Pearson Edexcel International GCSE in Biology (9-1)

Exemplar student answers with examiner comments

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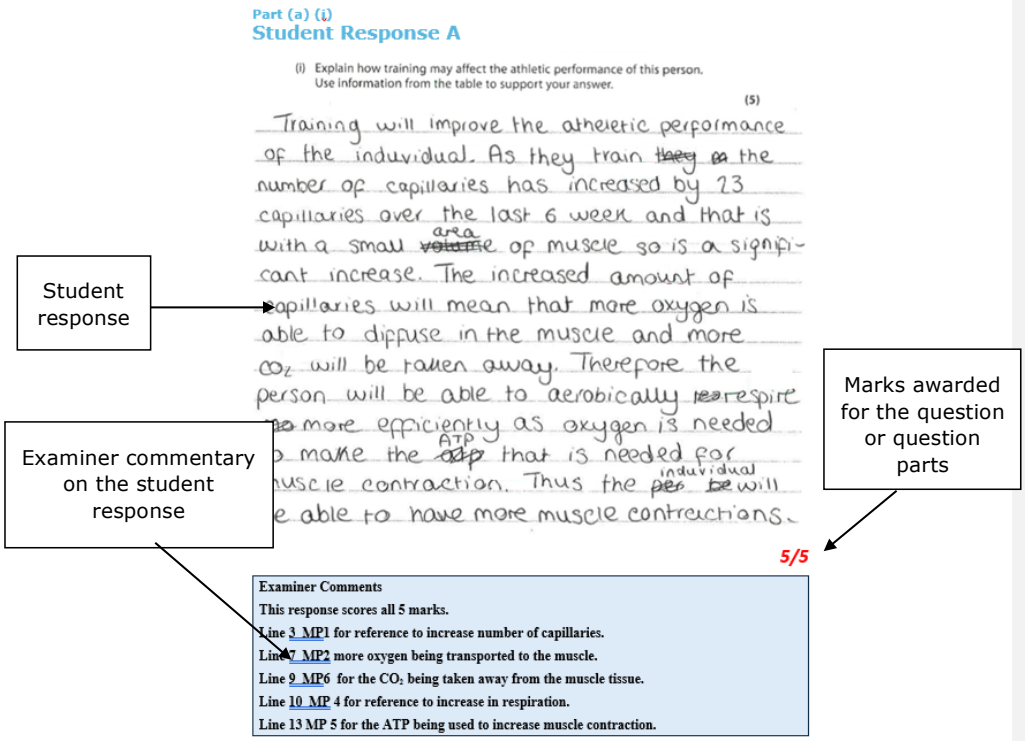
About this booklet

This booklet has been produced to support science teachers delivering the new International GCSE in Biology.

The booklet looks at questions from the Sample Assessment Materials, and some relevant questions from past papers. It shows real student responses to these questions, and how the examining team follow the mark scheme to demonstrate how the students would be awarded marks on these questions.

How to use this booklet

Our examining team have selected student responses to 6 questions. Following each question you will find the mark scheme for that question and then a range of student responses with accompanying examiner comments on how the mark scheme has been applied and the marks awarded, and on common errors for this sort of question.



Paper 1

Exemplar Question 1

3. A study investigates the effect of training on athletic performance.

In the study, the number of capillaries in the muscle tissue of a person is measured before and after a six-week period of training.

(a) The table shows the results.

Mean number of capillaries per mm^2	
before training	after training
437	460

(i) Explain how training may affect the athletic performance of this person. Use information from the table to support your answer.

(5)

(ii) Give **two** ways in which the design of the study could be improved.

(2)

1 .....

.....

2 .....

.....

(b) The diameter of a capillary is 8.0μm and the diameter of the aorta is 25.0mm.

1000μm = 1mm.

(i) Calculate the ratio of the diameter of the aorta to the diameter of the capillary. Show your working.

(2)

ratio = ...

(ii) Explain why the aorta has a thicker wall than the capillary.

(2)

(Total for Question 3 = 11 marks)

Mark Scheme

Question	Answer	Mark
3(a)(i)	An explanation that makes reference to the following five points: • training improves performance by increasing the number of capillaries (1) • better supply of oxygen/aerobic (1) • better supply of glucose (1) • respiration/energy/ATP (1) • muscle contraction (1) • better removal of lactic acid/carbon dioxide (1) • can run for longer/equivalent (1)	**5**

Question	Answer	Mark
3(a)(ii)	An answer that makes reference to two of the following points: • use more people (1) • extend training period (1) • compare different ages/genders (1)	**2**

Question	Answer	Additional guidance	Mark
3(b)(i)	Multiplication • 0.008 (1) Division • 25 ÷ 0.008 = 3125 = 3100 (1)	award full marks for correct numerical answer without working accept 3125 the final answer should reflect the precision of the least precise data (in this case two sig figs)	**2**

Question	Answer	Additional guidance	Mark

Question	Answer	Additional guidance	Mark
3(b)(ii)	An explanation that makes reference to two of the following points: • wall contains muscle/elastic tissue (1) • blood is under high pressure from the left ventricle (1) • aorta needs to expand (1) • need to transport more blood (1)	allow converse	**2**

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Exemplar Question 1

Part (a) (i)

Student Response A

(i) Explain how training may affect the athletic performance of this person.
Use information from the table to support your answer.

(5)

Training will improve the atheletic performance of the induvidual. As they train ~~they~~ ~~as~~ the number of capillaries has increased by 23 capillaries over the last 6 week and that is with a small ~~volume~~ area of muscle so is a significant increase. The increased amount of capillaries will mean that more oxygen is able to diffuse in the muscle and more CO_2 will be taken away. Therefore the person will be able to aerobically ~~rea~~ respire ~~mo~~ more efficiently as oxygen is needed to make the ~~atp~~ ATP that is needed for muscle contraction. Thus the ~~per~~ individual ~~be~~ will be able to have more muscle contractions.

5/5

Examiner Comments
This response scores all 5 marks.
Line 3 MP1 for reference to increase number of capillaries.
Line 7 MP2 more oxygen being transported to the muscle.
Line 9 MP6 for the CO_2 being taken away from the muscle tissue.
Line 10 MP 4 for reference to increase in respiration.
Line 13 MP 5 for the ATP being used to increase muscle contraction.

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Exemplar Question 1

Part (a) (i)

Student Response B

(i) Explain how training may affect the athletic performance of this person. Use information from the table to support your answer.

(5)

The table shows that the mean number of capillaries increases after training, going from 437 to 460 capillaries per mm^2. This is a percentage increase of 5.26%. The capillaries transport the blood to muscles and. The blood carries oxygen and glucose to these muscles used for aerobic respiration. With more capillaries then more blood and thereby oxygen and glucose can reach the muscle tissue and muscle cells meaning the rate of aerobic respiratio increased increases so that the person can have more muscle contraction. and Respiration releases energy for the atheletes performance, increasing it. With more capillaries there is also a higher surface area for the oxygen and glucose to diffuse in and CO_2 and waste products to diffuse out, increasing the rate of aerobic respiratio

5/5

Examiner Comments
An excellent example giving 6 clear marking points for a maximum of 5 marks.
Line 2 MP1 reference to increase number of capillaries.
Line 9 MP2 more oxygen available to muscle cells.
Line 9 MP3 more glucose available to muscle cells.
Line 10 MP 4 these lead to increased rate of respiration.
Line 11 MP5 more respiration enables more muscle contraction.
Line 16 MP6 credit for CO2 being taken away from the muscle tissue.

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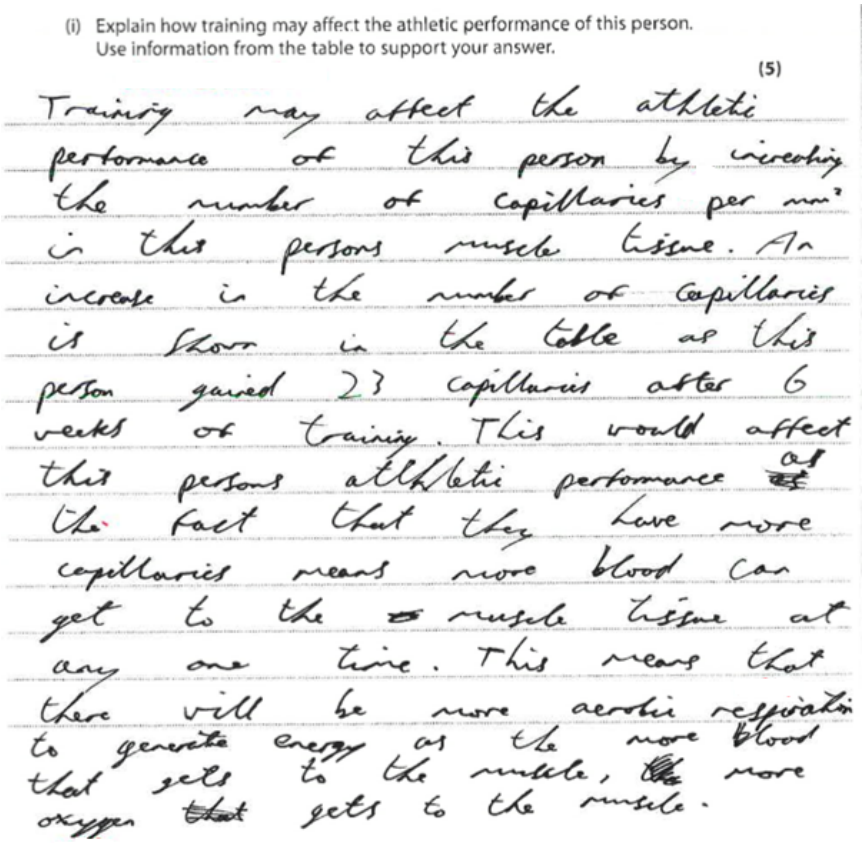
Exemplar Question 1

Part (a) (i)

Student Response C

(i) Explain how training may affect the athletic performance of this person. Use information from the table to support your answer.

(5)



Training may affect the athletic performance of this person by increasing the number of capillaries per mm^2 in this persons muscle tissue. An increase in the number of capillaries is shown in the table as this person gained 23 capillaries after 6 weeks of training. This would affect this persons athletic performance as the fact that they have more capillaries means more blood can get to the muscle tissue at any one time. This means that there will be more aerobic respiration to generate energy as the more blood that gets to the muscle, the more oxygen that gets to the muscle.

3/5

Examiner Comments

Scores 3 marks.

Line 3 credit for MP1 increase number of capillaries.

This candidate has wasted time writing out the stem of the question making reference to improved athletic performance.

Line 14 scores MP2 aerobic which is an alternative to oxygen and MP4 for increased respiration.

Therefore, no credit on line 16 for MP2 as already awarded.

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Exemplar Question 1

Part (a) (i)

Student Response D

(i) Explain how training may affect the athletic performance of this person. Use information from the table to support your answer.

(5)

The training may improve performance as it increases the number of capillaries. As there are more capillaries, more oxygen and glucose can be supplied to the muscle tissue during aerobic respiration, so therefore more energy can be produced, so the muscles can contract much faster and more efficiently. As well as this, lactic acid build up can be more quickly removed due to good blood supply, so muscles can contract for much longer before experiencing fatigue.

5/5

Examiner Comments

This is an excellent answer showing 7 of the marking points. No time is wasted rewriting the stem and the response concisely describes the effect of increasing blood flow on respiration and thus muscle contraction.

It gains marks for increasing the number of capillaries, providing more glucose and oxygen for increased respiration. Muscles can thus contract faster lactic will not build up and the athlete can run for longer.

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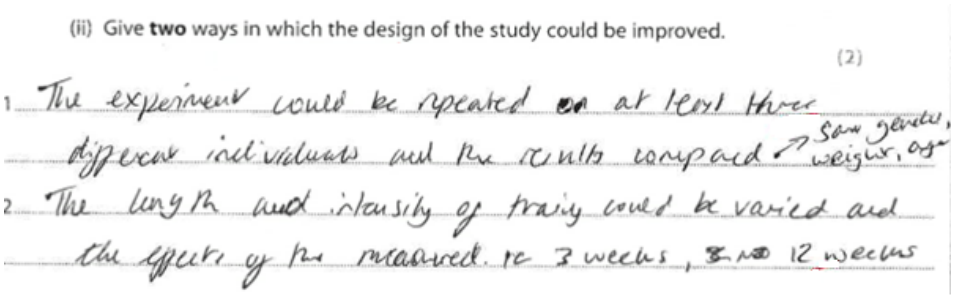
Exemplar Question 1

Part (a) (ii)
Student Response A

(ii) Give **two** ways in which the design of the study could be improved.

(2)



2/2

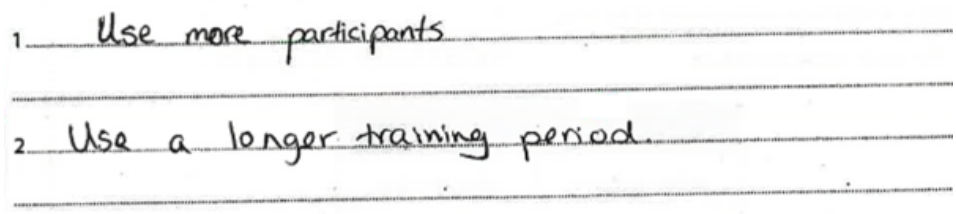
Examiner Comments

Both marks gained for MP1 use more people and MP2 extend training period to 12 weeks.

Part (a) (ii)
Student Response B

(ii) Give **two** ways in which the design of the study could be improved.

(2)



2/2

Examiner Comments

Both marks gained for MP1 use more participants and MP2 use longer training period.

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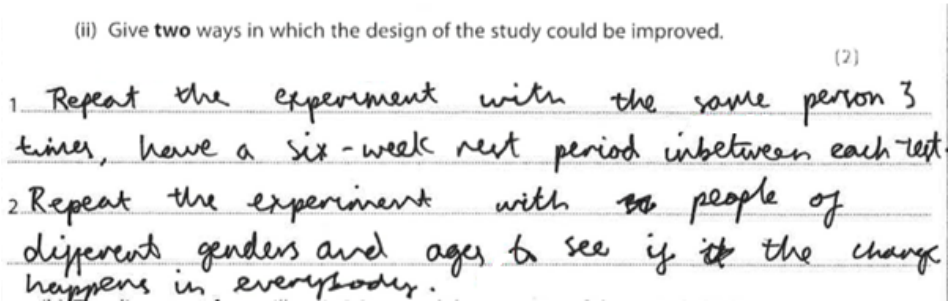
Exemplar Question 1

Part (a) (ii)

Student Response D

(ii) Give **two** ways in which the design of the study could be improved.

[2]



2/2

Examiner Comments

Scores MP 3 use different genders

No credit for MP1 on line 1 as repeat with same person.

But then gets MP1 for repeat with people of = using different people on line 3.

Different ages same MP as different genders.

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Exemplar Question 1

Part (b) (i)
Student Response A

(b) The diameter of a capillary is 8.0 µm and the diameter of the aorta is 25.0 mm.
1000 µm = 1 mm.

(i) Calculate the ratio of the diameter of the aorta to the diameter of the capillary.
Show your working.

(2)

1 mm - 1000 µm
25.0 mm

25.0 x 1000 = 25,000 µm

25,000 : 8
12,500 : 4
6,250 : 2
3,125 : 1

ratio = 3125 : 1

2/2

Examiner Comments

Gains full marks for correct numerical answer without working.

We would encourage candidates to show working as computational error in one stage might gain some credit for method if answer wrong.

Part (b) (i)
Student Response C

(b) The diameter of a capillary is 8.0 µm and the diameter of the aorta is 25.0 mm.
1000 µm = 1 mm.

(i) Calculate the ratio of the diameter of the aorta to the diameter of the capillary.
Show your working.

(2)

8 µm → x mm
1000 µm → 1 mm

$\frac{8}{1000} = 0.008$ mm

25 : 0.008
3125 : 1

ratio = 3125 : 1

2/2

Examiner Comments

Again full credit and working clearly shown.

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Exemplar Question 1

Part (b) (i)

Student Response D

(b) The diameter of a capillary is 8.0 µm and the diameter of the aorta is 25.0 mm.
1000 µm = 1 mm.

(i) Calculate the ratio of the diameter of the aorta to the diameter of the capillary.
Show your working.

8.0 µm → x

1000 µm → 1mm

$x = \frac{1 \times 8.0}{1000}$

$= 0.00800$ mm

25.0mm : 0.00800 mm (2)

ratio = 25.0mm : 0.008

1/2

Examiner Comments

This candidate fails to get the correct answer but scores 1 mark for 0.008 (multiplication) mark stage.

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Exemplar Question 1

Part (b) (ii)
Student Response A

(ii) Explain why the aorta has a thicker wall than the capillary.

(2)

The aorta transports blood at high pressure so the walls need to be strong. The capillary transports blood at lower pressure so its walls don't need to be that thick because they are not at risk of bursting.

1/2

Examiner Comments

Scores 1 for MP2 for idea of higher pressure in arteries.

Part (b) (ii)
Student Response B

(ii) Explain why the aorta has a thicker wall than the capillary.

(2)

The aorta carries blood under higher pressures than the capillaries carry therefore a thicker wall helps the aorta withstand the hydrostatic pressure, by stretching and recoiling.

The walls of the capillary are thinner to come in close contact with tissues and be able to allow exchange of substances.

2/2

Examiner Comments

Scores 2 marks for MP2 carry blood under high pressure and then MP3 for stretching and recoiling as equivalent to expand.

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Exemplar Question 1

Part (b) (ii)

Student Response C

(ii) Explain why the aorta has a thicker wall than the capillary.

[2]

The aorta is an artery leaving the heart. This means that the blood is at a higher pressure than that in a capillary. The walls need to be strong and elasticated so they can expand. The aorta also has a much larger lumen than the capillary.

2/2

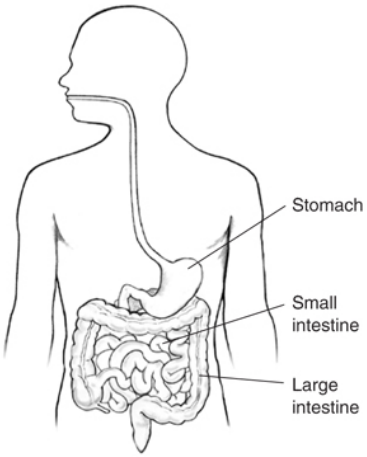
Examiner Comments

This excellent answer scores 2 max, but has 3 clear marking points.

Higher pressure with strong and elasticated walls so they can expand earning MP2, MP2 and MP1.

Exemplar Question 2

7. The diagram shows parts of the human digestive system.



(a) Describe how food passes from the mouth to the stomach.

(2)

.....

.....

.....

(b) Explain what happens to protein in the stomach.

(4)

.....

.....

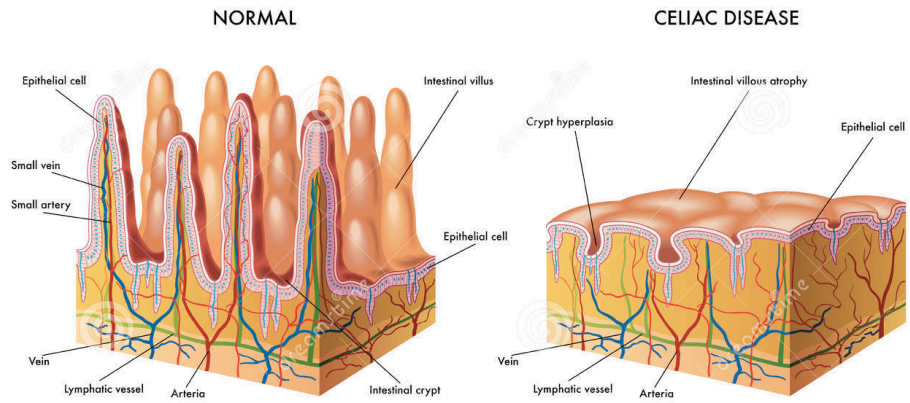
.....

.....

(c) Gluten is a protein found in wheat.

In some people, the lining of the small intestine can be damaged by gluten. This causes a condition called coeliac disease.

The diagram shows the lining of the small intestine of a child unaffected by gluten and a child with coeliac disease.



Suggest how coeliac disease could affect the growth of a child.

(4)

.....

.....

.....

.....

.....

.....

(Total for Question 7 = 10 marks)

Question number	Answer	Mark
7(a)	A description that makes reference to two of the following points: • softened by saliva/bolus (1) • muscle contraction in oesophagus (1) • peristalsis (1)	**2**

Question number	Answer	Mark
7(b)	An explanation that makes reference to four of the following points: • churning/equivalent (1) • digested/broken down (1) • protease/pepsin (1) • amino acids (1) • hydrochloric acid/low pH/optimum pH (1)	**4**

Question number	Answer	Mark
7(c)	An explanation that makes reference to four of the following points: • growth reduced (1) • lack of villi (1) • fewer capillaries/fewer lacteals/less surface area (1) • less absorption of named food molecule (1) • function of named food molecule linked to growth (1)	**4**

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Exemplar Question 2

Part (a)

Student Response A

(a) Describe how food passes from the mouth to the stomach.

In the mouth food is broken down by mechanical digestion. The food (bolus) travels down the oesophagus using a process called peristalsis. This is where the circular muscles contract behind the bolus of food to push it down into the stomach. When the circular muscles contract the longitudinal relax

DO NOT WRITE IN THIS A

2/2

Examiner Comments
Scores 2 marks for MP3 food moved by peristalsis and MP2 muscles in oesophagus contract.

Part (a)

Student Response B

(a) Describe how food passes from the mouth to the stomach.

~~Food~~ Food passes from the mouth to the stomach through the gullet. It is chewed and forms a bolus and then goes down the gullet to the stomach.

1/2

Examiner Comments
This scores one for MP1 chewed and bolus formed.

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Exemplar Question 2

Part (a)

Student Response C

(a) Describe how food passes from the mouth to the stomach.

(2)

In the mouth we use our saliva (containing amylase) to soften and partially break down the food. Then a muscular wave-like motion called peristalsis forces the food down the oesophagus into the stomach.

2/2

Examiner Comments

2 marks for softened by saliva MP1 and MP3 peristalsis moving food down oesophagus.

Part (a)

Student Response D

(a) Describe how food passes from the mouth to the stomach.

The food goes into the mouth, is broken down (homogenised) by the teeth and broken down by enzymes in the saliva, then swallowed, so it travels down into the esophagus, and is pushed down by circular muscles contracting until it reaches the stomach

1/2

Examiner Comments

This response scores 1.

No credit to reference to enzymes in the saliva breaking down food. The marking point MP 1 is for the action of saliva to soften food. Credit MP2 for muscles contract in oesophagus.

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Exemplar Question 2
Part (b)

Student Response A

(b) Explain what happens to protein in the stomach.

(4)

The low pH of the stomach acid enables the protease enzyme to break down protein into amino acids. The enzyme binds to the active site of the protein and digests it into a small soluble molecule from a large insoluble molecule. This enables it to be absorbed into the bloodstream in the duodenum and assimilated for use in cells later on. An enzyme substrate complex is formed. Amino acids are used for growth of tissues.

4/4

Examiner Comments

Scores 4 marks. Line 1 MP for low pH of the stomach and MP3 for protease named as a correct enzyme. On line 2 MP 2 for protease breaking down protein into amino acids MP4.

While the marker credited MP2 for break down I would prefer the use of the term digestion.

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Exemplar Question 2
Part (b)

Student Response B

(b) Explain what happens to protein in the stomach.

(4)

In the stomach protein is digested and broken down by an enzyme, in this case protease. The protein is broken down into amino acids of which there are over 20 types. Peptides are an example of what is formed when the active site of the protease enzyme is ~~broken~~ collides with the correct substrate in this case protein. This is chemical digestion. Mechanical digestion also takes place in the stomach. physically breaking the ~~food~~ protein into smaller pieces for the enzymes to have a greater surface area. Enzymes are a biological catalyst.

4/4

Examiner Comments
This response also scores 4 marks but makes 5 points.
Line 1 protein digested MP2.
Line 2 by protease, MP3, into amino acids MP4.
The next 4 lines do not earn any credit but MP1 is given on line 8 for reference to mechanical digestion in the stomach, I would have preferred churning.

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Exemplar Question 2
Part (b)

Student Response C

(b) Explain what happens to protein in the stomach.

(4)

It is broken down by in acidic conditions (due to hydrochloric acid) by protease enzymes such as pepsin. The protein is broken down into amino acids by protease, as the protein substrate fits the active site of the protease enzyme and it broke down into amino acids

4/4

Examiner Comments

Scores 4 Line 1 MP2 protein broken down (again I would prefer digested) in acidic conditions MP 5 by protease MP3.

Line 4 MP broken down into amino acids MP4.

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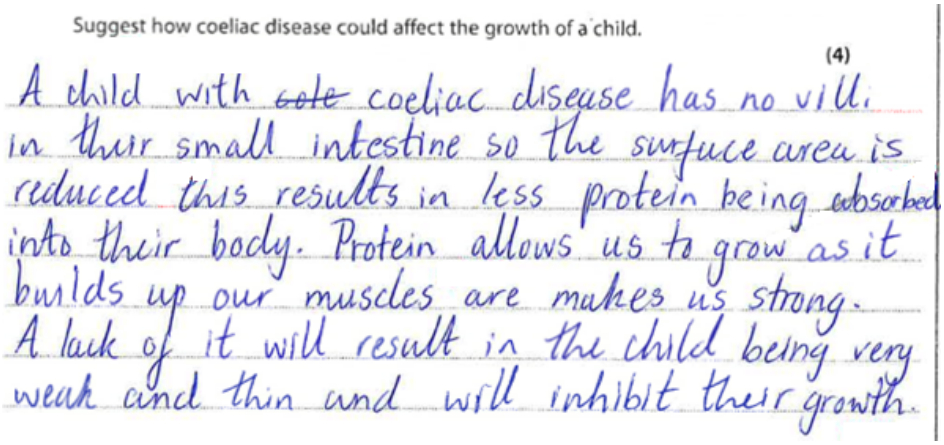
Exemplar Question 2

Part (c)

Student Response A

Suggest how coeliac disease could affect the growth of a child.

(4)


A child with ~~cole~~ coeliac disease has no villi in their small intestine so the surface area is reduced this results in less protein being absorbed into their body. Protein allows us to grow as it builds up our muscles are makes us strong. A lack of it will result in the child being very weak and thin and will inhibit their growth.

4/4

Examiner Comments

This example scores 4.

Line 1 no villi gains MP2.

Line 2 and 3 this reduces surface area MP3.

Line 3 no credit for MP4 absorption of protein as the intestine absorbs amino acids not protein,

Line 5 function of amino acids allowed MP5 . (as idea of absorption of protein already penalised)

Line 7 inhibit growth MP1.

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Exemplar Question 2
Part (c)

Student Response B

Suggest how coeliac disease could affect the growth of a child.

(4)

The coliac disease destroys the villi lining the intestine reducing surface area which in turn reduces the rate of absorbtion in the intestine. Also it ~~s~~ reduces the blood supply to the cell surface meaning less things can be absord. This reduction in absorbtion means the child will take in ~~es~~ less proteins and other minerals from their food. ~~EA~~ This In turn will lead to reduced growth in the child as protein is used for growth and so the child will be very small.

3/4

Examiner Comments
MP 2 no villi
MP3 surface area reduced
No credit for less protein absorbed as it is not absorbed
MP1 reduced growth

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Exemplar Question 2
Part (c)

Student Response C

Suggest how coeliac disease could affect the growth of a child.

(4)

Coeliac disease damages the villi in the gut which decreases their surface area ~~Their~~ Due to a decreased surface area of the villi, there is ~~a~~ less surface area for the ~~body~~ gut small intestine to absorb the nutrients needed for growth. This means that due to less nutrients, the child will not grow as much and it will affect their growth.

3/4

Examiner Comments

Scores 3

Line 1 damages villi.

Line 2 decreases surface area for absorption.

No credit for absorption of nutrients in line 6 as must give named food molecule.

Line 8 child will not grow is MP1.

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Exemplar Question 2
Part (c)

Student Response E

Suggest how coeliac disease could affect the growth of a child.

(4)

The lining of the small intestine with coeliac disease has a much smaller surface area than the lining without the disease. As nutrients such as glucose and vitamin are absorbed through the ~~wall~~ lining of the small intestine the child with coeliac disease would absorb much less nutrients than the child without. ~~This means that~~ Because the child would end up absorbing less nutrients, which are essential for growth the child growth would be adversley affected ~~the child growth~~

3/4

Examiner Comments
Scores 3
Line 2 reduced surface area MP3.
Line 4 – 6 reduces absorption of glucose MP4 for named food molecule.
Line 8 child's growth adversely affected MP1.

Exemplar Question 3

8. Male infertility can be caused by reduced sperm production and reduced sperm movement.

Scientists investigated the effect of a drug called letrozole on male infertility.

A large group of infertile men was divided into two smaller groups.

Group 1 received 2.5 mg of letrozole per day for six months and Group 2 received no treatment.

The scientists measured the following at the start of the investigation and after six months:

- sperm concentration
- percentage of moving sperm
- blood testosterone level
- blood oestrogen level
- side effects such as hair loss and skin rash

Factors measured	Group 1 (letrozole)	Group 2 (no treatment)

The table below shows the results.

	Start	After 6 months	Start	After 6 months
Sperm concentration/number per cm^3	450	1.4×10^6	475	450
Percentage of moving sperm	2	18	2	2
Blood testosterone level/arbitrary units	249	1198	266	266
Blood oestrogen level/arbitrary units	44	0	44	48
Number of men with side effects	0	8	0	0

Exemplar Question 3

The scientists concluded that letrozole is a safe and effective treatment for male infertility.

Evaluate this conclusion.

(6)

(Total for Question 8 = 6 marks)

Mark Scheme

Question number	Answer	Additional guidance	Mark
8	An evaluation that makes reference to the following points: • letrozole does improve male fertility (1) • sperm concentration increases/sperm motility increases (1) • letrozole increases testosterone levels/ decreases oestrogen levels (1) • letrozole causes side effects/equivalent (1) • need to know group size (1) • matched groups (1) • need to know other factors controlled (1)	e.g. age, diet, smoking, drugs	**6**

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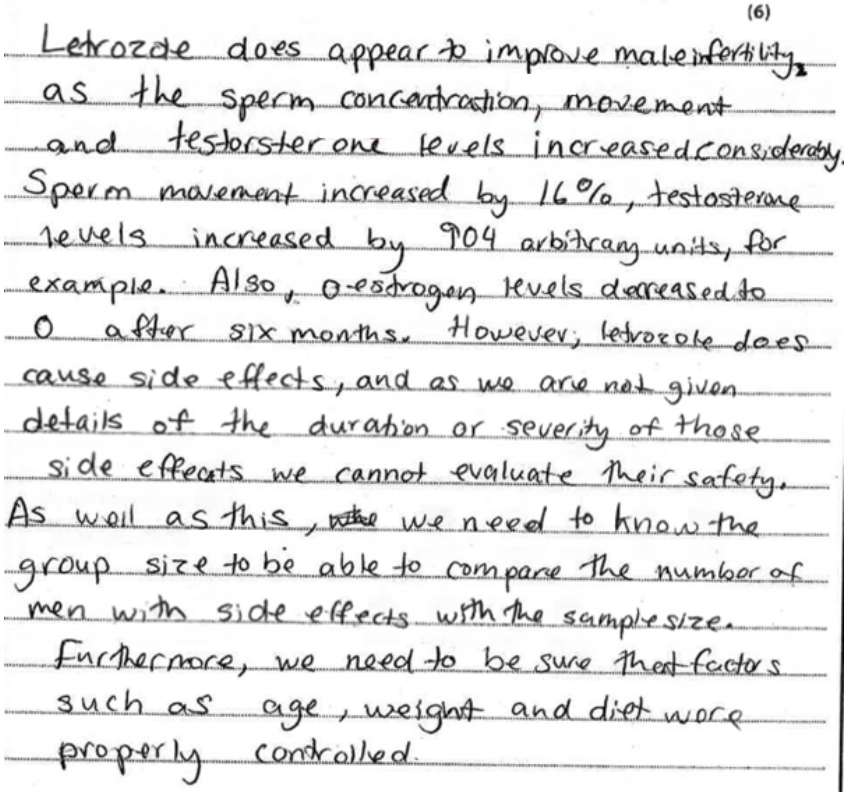
Exemplar Question 3

Student Response A

The scientists concluded that letrozole is a safe and effective treatment for male infertility.

Evaluate this conclusion.

(6)



Letrozde does appear to improve male infertility as the sperm concentration, movement and testorsterone levels increased considerably. Sperm movement increased by 16%, testosterone levels increased by 904 arbitrary units, for example. Also, o-estrogen levels decreased to 0 after six months. However, letrozole does cause side effects, and as we are not given details of the duration or severity of those side effects we cannot evaluate their safety. As well as this, ~~the~~ we need to know the group size to be able to compare the number of men with side effects with the sample size. Furthermore, we need to be sure that factors such as age, weight and diet were properly controlled.

6/6

Examiner Comments
Scores 6 marks
Line 1 MP1 is effective treatment.
Line 2 MP2 sperm concentration increases.
Line 3 MP3 testosterone level increases.
Line 8 MP4 causes side effects.
Line 12 MP5 we need to know group size.
Line 16 MP7 need to know other factors such as age.

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Exemplar Question 3

Student Response B

The scientists concluded that letrozole is a safe and effective treatment for male infertility.

Evaluate this conclusion.

[6]

The group with the letrozole did have a sperm concentration increase of 97%, and a 16% increase of moving sperm. The increase of blood testosterone levels was significant also. This proves that the drug was effective, as they wanted to increase the level of sperm, which they did by adding more testosterone to generate more sperm.

However, there ~~was~~ were some men who had side affects. We aren't told how many men took part, meaning all 8 men could be affected in a test grop, or 8/108 could be affected. But, as there is side affects of hair loss and skin rash, the drug cannot be called 'safe' because it affects the body, and there is no evidence to why it does harm the body.

Therefore letrozole can be called an effectric treatment, but until there are futher tests, or more data, it cannot be called safe.

(Total for Question 8 = 6 marks)

5/6

Examiner Comments

Scores 5 marks

Line 2 MP2 sperm concentration increases.

Line 3 MP3 testosterone level increases.

Line 5 MP1 drug is effective

Line 8 and 9 MP4 drug causes side effects.

Line 9 MP5 not told how many men took part.

No credit for references to safety.

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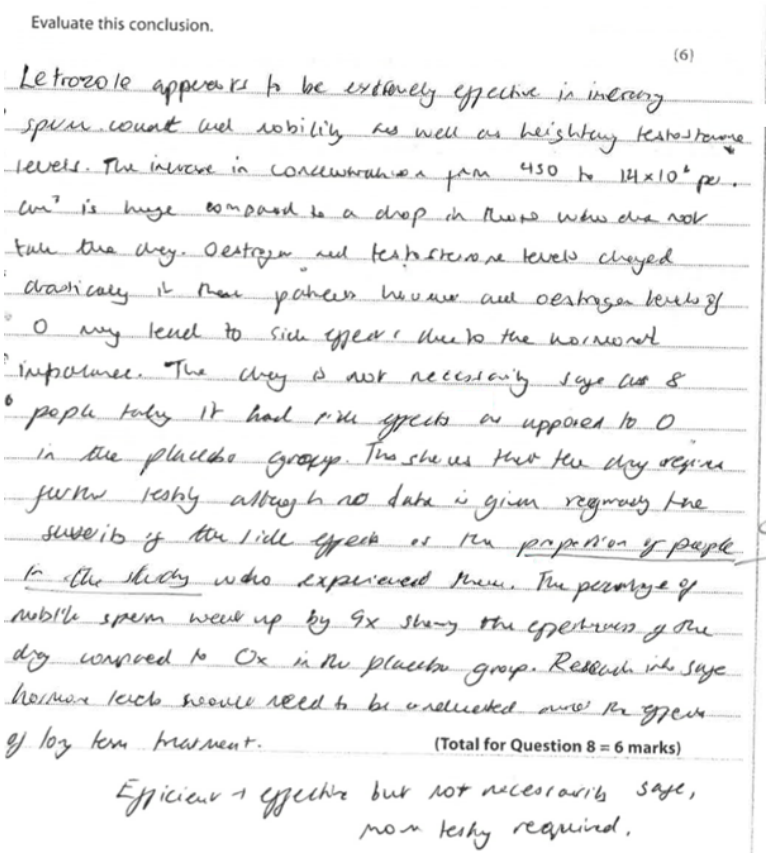
Exemplar Question 3

Student Response C

The scientists concluded that letrozole is a safe and effective treatment for male infertility.

Evaluate this conclusion.

(6)



Letrozole appears to be extremely effective in increasing sperm count and mobility as well as heightening testosterone levels. The increase in concentration from 450 to 14×10^6 per cm^3 is huge compared to a drop in those who did not take the drug. Oestrogen and testosterone levels changed drastically in male patients however and oestrogen levels of 0 may lead to side effects due to the hormonal imbalance. The drug is not necessarily safe as 8 people today it had side effects as opposed to 0 in the placebo group. This shows that the drug requires further testing although no data is given regarding the severity of the side effects or the proportion of people in the study who experienced them. The percentage of mobile sperm went up by 9x showing the effectiveness of the drug compared to 0x in the placebo group. Research into safe hormone levels should need to be undertaken over the effects of long term treatment.

(Total for Question 8 = 6 marks)

Efficient + effective but not necessarily safe, more testing required.

4/6

Examiner Comments

Scores 4 marks

Line 1 MP1 drug is effective.

Line 2 MP2 sperm concentration increases.

Line 2 MP3 heightening testosterone level (increases)

Line 9 MP4 had side effects.

Line 13 no credit for proportion of people that had side effects.

Exemplar Question 4

9 Genetic conditions can be controlled by dominant alleles or by recessive alleles.

(a) Explain the differences between a dominant allele and a recessive allele.

(2)

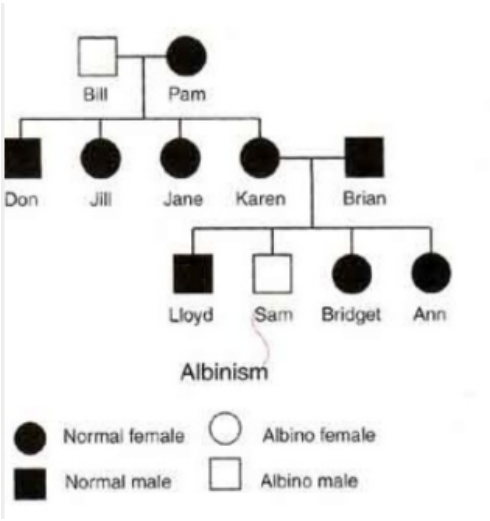
.....

.....

.....

(b) Pedigree analysis can be used to find out if characteristics are controlled by dominant or recessive alleles.

The diagram below shows a family pedigree for albinism.



Explain, using information in the pedigree, whether albinism is controlled by a recessive allele or a dominant allele.

(3)

.....

.....

.....

(c) Sickle cell anaemia is a genetic condition that results in the formation of abnormal red blood cells.

Sickle cell anaemia is controlled by a gene with two alleles. The allele (N) produces normal red blood cells and the allele (n) produces abnormal red blood cells.

Two parents who are both heterozygous plan to have children.

Use a genetic diagram to show the parent genotypes, the gametes produced and all the possible genotypes and phenotypes of their offspring.

(3)

Parent genotypes

Gametes

Offspring genotypes

(d) Individuals who are heterozygous for sickle cell anaemia are protected from malaria.

Suggest how this would affect the number of individuals born with sickle cell anaemia in parts of the world where malaria is common.

(4)

.....

.....

.....

.....

(Total for Question 9 = 12 marks)

Question number	Answer	Additional guidance	Mark
9(a)	An explanation that makes reference to two of the following points: • dominant allele always expressed (1) • dominant expressed in heterozygote (and homozygote)/recessive allele not expressed in heterozygote (1) • recessive allele only expressed in phenotype of homozygote/equivalent (1)	allow seen/visible	**2**

Question number	Answer	Mark
9(b)	An explanation that makes reference to three of the following points: • Karen and Brian unaffected (1) • they both are heterozygous/carriers/have a recessive allele (1) • Sam is albino (1) • Sam is aa/homozygous recessive (1)	**3**

Question number	Answer	Additional guidance	Mark
9(c)	A genetic diagram including: • parents Nn and Nn (1) • gametes N or n (1) • genotypes of offspring NN Nn Nn nn and phenotypes correctly assigned (1)	allow max 3 for transfer error allow all marks from Punnett square	**3**

Question number	Answer	Additional guidance	Mark
9(d)	An answer that makes reference to the following points: • Nn not affected/killed by malaria/survive (1) • reproduce (1) • so number of Nn individuals increase (1) • so number of nn individuals increases/frequency of (n) allele increases (1)	allow converse for NN	**4**

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Exemplar Question 4

Part (a)

Student Response A

(a) Explain **one** difference between a dominant allele and a recessive allele. **(2)**

Dominant alleles are always expressed in an organism, whereas recessive alleles are only expressed when there are two recessive alleles present or it is homozygous recessive.

2/2

Examiner Comments
Excellent concise answer well expressed.
MP1 dominant always expressed.
MP3 recessive only expressed in homozygous

Part (a)

Student Response B

(a) Explain **one** difference between a dominant allele and a recessive allele. **(2)**

a dominant allele is always expressed in the phenotype of the individual but a recessive allele is only expressed in a homozygous individual for the recessive allele.

2/2

Examiner Comments
Also scores 2 marks for MP1 and MP3.

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Exemplar Question 4
Part (b)

Student Response A

Explain, using information in the pedigree, whether albinism is controlled by a recessive allele or a dominant allele.

(3)

It is recessive, as for two unaffected people to produce an affected offspring, this implies that they both must be carriers for the albinism allele. Karen could have then inherited the recessive allele from her parents and reproduced with Brian to produce Sam who is affected

3/3

Examiner Comments
Scores 3 marks
Line 1 MP1 parents unaffected.
Line 3 MP2 both parents are carriers.
Line 7 MP3 Sam is affected.

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Exemplar Question 4
Part (b)

Student Response B

Explain, using information in the pedigree, whether albinism is controlled by a recessive allele or a dominant allele.

(3)

a recessive allele because only one of all of the offspring was albino. Because both of the parents of the albino offspring were normal they must be heterozygous and so because only one of their offspring was albino, albinism must be controlled by a recessive allele.

2/3

Examiner Comments
Scores 2 marks
Line 4 MP1 parents normal.
Line 4 MP2 both heterozygous.
Line 5 no credit for one of offspring is albino as does not state which one.

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Exemplar Question 4

Part (c)

Student Response A

(c) Sickle cell anaemia is a genetic condition that results in the formation of abnormal red blood cells.

Sickle cell anaemia is controlled by a gene with two alleles. The allele (N) produces normal red blood cells and the allele (n) produces abnormal red blood cells.

Two parents who are both heterozygous plan to have children.

Use a genetic diagram to show the parent genotypes, the gametes produced and all the possible genotypes and phenotypes of their offspring.

(3)

Parent genotypes – Both unaffected

Gametes – N, n, N, n

	N	n
N	NN	Nn
n	Nn	nn

Offspring genotypes , 75% unaffected 25% affected, 3/4 ~~unaffe~~unaffected, 1/4 affected.

Offspring phenotypes homozygous dominant, heterozygous, heterozygous, homozygous recessive.

3/3

Examiner Comments
Scores 3
MP1 parents Nn and Nn from Punnett square.
MP2 gametes N or n from Punnett square.
MP3 genotypes of offspring NN Nn Nn nn and phenotypes correctly assigned.

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Exemplar Question 4
Part (c)

Student Response B

(c) Sickle cell anaemia is a genetic condition that results in the formation of abnormal red blood cells.

Sickle cell anaemia is controlled by a gene with two alleles. The allele (N) produces normal red blood cells and the allele (n) produces abnormal red blood cells.

Two parents who are both heterozygous plan to have children.

Use a genetic diagram to show the parent genotypes, the gametes produced and all the possible genotypes and phenotypes of their offspring.

(3)

Parent genotypes

Nn Nn

	N	n
N	NN	Nn
n	Nn	nn

Gametes

(N) (n) (N) (n)

Offspring genotypes

NN Nn Nn n n

Offspring phenotypes

normal, carrier, carrier, sufferer

3/3

Examiner Comments
All 3 marks awarded.

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Exemplar Question 4
Part (d)

Student Response A

(d) Individuals who are heterozygous for sickle cell anaemia are protected from malaria.

Suggest how this would affect the number of individuals born with sickle cell anaemia in parts of the world where malaria is common.

(4)

Those who are heterozygous would not be killed by malaria, and therefore survive to reproduce, so their offspring may therefore inherit alleles that also make them heterozygous. So therefore, this increases the likelihood of people being born homozygous recessive for sickle cell anaemia, increasing the amount of those with the disease in parts of the world where malaria is common.

(Total for Question 9 = 12 marks)

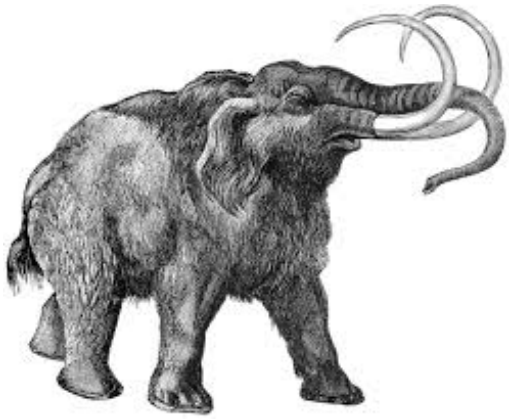
4/4

Examiner Comments
A very good answer that clearly gains all 4 marks.
Line 2 MP1 heterozygous not killed by malaria.
Line 2 MP2 so they reproduce.
Line 3 MP3 so offspring inherit alleles that make them heterozygous equivalent to individuals increase.
Lines 5 and 6 MP4 so number of homozygous recessive individuals increases.

Exemplar Question 5

2 Mammoths were large animals that existed from 5 million to 4500 years ago, but are now extinct. They shared a common ancestor with modern-day elephants.

The drawing shows a mammoth.



Scientists recently found a thigh bone of a frozen mammoth in Russia.

The bone had been frozen for 40 000 years. The scientists intend to use the bone cells to clone a mammoth.

Describe the method that could be used to clone a mammoth.

(4)

(Total for Question 2 = 4 marks)

Mark Scheme

Question number	Answer	Mark
2	A description that makes reference to four of the following points: • mammoth cell nucleus put into enucleated (elephant) egg cell (1) • electric shock/equivalent (1) • cell division/mitosis (1) • embryo (1) • uterus/womb (1) • surrogate mother (elephant) (1)	**4**

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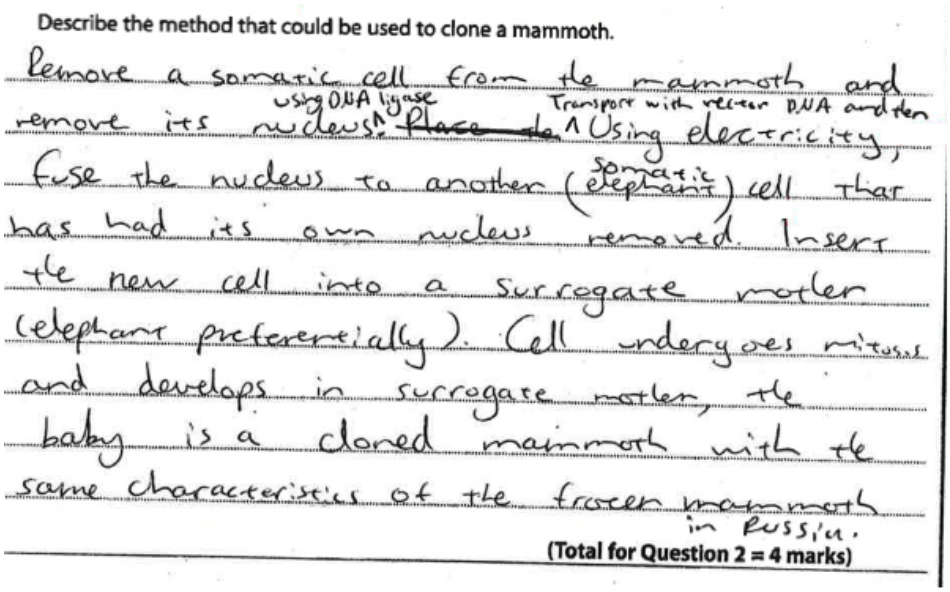
Exemplar Question 5

Student Response A



Describe the method that could be used to clone a mammoth.

Remove a somatic cell from the mammoth and remove its nucleus using DNA ligase ~~Place~~ Transport with vector DNA and then Using electricity, fuse the nucleus to another (elephant somatic) cell that has had its own nucleus removed. Insert the new cell into a surrogate mother (elephant preferentially). Cell undergoes mitosis and develops in surrogate mother, the baby is a cloned mammoth with the same characteristics of the frozen mammoth in Russia.

(Total for Question 2 = 4 marks)

4/4

Examiner Comments
All 4 marks awarded
Line 2 MP2 use electricity to fuse nucleus into cell
Line 4 MP1 mammoth cell nucleus put into enucleated (elephant) egg cell
Line 5 MP6 use of surrogate
Line 6 MP3 cell undergoes mitosis

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Exemplar Question 5

Student Response B

Describe the method that could be used to clone a mammoth.

They could use the ovum of an elephant and remove the genetic information from it, then insert the genetic information from the bone cells into the empty ovum. They could then stimulate dividing by giving the ovum a small eletric shock, and once it had formed into an embryo, insert it into the womb of a surrogate female elephant to carry the developing clone until it's born.

4/4

Examiner Comments
Very Good response scores 4 max but with 5 clear points.
Line 4 MP1 genetic information (I would prefer nucleus) from mammoth put into empty elephant ovum
Line 6 MP2 stimulate division by giving electric shock.
Line 7 MP4 becomes embryo.
Line 7 MP5 insert into womb
Line 7 MP6 of surrogate elephant.

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Exemplar Question 5

Student Response C

Describe the method that could be used to clone a mammoth.

~~A bone cell can be taken from the thigh bone.~~

An egg cell from a modern day elephant must be taken and the nucleus must be removed. The bone cell taken from the thigh bone must be inserted into the egg cell. ~~therefore, egg~~ this egg cell must be implanted in the uterus of a female elephant (surrogate mother) the egg cell will develop into a mammoth that is genetically identical to the frozen mammoth found in Russia. this is because the egg cell contained the nucleus of the bone cell with the specific DNA of the frozen mammoth.

3/4

Examiner Comments
Scores 3 marks
Line 2 no credit for bone cell inserted as no reference to nucleus.
Line 4 MP5 into uterus
Line 4 MP6 of surrogate mother
Line 9 now allow reference to nucleus of bone so award MP1.

Exemplar Question 6

5 The DNA molecule codes for the production of proteins in cells.

(a) Describe the structure of a DNA molecule.

(3)

.....

.....

.....

(i) DNA is used as a template for protein synthesis.

Which of the following is the correct sequence for this synthesis?

(1)

Chetna Somaiya 3/3/2016 16:33
Comment [1]: insert arrows at typesetting stage

[ ] **A** DNA → transcription → mRNA → translation → amino acid chain

[ ] **B** amino acid chain → mRNA → transcription → DNA → translation

[ ] **C** DNA → translation → mRNA → transcription → amino acid chain

[ ] **D** mRNA → translation → transcription → amino acid chain → DNA

(ii) A codon is made of three bases. There are four different bases.

How many different codons can be produced?

(1)

(i) Describe how a mutation in the DNA of a cell can affect the functioning of an enzyme.

(3)

.....

.....

.....

(ii) Explain why some mutations have little effect on the phenotype of an organism.

(2)

.....

.....

.....

(iii) State one factor that will increase the incidence of mutations.

(1)

(Total for Question 5 = 11 marks)

Question number	Answer	Mark
5(a)	A description that makes reference to three of the following points: • helix (1) • double stranded (1) • paired bases (1) • A with T and C with G (1)	3

Question number	Answer	Mark
5(b)(i)	A	1

Question number	Answer	Mark
5(b)(ii)	$4^3 = 64$	1

Question number	Answer	Mark
5(c)(i)	A description that makes reference to three of the following points: • change in the order of bases/equivalent (1) • leads to different codon (1) • different amino acid in protein (1) • different-shaped enzyme/change to active site/enzyme not made/equivalent (1)	3

Question number	Answer	Mark
5(c)(ii)	An explanation that makes reference to two of the following points: • change in base may code for same amino acid (1) • amino acid may not be involved in active site (1) • enzyme still made/still functions/equivalent (1) • could be recessive allele (1) • so not expressed in phenotype (1)	2

Question number	Answer	Mark
5(c)(iii)	An answer that makes reference to x-rays/ultraviolet radiation/gamma radiation/tar/ carcinogens/equivalent	1

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Exemplar Question 6

Part (a)

Student Response A

(a) Describe the structure of a DNA molecule.

(3)

A DNA molecule is a double helix consisting of complimentary base pairs; cytosine and guanine, adenine and thymine each on opposite strands, linked by hydrogen bonds. The sequence of DNA enables protein synthesis and some section of the molecule code for proteins. → in ribosomes.

The DNA is wound around histone protein which influence how heavily the DNA is expressed.

3/3

Examiner Comments
Very good example clearly shows 4 marking points.
Line 1 MP2 molecule described as double
Line 1 MP1 molecule described as helix.
Line 1 MP3 reference to base pairs between
Line 2 MP4 adenine and thymine and cytosine and guanine.

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Exemplar Question 6

Part (c) (i)

Student Response A

(c) (i) Describe how a mutation in the DNA of a cell can affect the functioning of an enzyme.

(3)

This could cause a change in the order of the bases, which could lead to a different amino acid being produced. Therefore, this could cause a change in shape to an enzyme, which could cause it to be less effective at breaking down a particular substance

3/3

Examiner Comments
Good example scores 3
Line 1-2 MP1 change in the order of bases
Line 2-3 MP3 leads to different amino acid being produced
Line 5 MP4 causes production of different-shaped enzyme.

Part (c) (i)

Student Response B

(c) (i) Describe how a mutation in the DNA of a cell can affect the functioning of an enzyme.

(3)

The DNA codes for how the active sidde of the enzyme is produced therefore if the mutation alters the protein coding then the shape of the active site will change as these proteins make up the enzyme. And so therefore the substrate won't be able to fit into the active site and the enzyme won't function.

1/3

Examiner Comments
Only scores MP4 for correct reference to change in active site.
No credit for line 3 alter protein as no reference to amino acids being changed.

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Exemplar Question 6

Part (c) (i)

Student Response C

(c) (i) Describe how a mutation in the DNA of a cell can affect the functioning of an enzyme.

(3)

A mutation in the DNA means that 8 different amino-acids are formed and therefore different proteins. The enzyme will not be able to catalyse the substrates because its active site is going to change shape

2/3

Examiner Comments
Scores 2
Line 2 MP3 different amino acids formed.
Line 4 MP4 changes shape of active site.

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Exemplar Question 6

Part (c) (ii)

Student Response A

(ii) Explain why some mutations have little effect on the phenotype of an organism.

[2]

Some mutations may occur in the recessive gene and so could not be seen in the phenotype

2/2

Examiner Comments
Scores 2
Line 1 – 2 MP4 could be recessive gene (would prefer allele)
Line 3 MP5 not shown in phenotype

Part (c) (ii)

Student Response B

(ii) Explain why some mutations have little effect on the phenotype of an organism.

(2)

some mutations have little effect on the phenotype of an organism as they can be present in the recessive allele. They are only expressed in the phenotype of a homozygous individual for that mutation and since that is only a 25% they have little effect

2/2

Examiner Comments
Scores 3 nicely composed.
Line 1 MP4 little effect on phenotype
Line 3 MP5 as present in recessive allele.

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Exemplar Question 6
Part (c) (ii)

Student Response C

(ii) Explain why some mutations have little effect on the phenotype of an organism.

(2)

This is because ~~most mutations~~ although some mutations lead to a change in nitrogenous base sequence in one triplet due to a substitution or inversion, ~~there are sometimes~~ there are more than one ~~amino acid~~ triplet sequence coding for the same amino acid. Therefore, the protein, ~~structure~~ is not unaltered and it codes for the same ~~function~~ physical feature/characteristic.

1/2

Examiner Comments

Scores only 1 for MP1 change in base may code for same amino acid lines 1-4.

No credit for protein not unaltered as suggests it will change.