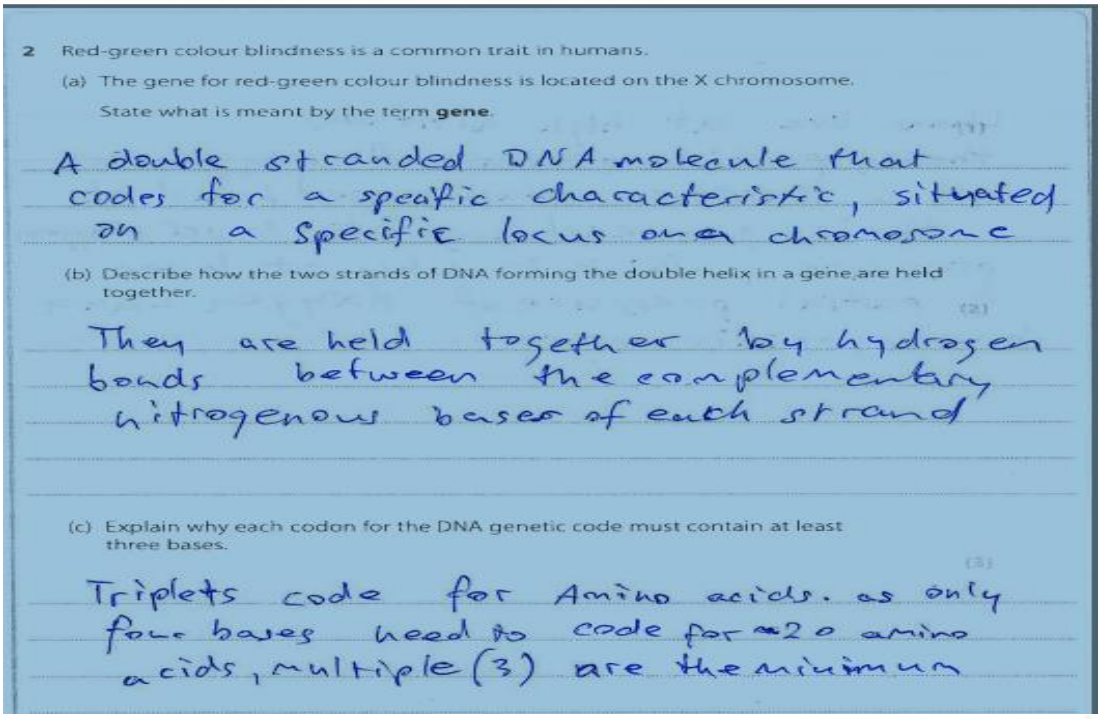
Question number	Answer	Mark
1(a)(ii)	C	(1)

Question number	Answer	Mark
1(b)(i)	B at 0.4 seconds	(1)

Question number	Answer	Additional guidance	Mark
1(b)(ii)	A calculation in which: volume of blood per beat from graph = 59 cm^3 (1) heart rate calculated from graph = 75 bpm (1) • volume of blood converted into dm^3 (1) Example of calculation: (59 × 75) ÷ 1000 = 4.425 dm^3	Accept 109 − 50 Correct answer with no working shown gains all three marks	(3)

Question number	Answer	Mark
1(c)	An explanation that includes the following points: dissociation curve for the llama is to the left of that for the human (1) therefore llama haemoglobin has a higher affinity for oxygen (1) llama haemoglobin will be fully saturated with oxygen at lower partial pressures (1) this is necessary as there is less oxygen available in the atmosphere at high altitudes where llamas live (1)	(4)

Question 2 – Exemplar 1



2 Red-green colour blindness is a common trait in humans.

(a) The gene for red-green colour blindness is located on the X chromosome.

State what is meant by the term **gene**.

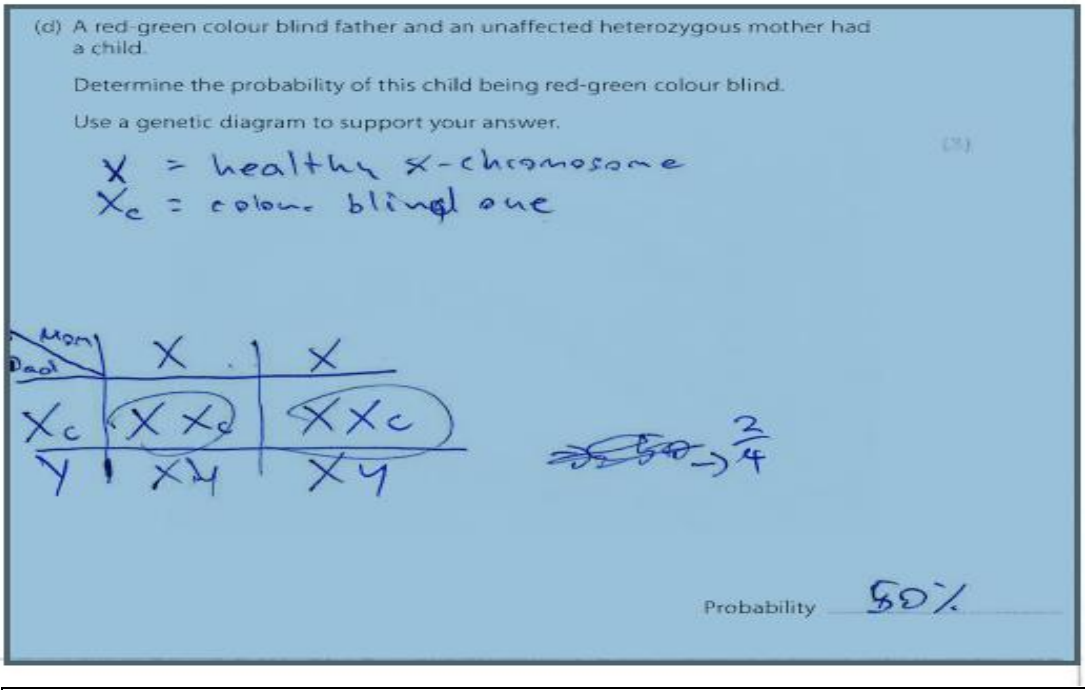
A double stranded DNA molecule that codes for a speafic characteristic, situated on a specific locus on a chromosome

(b) Describe how the two strands of DNA forming the double helix in a gene are held together.

They are held together by hydrogen bonds between the complementary nitrogenous bases of each strand

(c) Explain why each codon for the DNA genetic code must contain at least three bases.

Triplets code for Amino acids. as only four bases need to code for 20 amino acids, multiple (3) are the minimum



(d) A red-green colour blind father and an unaffected heterozygous mother had a child.

Determine the probability of this child being red-green colour blind.

Use a genetic diagram to support your answer.

X = healthy X-chromosome

X_c = colour blind one

Mom / Dad	X	X
X_c	XX_c	XX_c
Y	X^Y	X^Y

$\frac{2}{4}$

Probability 50%

Examiner commentaries
Question 2 Exemplar 1

Correct idea in part (a) but the terminology was not appropriate for A level.
One mark awarded in part (b) for the bases that pair up but the mark scheme required more detail about the number of H bonds that can form between in pair of bases.
The answer in part (c) was awarded two marks.
One mark for the probability as a consequential error for what was contained in the punnet square.
Sex-linked inheritance is a new topic in the specification.

Q2a (1)	0
Q2b (2)	1
Q2c (3)	2
Q2d (3)	1

Question 2 – Exemplar 2

2 Red-green colour blindness is a common trait in humans.

(a) The gene for red-green colour blindness is located on the X chromosome.

State what is meant by the term **gene**.

(1)

Part of the DNA sequence that codes for a protein

(b) Describe how the two strands of DNA forming the double helix in a gene are held together.

(2)

They are held together by nitrogenous bases which join according to the base-pairing rule. Adenine only binds with thymine, and guanine and cytosine only bind with each other. The nitrogenous bases join via hydrogen bonds.

(c) Explain why each codon for the DNA genetic code must contain at least three bases.

(3)

~~Because science.~~

~~So the organism can produce enough proteins, so there are enough com~~

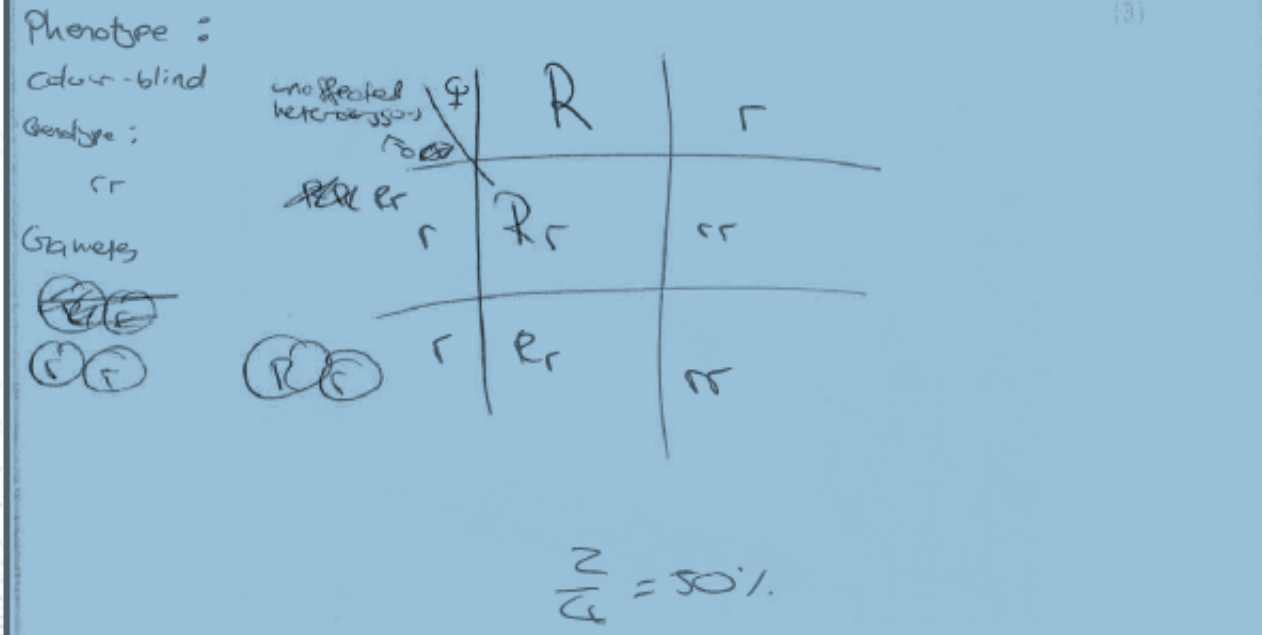
So there are many possible combinations so the organism can produce enough proteins such as enzymes.

(d) A red-green colour blind father and an unaffected heterozygous mother had a child.

Determine the probability of this child being red-green colour blind.

Use a genetic diagram to support your answer.

(3)



$\frac{2}{4} = 50\%$.

Probability 50%.

Examiner commentaries Question 2
Exemplar 2

Correct idea in part (a) but the terminology was not appropriate for A level.
One mark awarded in part (b) for the bases that pair up but the mark scheme required more detail about the number of H bonds that can form between in pair of bases.
The answer in part (c) was incorrect.
One mark for the probability as a consequential error for what was contained in the punnet square.

Q2a (1)	0
Q2b (2)	1
Q2c (3)	0
Q2d (3)	1

Question 2 exemplar 3

2 Red-green colour blindness is a common trait in humans.

(a) The gene for red-green colour blindness is located on the X chromosome.

State what is meant by the term **gene**.

(1)

codes for DNA

(b) Describe how the two strands of DNA forming the double helix in a gene are held together.

(2)

two DNA strands held together by glycosidic bonds

(c) Explain why each codon for the DNA genetic code must contain at least three bases.

(3)

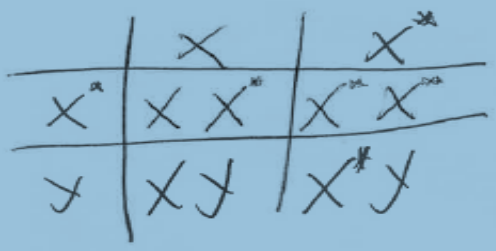
Because they need homologous base pairing

(d) A red-green colour blind father and an unaffected heterozygous mother had a child.

Determine the probability of this child being red-green colour blind.

Use a genetic diagram to support your answer.

(3)



Probability 50%

Examiner commentaries
Question 2 – Exemplar 3

Parts (a), (b) and (c) were attempted but the statements were either incorrect or too vague for an A level response. No marks awarded.
2d - This student scored all three marks.

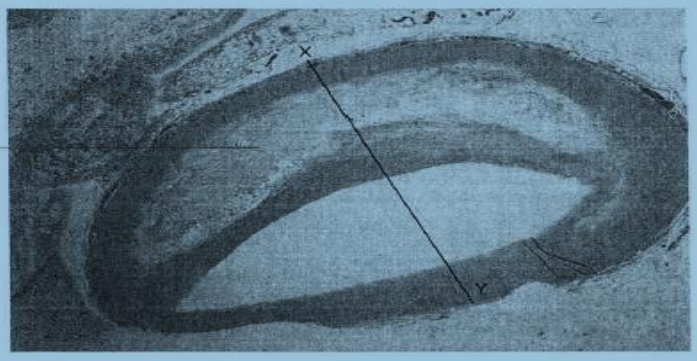
Question 2 – Mark scheme

Question number	Answer	Additional guidance	Mark
2(a)	• sequence of bases of DNA that code for a polypeptide		(1)
Question number	**Answer**		**Mark**
2(b)	A description that includes the following points: • complementary bases / named pair of complementary bases (1) • it enables the formation of {two hydrogen bonds between adenine and thymine / three hydrogen bonds between cytosine and guanine} (1)		(2)
Question number	**Answer**	**Additional guidance**	**Mark**
2(c)	A explanation that includes the following points: • enough codons needed for 20 different amino acids (1) • four bases are used in the genetic code (1) • (triplet code) provides {enough / 43 / 64} possible codons (1)	Allow descriptions of single and doublet code providing insufficient alternatives	(3)
Question number	**Answer**	**Additional guidance**	**Mark**
2(d)	A answer that includes the following points: • correct genotypes of parents (1) • affected genotype of children correctly identified (1) • correct calculation of probability is 0.5 (1)	Accept 50%, 1 in 2, ½	(3)

Question 3 – Exemplar 1

3 Many studies have linked the development of atherosclerosis with cardiovascular disease (CVD).

(a) The photograph shows a section through an artery with a plaque (atheroma) from a patient with atherosclerosis.



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Calculate the percentage increase in the thickness of the artery wall where the plaque is located.

Take your measurements along the line labelled X–Y.

(3)

3cm → 1cm

increase of 200 %.

Answer ..... %

(b) Explain how atherosclerosis can result in damage to the heart muscle.

(4)

artery sclerosis damages the endothelium

inflammatory response

atheroma formation

plaque

plaque ruptures

open

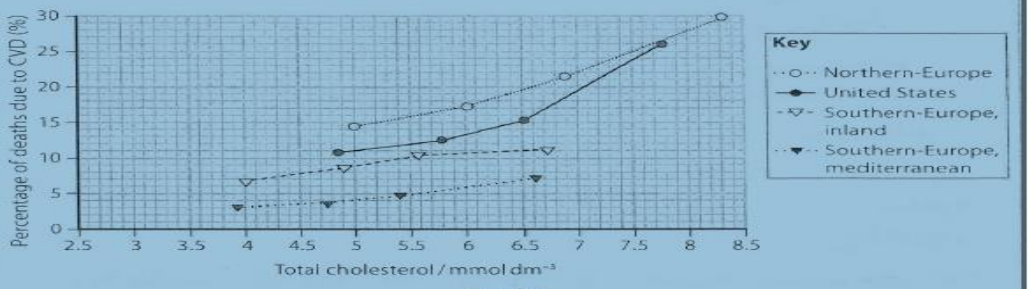
clots.

no oxygen and glucose to heart muscles,

*(c) Cholesterol is transported in the blood as lipoproteins LDL and HDL.

In one study, the relationship between total blood cholesterol and the risk of death from CVD was investigated.

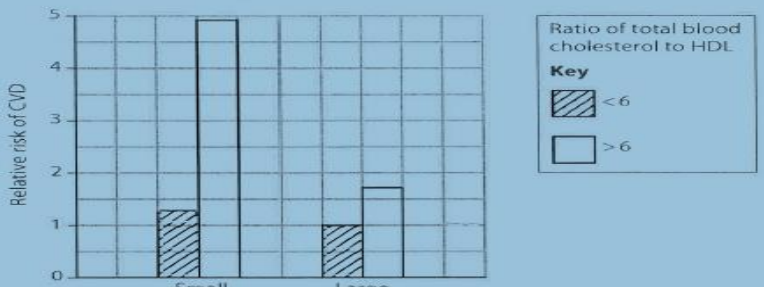
The results are shown in the graph.



Graph 1

In another study, the effect of the size of LDL and the ratio of total blood cholesterol to HDL on the relative risk of CVD was investigated.

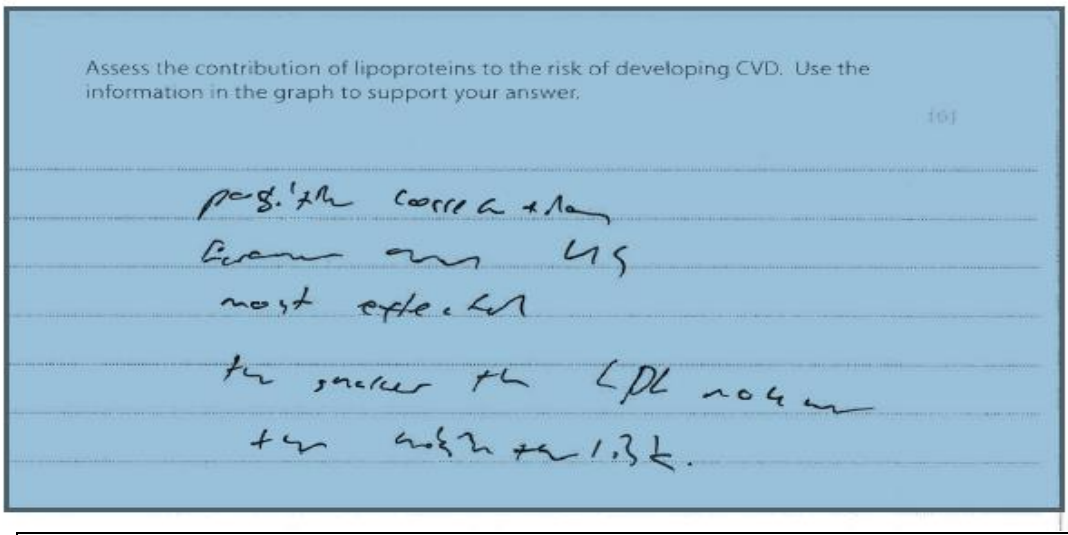
The results are shown in the graph.



Graph 2

Assess the contribution of lipoproteins to the risk of developing CVD. Use the information in the graph to support your answer.

[6]



Examiner commentaries
Question 3 – Exemplar 1

3a - the student was awarded mp1 for two correct measurements. However the calculation that the student performed was incorrect and there was no answer on the answer line. Therefore no more marks could be awarded.

3b - It is important to note that the bullet points of key terms in this answer were not sufficient as they were not given in context. 'Clotting' was not sufficient for mp1 for example. There was also significant difficulty in reading much of this response. Mp4 was awarded for the final line for 'no oxygen and glucose to the heart muscle'

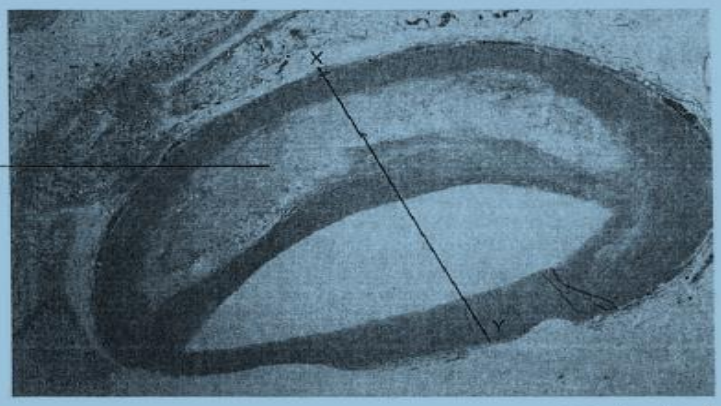
3c - The student gave a scientific assessment of a factor with limited relevant evidence from the scientific evidence provided. The first three lines was not clearly linked to a graph or factor and therefore was not credit worthy. Some of the second line could not be read.

Q3a (3)	1
Q3b (4)	1
Q3c (6)	2

Question 3 Exemplar 2

3 Many studies have linked the development of atherosclerosis with cardiovascular disease (CVD).

(a) The photograph shows a section through an artery with a plaque (atheroma) from a patient with atherosclerosis.



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Calculate the percentage increase in the thickness of the artery wall where the plaque is located.

Take your measurements along the line labelled X–Y.

(3)

artery wall = 1.2

atherosclerosis = 3.2

$\frac{3.2}{1.2} \times 100 = 267.$

Answer 267 %

(b) Explain how atherosclerosis can result in damage to the heart muscle.

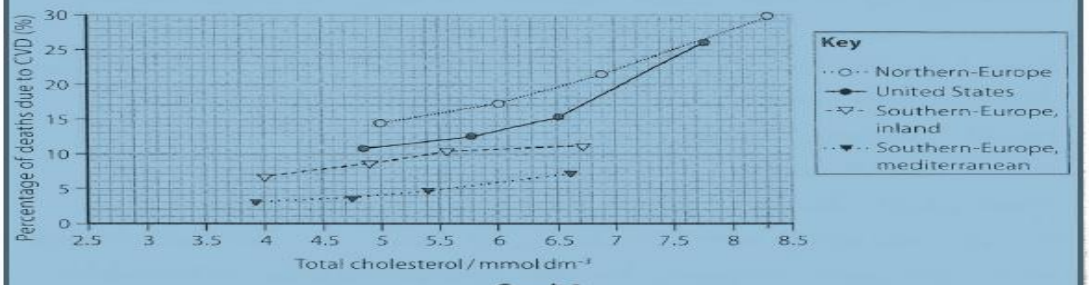
(4)

~~when~~ atherosclerosis forms because of LDL-cholesterol building up in the wall of an artery. It causes harm, because when the plaque thickens, it increases the blood pressure so the heart has to pump faster and harder than usual which causes strain and could lead to a heart attack. Furthermore, the plaque could lead to the artery wall breaking. ~~or~~ Also there is a chance of a blood clot forming, ~~and since~~ the artery may be the heart artery ~~not~~ which could lead to reduced blood and oxygen supply to the heart muscle, ultimately causing it to die off leading to a CVD and heart failure.

*(c) Cholesterol is transported in the blood as lipoproteins LDL and HDL.

In one study, the relationship between total blood cholesterol and the risk of death from CVD was investigated.

The results are shown in the graph.



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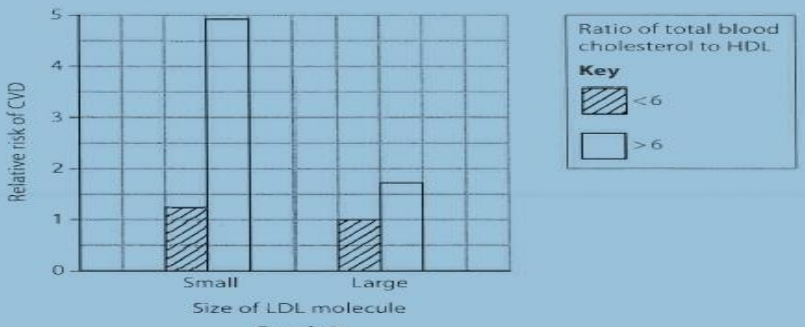


Graph 2

Assess the contribution of lipoproteins to the risk of developing CVD. Use the information in the graph to support your answer.

(6)

An increase in blood cholesterol increases the chance of developing CVD. Graph 1 shows a positive correlation between the increase in total cholesterol and % of deaths due to CVD. Northern Europe shows the highest % of deaths at 30 at a total blood cholesterol of 8.3 mmol dm^{-3}. ~~which~~ however, the ~~of~~ Graph does not show other possible factors that could contribute to an increase in CVD. lipoproteins are a huge factor, however not doing enough sport, drinking, ~~and~~ smoking and eating fatty food also has a major effect on the development of CVD. Gender and age also plays a role ~~and~~ as females tend to have a lower risk than males. thus the graphs are slightly unreliable. This is especially proven as every area of Europe and the USA has a different % of death regarding their cholesterol level. Graph 2 furthermore indicates that smaller sizes of LDL molecules that are also >6 ratio of blood cholesterol to HDL shows the greatest risk of CVD at 4.9 which shows that having LDL cholesterol has a greater risk of having CVD than if one has a greater HDL cholesterol level (<6). so

HDL lipoproteins are actually less harmful and necessary for the human body.

Examiner commentaries
Question 3 – Exemplar 2

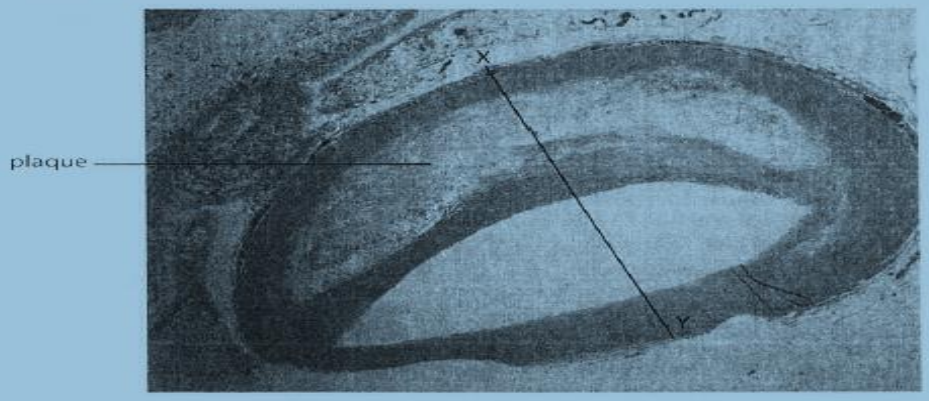
3a - the student was not awarded mp1 as they had not given two correct measurements. It is worth noting that giving units with measurements demonstrates good practice. The calculation that the student performed was incorrect resulting in the answer on the answer line also being incorrect. Therefore no marks could be awarded.
3b - This response gained 3 marks. Mp1 was awarded for either the formation of a blood clot or for plaque formation. There was no linkage of either of these aspects to the effect on the lumen of the coronary artery so mp2 could not be awarded. Mp3 was awarded for reduced blood flow and mp4 was awarded for reduced oxygen supply to the heart muscle.
3c - The student gave a scientific assessment of some factors with some relevant evidence from the scientific evidence provided. There was also evidence of linkages to elements of biological knowledge and understanding so a high level 2 was awarded.

Q3a (3)	0
Q3b (4)	3
Q3c (6)	4

Question 3 – Exemplar 3

3 Many studies have linked the development of atherosclerosis with cardiovascular disease (CVD).

(a) The photograph shows a section through an artery with a plaque (atheroma) from a patient with atherosclerosis.



© Ogphoto/iStock

Calculate the percentage increase in the thickness of the artery wall where the plaque is located.

Take your measurements along the line labelled X–Y.

(2)

~~8.5~~ 1.25

3.3 − 1.25 = 2.05

$\frac{2.05}{1.25} \times 100 = 164$

Answer 164 %

(b) Explain how atherosclerosis can result in damage to the heart muscle.

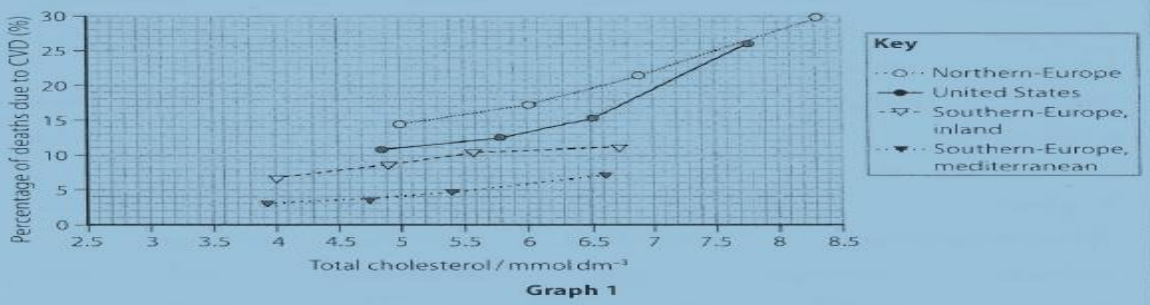
(4)

Atherosclerosis damages the heart muscle because less red blood cells containing oxygen can't enter heart muscles. This means less oxygen to the heart muscle causing anarobic respiration producing lactic acid. This acid causes cells to be destroyed and higher risk of ~~fa~~ heart failure. Atherosclerosis narrows ~~of~~ the artery which causes the elasticity of the artery wall to reduce. Thus, an increase in blood pressure is likely to happen.

*(c) Cholesterol is transported in the blood as lipoproteins LDL and HDL.

In one study, the relationship between total blood cholesterol and the risk of death from CVD was investigated.

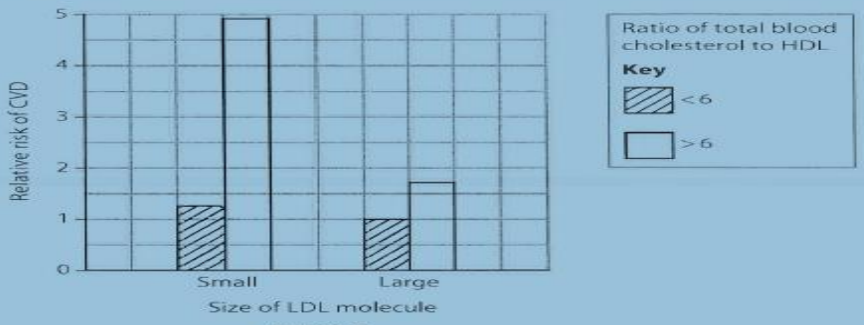
The results are shown in the graph.



Graph 1

In another study, the effect of the size of LDL and the ratio of total blood cholesterol to HDL on the relative risk of CVD was investigated.

The results are shown in the graph.



Graph 2

Assess the contribution of lipoproteins to the risk of developing CVD. Use the information in the graph to support your answer.

(6)

Lipoproteins does increase the risk of CVD but, to an extent. HDL actually, decreases the risk of CVD because binds to cholesterol in blood and transport it to the liver. For example, in graph 2 a larger ratio of total cholesterol to HDL shows a decrease in relative risk of CVD than those with ~~bro~~ smaller ratio's. However, LDL does not bind to cholesterol and stays in the blood vessel. For instance, in graph 1 as total cholesterol increase so, does the percentage of deaths due to CVD increases. As well in graph 2 it shows that a ~~larger~~ smaller ratio of total cholesterol to HDL causes shows an increase in relative risk to CVD.

Examiner commentaries
Question 3, Exemplar 3

3a - the student was not awarded mp1 as there were not two correct measurements. However the calculation that the student performed with their measurements was correct and therefore mp2 and mp3 could be awarded as ECF.
3b - This response gained one mark for a correct explanation of the heart muscle being supplied with less oxygen. The same two sentences were not awarded mp3 as there was not a clear reference to reduced blood flow. The statement about atherosclerosis narrowing the artery was not sufficient for mp2 as the context was heart muscle. Therefore the student needed to be specific about it being a coronary artery.
3c - The student gave a scientific assessment of a factor, however did not back this up with relevant evidence from the scientific evidence provided. Therefore a lower level 1 was awarded.

Q3a (3)	2
Q3b (4)	1
Q3c (6)	1

Mark scheme – Question 3

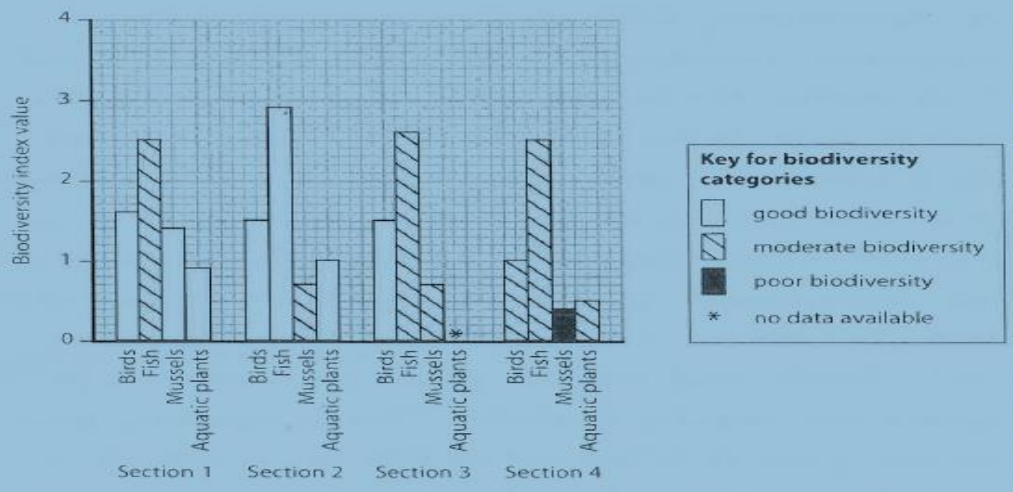
Question number	Answer	Additional guidance	Mark
3(a)	A calculation which: measured widths of wall as 10 mm and 30 mm (1) shows the difference between widths, divided by smaller value (1) • × 100% (1) Example of calculation: (30 − 10) = 20 mm (20 ÷ 10) × 100 = 200%	Accept measurements consistent with printed image Correct answer with no working gains all 3 marks	(3)
Question number	**Answer**		**Mark**
3(b)	An explanation that includes the following points: formation of blood clot / thickening of artery wall (1) therefore {blocks / narrows} coronary arteries (1) therefore reduces blood flow (1) therefore deprives heart muscle of {oxygen / nutrients} (1)		(4)
Question number	**Answer**	**Additional guidance**	**Mark**
3(c)	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material indicated as relevant. Additional content included in the response must be scientific and relevant. **Indicative content** increased cholesterol increases chance of dying from CVD cholesterol concentrations are different in different countries same cholesterol level does not confer same risk in different countries greater the cholesterol to HDL ratio, the greater the risk of CVD the smaller the diameter the LDL, the greater the risk of CVD individuals at greatest risk of CVD are those with a large cholesterol to HDL ratio and small LDL diameter and a high cholesterol concentration • not possible to say if different risks for a particular cholesterol concentration in the first study are due to differences in cholesterol to HDL ratio / diameter of LDL	Allow differences in the first study may be due to differences in cholesterol to HDL ratio / diameter of LDL	(6)

Question 4 - Exemplar 1

4 The biodiversity of four groups of organisms – birds, fish, mussels and aquatic plants – was studied along four sections of the Rideau River in Canada.

A biodiversity index value was calculated for each group of organisms.

The graph shows the results of this study.



The biodiversity index value can be used to compare biodiversity within one group of organisms.

The biodiversity categories (good, moderate and poor) can be used to compare biodiversity between different groups of organisms.

(a) Which statement describes biodiversity?

(1)

- ☐ **A** species richness of only the endemic species within a habitat
- ☒ **B** species richness of all the species within a habitat
- ☐ **C** the role of only the endemic species within a habitat
- ☐ **D** the role of all the species within a habitat

*(b) Describe the changes in biodiversity along the Rideau River. Use the information in the graph to support your answer.

(6)

In Section 1, Birds, mussles and aquatic plants show the a good biodiversity which shows that there would be species richness within the species. Fish are the only one to have a moderate biodiversity with the hoever the highest index value of the section at 2.5. This hoever changes in section 2 as fish here now to once again the highest index value of 2.9 (0.4 higher) but are also now here a good biodiversity. Mussels and birds here both fallen in the index and mussles now also only here a moderate biodiversity. Along section 3 and 4 biodiversity reduce, however species richness imporves which may however indicate that there may be a dominant specy. Fish remain with the highest index value of 2.5 but mussels have fallen to 0.4 & and have a poor biodiversity. This shows that fish are the one dominate specy throughout the Rideau River.

(c) In Section 1, birds have a biodiversity index value of 1.6 and fish have a biodiversity index value of 2.5.

Suggest why the fish are considered to have a moderate biodiversity and the birds have a good biodiversity, but the biodiversity index value of the fish is greater.

[2]

Although they may have a more moderate biodiversity, they may still have more individuals showing a lower species evenness as there may be a dominant species within the both populations. The birds have greater species ~~evenness~~ richness and possibly evenness...

(d) No data were available for aquatic plants in Section 3.

A student collected some data in Section 3 to calculate a biodiversity index value.

The equation that the student used is:

$$D = \frac{N(N - 1)}{\Sigma n(n - 1)}$$

The data are shown in a table prepared by the student.

Species of aquatic plant	Number of aquatic plants counted	(n – 1)	n(n – 1)
Coontail	8	7	56
Tape grass	6	5	30
Common waterweed	3	2	6
Northern water milfoil	2	1	2
Star duckweed	9	8	72
White water lily	2	1	2
Water stargrass	2	1	2
Eurasian water milfoil	6	5	30
Curly pondweed	5	4	20
European frogbit	2	1	2
Flowering rush	3	2	6

(i) Complete the table.

[1]

(ii) Calculate the biodiversity index value for the aquatic plants in Section 3 of this river.

[3]

$\frac{228}{11} = 20.72$

Answer 21

Examiner commentaries
Question 4, Exemplar 1

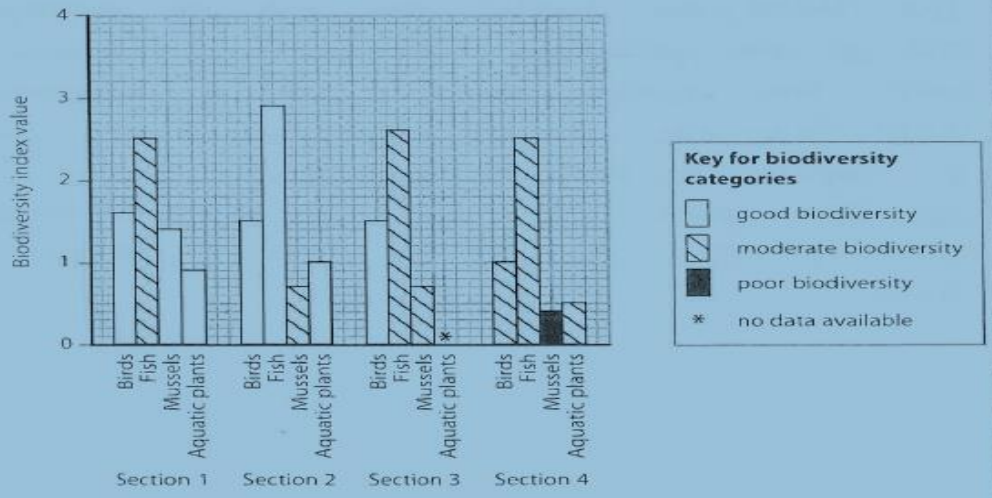
4a - The student gave the correct answer of 'B' for the correct description of biodiversity (1 mark).
4b - This response achieved a low level 2 (3 marks). It was clear from the response whether the student was referring to biodiversity index value or the biodiversity category. They selected and applied some relevant biological facts / concepts to provide their description and there was a suitable structure to their response.
4c - this response could not be awarded either of the marking points.
4di - The student correctly filled in both columns and was awarded the mark.
4dii - The student has correctly calculated the value for $\sum n(n-1)$ and therefore was awarded the first mark. They have incorrectly calculated N(N-1) as 11 and were not awarded mp2. (1 mark). They have inserted their values into the formula incorrectly and therefore could not gain mp3 as ECF.

Question 4 exemplar 2

4 The biodiversity of four groups of organisms – birds, fish, mussels and aquatic plants – was studied along four sections of the Rideau River in Canada.

A biodiversity index value was calculated for each group of organisms.

The graph shows the results of this study.



The biodiversity index value can be used to compare biodiversity within one group of organisms.

The biodiversity categories (good, moderate and poor) can be used to compare biodiversity between different groups of organisms.

(a) Which statement describes biodiversity?

(1)

☐ **A** species richness of only the endemic species within a habitat

☒ **B** species richness of all the species within a habitat

☐ **C** the role of only the endemic species within a habitat

☐ **D** the role of all the species within a habitat

*(b) Describe the changes in biodiversity along the Rideau River. Use the information in the graph to support your answer.

[6]

Along the river the biodiversity index stayed relatively stable for fish with some fluctuations. The biodiversity for mussels went from good to poor along the river, however their biodiversity index value only decreased by 0.5. Although the fish have a high biodiversity index, ranging between 2.5 and 2.9, they have moderate biodiversity in three out of four sections of the river. In general section 1&2 had the best biodiversity, as birds, mussels and aquatic plants all had good biodiversity and so did the fish in section 2. It then decreased along the river from there.

(c) In Section 1, birds have a biodiversity index value of 1.6 and fish have a biodiversity index value of 2.5.

Suggest why the fish are considered to have a moderate biodiversity and the birds have a good biodiversity, but the biodiversity index value of the fish is greater.

[2]

Because the biodiversity index also takes the number / the abundace ~~of f~~ ~~of anima~~ into ~~consi~~ consideration and not only species richness & species evenness. The fish may be greater in numbers than the birds but have lower species richness & evenness

(d) No data were available for aquatic plants in Section 3.

A student collected some data in Section 3 to calculate a biodiversity index value.

The equation that the student used is:

$$D = \frac{N(N-1)}{\Sigma n(n-1)}$$

The data are shown in a table prepared by the student.

Species of aquatic plant	Number of aquatic plants counted	(n – 1)	n(n – 1)
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Northern water milfoil	2	1	2
Star duckweed	9	8	72
White water lily	2	1	2
Water stargrass	2	1	2
Eurasian water milfoil	6	5	30
Curly pondweed	5	4	20
European frogbit	2	1	2
Flowering rush	3	2	6

(i) Complete the table.

[1]

~~N = 48~~

N =

(ii) Calculate the biodiversity index value for the aquatic plants in Section 3 of this river.

[3]

D =

N = 48

48 · 47

Answer .....

Examiner commentaries
Question 4 exemplar 2

4a - The student gave the correct answer of 'B' for the correct description of biodiversity.
4b - This response was awarded a higher level 2 for their numerous correct statements in their description of the changes in biodiversity along the river. For example their statements about the fish biodiversity. It was clear when the student was referring to the biodiversity index value and when they were referring to the biodiversity category.
4c - this response was not awarded a mark because the student was not precise enough in their answer. The reference to the 'fish may be greater in numbers' was not sufficient for mp1 as they did not refer to greater numbers of species.
4di - The student correctly filled in both columns and was awarded the mark.
4dii - The student has not given a value for ∑n(n-1) and therefore could not be awarded the first mark. They have not given a correct value for N(N-1) so mp2 was not awarded.

Q4a (1)	1
Q4b (6)	4
Q4c (2)	0
Q4di (1)	1
Q4dii (3)	0

Question 4 Mark scheme

Question number	Answer	Mark
4(a)	B species richness of all the species within a habitat	(1)
Question number	**Answer**	**Mark**
4(b)	Answers will be credited according to student's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and students are not required to include all the material indicated as relevant. Additional content included in the response must be scientific and relevant. **Indicative content** good diversity for birds in all sections except Section 4, which decreases to moderate good diversity for birds is very similar in Sections 1, 2 and 3 moderate diversity for fish in Section 1, which increases in Section 2 but then decreases again in Sections 3 and 4 moderate diversity is very similar in the three sections good diversity for aquatic plants in Sections 1 and 2, which has decreased by Section 4 good biodiversity for mussels in stretch 1, decreasing to moderate biodiversity in stretch 2 and poor diversity in stretch 4 • no overall trends as you move down the river	(6)

Level	Marks	Descriptor
	0	No awardable content.
1	1-2	Demonstrates isolated elements of biological knowledge related to the given context with generalised comments made. The description will contain basic information with some attempt made to link knowledge and understanding to the given context.
2	3-4	Demonstrates adequate knowledge by selecting and applying some relevant biological facts/concepts to provide the description being presented. The description shows some linkages and lines of reasoning with some structure.
3	5-6	Demonstrates comprehensive knowledge by selecting and applying relevant knowledge of biological facts/concepts to provide the description being presented. The description is clear, coherent and logically structured.
Question number	Answer	Mark
4(c)	An answer that includes the	(2)

Question number	Answer	Mark
4(d)(i)		(1)

Species of aquatic plant	Number of aquatic plants counted	(n-1)	n(n-1)
Coontail	8	7	56
Tape grass	6	5	30
Common waterweed	3	2	6
Northern water milfoil	2	1	2
Star duckweed	9	8	72
White water lily	2	1	2
Water star-grass	2	1	2
Eurasian water milfoil	6	5	30
Curly pondweed	5	4	20
European frogbit	2	1	2
Flowering rush	3	2	6

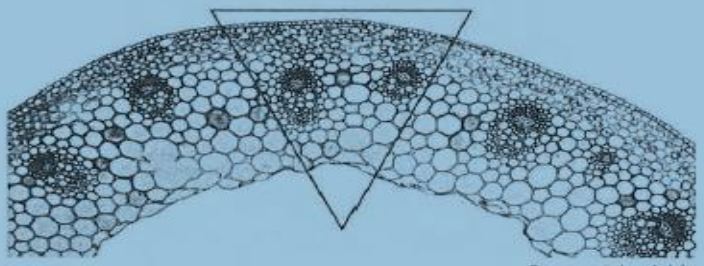
Question number	Answer	Mark
4(d)(ii)	• $\Sigma n(n-1)$ is 228 (1) • value for N(N-1) is (11 × 10) = 110 (1) • diversity index is 0.48 (1)	(3)

Question 5 – Exemplar 1

Write your answers in the spaces provided.

5 A student made observations of plant cells and tissues through a microscope.

(a) (i) Photograph A shows part of a transverse section of a stem at a magnification of ×40.

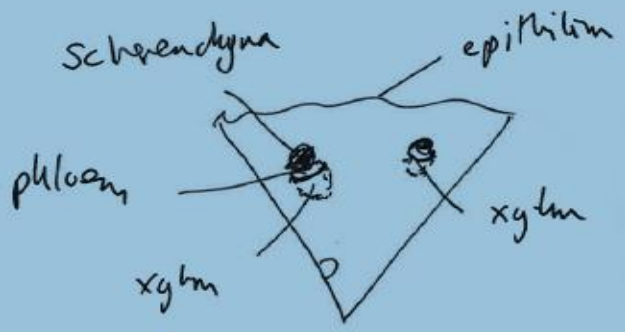


Source: John Adds

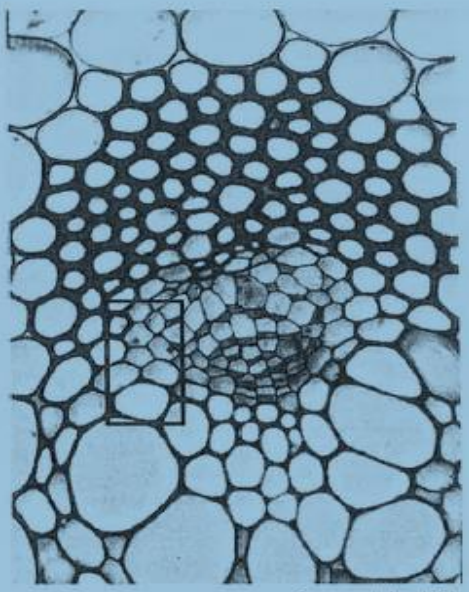
Photograph A

Draw a low-power plan of the area within the triangle shown on Photograph A **and** label two tissues on your drawing.

(3)



(ii) Photograph B shows part of a transverse section of the same stem at a magnification of ×400.



Source: John Adds

Photograph B

Draw the cells within the box shown on Photograph B. (3)

why

v happy ?

Examiner commentaries
Question 5 - Exemplar 1

This student had an attempt at doing low-power plans but it was not quite accurate enough to score anything but the label mark.
High-power diagram is also new but in this case the cell walls were shown correctly. More care is needed when drawing the cells the size required by the question.

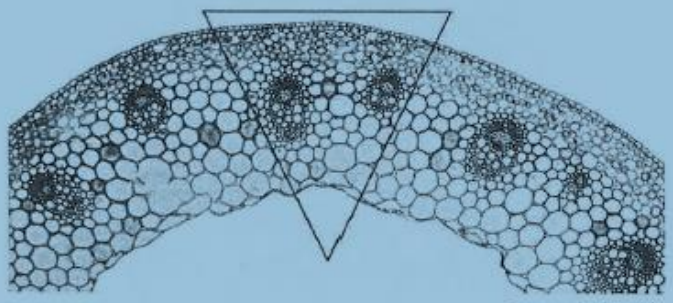
5ai (3)	1
5aii(3)	1

Question 5 – Exemplar 2

Write your answers in the spaces provided.

5 A student made observations of plant cells and tissues through a microscope.

(a) (i) Photograph A shows part of a transverse section of a stem at a magnification of ×40.

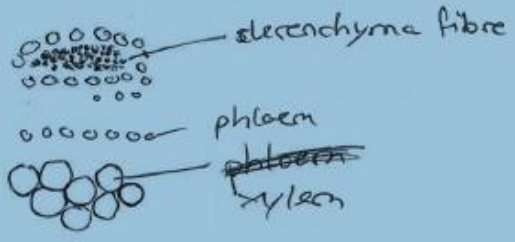


Source: John Adds

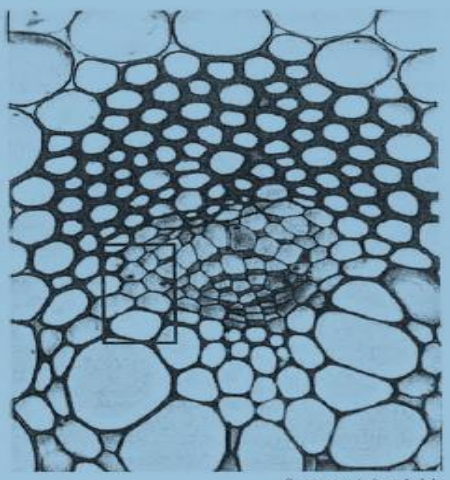
Photograph A

Draw a low-power plan of the area within the triangle shown on Photograph A **and** label two tissues on your drawing.

(3)



(ii) Photograph B shows part of a transverse section of the same stem at a magnification of ×400.

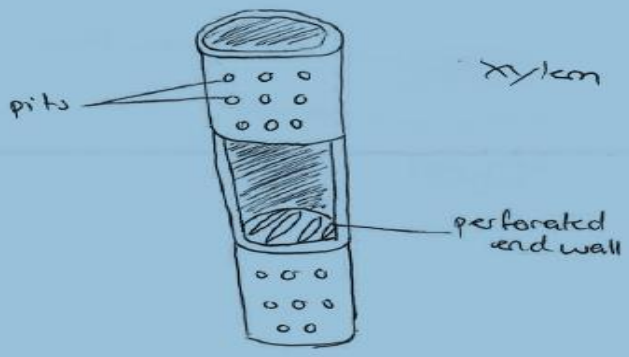


Source: John Adds

Photograph B

Draw the cells within the box shown on Photograph B.

[3]

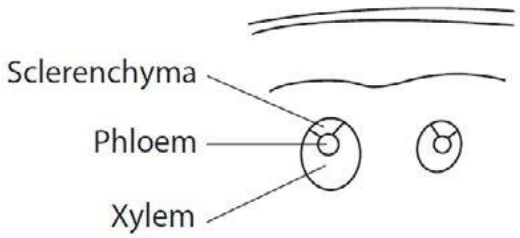


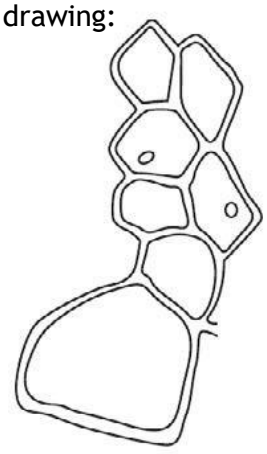
Examiner commentaries
Question 5 - Exemplar 2

5ai - The student did not draw a low-power plan of the entire area within the triangle and therefore was limited in the number of marks that could be awarded. Mp1 could not be awarded as the lines were not neat and cells were drawn. Mp2 could not be awarded as there wasn't two vascular bundles or three/four layers of tissue. Mp3 was just awarded for labelling the sclerenchyma and the xylem tissues.
5aii - The student did not draw any cells and therefore gained 0 marks.

5ai (3)	1
5aii (3)	0

Question 5 Mark Scheme

Question number	Answer	Mark
5(a)(i)	A drawing showing the following features: • neat lines and no cells drawn (1) • two vascular bundles drawn and three or four layers of tissue (1) • two tissues labelled (1) Example of labelled drawing:  	(3)

Question number	Answer	Mark
5(a)(ii)	A drawing showing the following features: • cells in the box drawn to the correct proportions (1) • nuclei drawn in the two cells (1) • cell walls shown correctly (1) Example of drawing: 	(3)

Question 6 – Exemplar 1

6 Mercerisation is a treatment used to increase the tensile strength of natural plant fibres. In this process, fibres are treated with sodium hydroxide solution.

A study was carried out to determine the concentration of sodium hydroxide solution to produce the strongest fibres.

Samples of fibres were obtained from four Nigerian plants: baobab, roselle, okra and kenaf.

All of these fibres were then mercerised by placing them in four different concentrations of sodium hydroxide solution.

The tensile strength of these fibres was then measured.

(a) (i) State the independent variable in this investigation.

(1)

Concerntration of sodium hydroxide

(ii) State how one named variable could be controlled when mercerising the fibres.

(2)

Variable temperature

How the variable could be controlled ~~by~~ use a water bath with 20 C

(iii) Devise a method that can be used to make a valid comparison of the tensile strength of fibres from the same plant, treated with different concentrations of sodium hydroxide solution.

NaOH = Sodium hydroxide

Fibres should be from the same plant. Soak fibres in different NaOH ~~sodium~~ concentrations of 10, 20, 30, 40, 50 percent and one soaked in normal water for 1-2 days. Remove the fibres from the plant with the same length 10cm and 1mm of diameter. Put them to a ~~ca~~ clamp stamp. Add 10g weights. Add weights until it breaks. Record the wheight when it broke the fibre. Repeat it 10 times and calculate a mean wheight to break fibre. Don't put your hands under wheight because you can hurt yourself when the fibres break.

Examiner commentaries
Question 6 Exemplar 1

6ai - the concentration of sodium hydroxide was the correct IV in this investigation and was awarded the mark.
6aii - one mark was awarded for correctly identifying that temperature should be controlled. However a 'water bath with 20°C' was not sufficient for mp2.
6aiii - This response - Mp3 was awarded twice; once for a suitable soaking time and again for specifying the size of the masses used. Mp1 was awarded for fibres being of the same length of 10cm. Mp4 was awarded for the idea of adding masses until the fibres snap. The student gained mp5 as there was reference to calculating an average / mean. The safety procedure was not credit worthy.

Question 6 – Exemplar 2

6 Mercerisation is a treatment used to increase the tensile strength of natural plant fibres. In this process, fibres are treated with sodium hydroxide solution.

A study was carried out to determine the concentration of sodium hydroxide solution to produce the strongest fibres.

Samples of fibres were obtained from four Nigerian plants: baobab, roselle, okra and kenaf.

All of these fibres were then mercerised by placing them in four different concentrations of sodium hydroxide solution.

The tensile strength of these fibres was then measured.

(a) (i) State the independent variable in this investigation.

(1)

Concentration of sodium hydroxide

(ii) State how one named variable could be controlled when mercerising the fibres.

(2)

Variable Temperature

How the variable could be controlled Thermostatically-controlled water bath

(iii) Devise a method that can be used to make a valid comparison of the tensile strength of fibres from the same plant, treated with different concentrations of sodium hydroxide solution.

(6)

Take 5 fibres and soak them for 5 minutes in ~~hydro~~ different concentration of sodium hydroxide solution. All should be soaked under the same conditions. Afterwards take them out and wash the solution off with distilled water. Hang all of the fibres on a clamp stand and attach a weight holder to each one. Add 10g weights slowly and carefully to each ~~clamp stand~~ weight holder until the fibres snap. Record how much weight each fibre could ~~take~~ hold before snapping. ~~And com~~ Repeat the experiment 5 times and calculate a mean for each concentration. Compare the tensile strengths for each fibre

Examiner commentaries Question 6 – Exemplar 2

6ai - the concentration of sodium hydroxide was the correct IV in this investigation and was awarded the mark.
6aii - one mark was awarded for correctly identifying that temperature should be controlled. The second mark was also awarded as 'thermostatically controlled water bath' was the accepted answer for how temperature could be controlled.
6aiii - This response gained three out of the possible five marks. Mp3 was awarded for specifying the size of the masses used. The reference to soaking was not sufficient as a suitable soaking time was not given. Mp4 was awarded for the idea of seeing how much weight the fibre could hold before it snapped. The student gained mp5 as there was reference to calculating an average / mean. There was no relevant comment about controlling an environmental variable or a relevant safety procedure.

Question 6 Mark Scheme

Question number	Answer	Mark
6(a)(i)	• concentration of sodium hydroxide solution	(1)
Question number	**Answer**	**Mark**
6(a)(ii)	An answer that includes any one of the following pairs: temperature of solution (1) •carry out in a thermostatically controlled water bath (1) or length of time in solution (1) • start them all at same time / stopwatch (1)	(2)
Question number	Answer	**Mark**
6(a)(iii)	An answer that includes any five of the following points: • a source material variable taken into account, e.g. length, width, age, mass, hydration level, part of plant extracted from (1) • environmental variable controlled, e.g. temperature, humidity (1) • named procedural variable controlled, e.g. size of masses used (1)	(5)