

Human Biology

Unit: F225: Genetics, Control and Ageing: Medium banded candidate style answer.

Introduction

OCR has produced these candidate style answers to support teachers in interpreting the assessment criteria for the new GCE specifications and to bridge the gap between new specification release and availability of exemplar candidate work.

This content has been produced by senior OCR examiners, with the input of Chairs of Examiners, to illustrate how the sample assessment questions might be answered and provide some commentary on what factors contribute to an overall grading. The candidate style answers are not written in a way that is intended to replicate student work but to demonstrate what a “good” or “excellent” response might include, supported by examiner commentary and conclusions.

As these responses have not been through full moderation and do not replicate student work, they have not been graded and are instead, banded “medium” or “high” to give an indication of the level of each response.

Please note that this resource is provided for advice and guidance only and does not in any way constitute an indication of grade boundaries or endorsed answers.

1 Homeostasis is essential if the body is to remain healthy. Both the endocrine and the nervous systems control the homeostatic mechanisms in the body.	
(a) Explain what is meant by the term <i>homeostasis</i>.	
[2]	
<i>Candidate style answer</i>	<i>Examiner's commentary</i>
<i>The ability to maintain a constant internal environment such as temperature and pH. It usually involves negative feedback and works very quickly.</i>	Good answer providing evidence for high marks.

(b) In the table below, list <u>four</u> differences between the endocrine and nervous systems.											
[4]											
<i>Candidate style answer</i>	<i>Examiner's commentary</i>										
<table border="1"><thead><tr><th>endocrine system</th><th>nervous system</th></tr></thead><tbody><tr><td><i>1 Chemical messages</i></td><td><i>Electrical messages</i></td></tr><tr><td><i>2 Slow responses</i></td><td><i>Fast responses</i></td></tr><tr><td><i>3 Uses glands</i></td><td><i>Uses nerves</i></td></tr><tr><td><i>Messages travel in blood</i></td><td><i>Messages travel in cells</i></td></tr></tbody></table>	endocrine system	nervous system	<i>1 Chemical messages</i>	<i>Electrical messages</i>	<i>2 Slow responses</i>	<i>Fast responses</i>	<i>3 Uses glands</i>	<i>Uses nerves</i>	<i>Messages travel in blood</i>	<i>Messages travel in cells</i>	Some marks can be awarded for the answers provided in row one and two. The third response is too vague and the fourth response is again imprecise in the use of terms. A lack of use of scientific terminology e.g. neurones/ axons has limited the marks in this question.
endocrine system	nervous system										
<i>1 Chemical messages</i>	<i>Electrical messages</i>										
<i>2 Slow responses</i>	<i>Fast responses</i>										
<i>3 Uses glands</i>	<i>Uses nerves</i>										
<i>Messages travel in blood</i>	<i>Messages travel in cells</i>										

(c)(i) State the exact site of insulin secretion in the pancreas.		[1]
<i>Candidate style answer</i>	<i>Examiner's commentary</i>	
<i>Islets of Langerhans</i>	Whilst the area is correct it is not the <u>specific</u> location and no mark can be awarded.	

(ii) State the stimulus which causes insulin secretion.		[1]
<i>Candidate style answer</i>	<i>Examiner's commentary</i>	
<i>High glucose levels in the blood</i>	Correct answer.	

(d) Suggest <u>three</u> recommendations which might be given by a GP to a patient in order to reduce the risk of Type 2 diabetes developing.		[3]
		[Total: 11]
<i>Candidate style answer</i>	<i>Examiner's commentary</i>	
1 <i>To keep a healthy body weight</i> 2 <i>Not to eat too much sugary foods</i> 3 <i>To take regular exercise</i>	Reference to exercise is correct. The comment regarding sugary food is too imprecise and needs to be qualified with the term refined sugar. The first answer is also vague and fails to use terms such as a high BMI or obesity.	

2 An understanding of the structure and function of the nervous system explains some of the social problems associated with Alzheimer's disease.

(a) Fig. 2.1 is a diagram of a motor neurone.

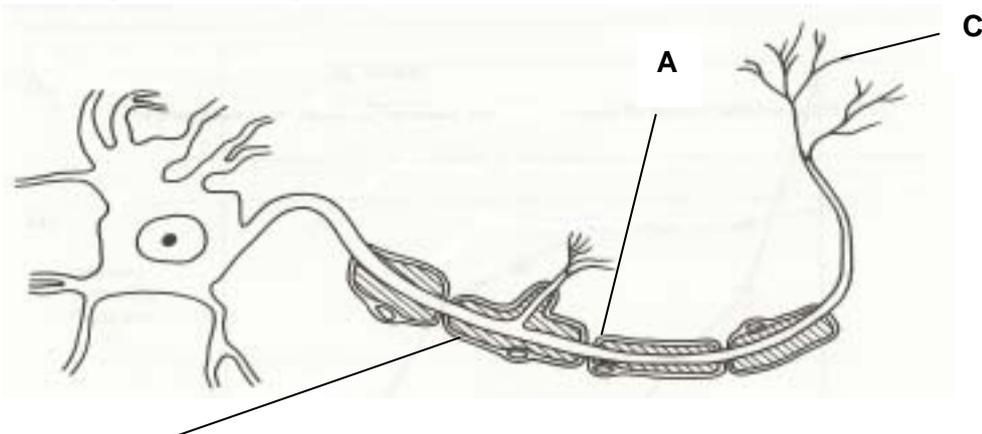


Fig. 2.1

(i) Indicate, by drawing an arrow on Fig. 2.1, the direction in which the nerve impulse travels.

[1]

Candidate style answer

Examiner's commentary



This question has been omitted by the candidate. Teachers could encourage candidates to check through their paper at the end of the examination and strike through the mark indicator ([1]) to double check they have attempted each question.

(ii) Name the structures labelled A to C.

[3]

Candidate style answer

Examiner's commentary

- A Node of Ranvier
- B Synapse
- C Schwann cell

Only structure A has been correctly identified and hence one mark would be awarded. The answer for B is too vague as is that for answer C.

(iii) State two ways in which the motor neurone in Fig. 2.1 differs from a sensory neurone

[2]

Candidate style answer

Examiner's commentary

1. The cell body will be in the middle of the cell not at one end
2. It will make a synapse with a muscle or gland rather than another neurone

The candidate has correctly given two differences and would gain high marks.

(b) Neurones have sodium-potassium pumps.	
(i) Where are these pumps situated?	
[1]	
<i>Candidate style answer</i>	<i>Examiner's commentary</i>
<i>In the cell membrane</i>	Correct answer.

(ii) What is the immediate source of energy used to drive the sodium-potassium pumps?	
[1]	
<i>Candidate style answer</i>	<i>Examiner's commentary</i>
<i>Glucose</i>	Incorrect answer. No marks would be awarded.

(c) Studies have shown that about 5% of the neurones in the part of the brain called the hippocampus disappear with each decade after the age of 50.	
For every 100 neurones present in the hippocampus at age 50, calculate how many will be present by the age of 70. Show your working.	
[2]	
<i>Candidate style answer</i>	<i>Examiner's commentary</i>
Answer = .91	In this case, this candidate would gain high marks as they have the correct answer. However, by not showing their working, had they used the correct method but recorded an incorrect answer, they could not be credited with the method mark.

(d) Fig. 2.2 shows diagrams of neurones from the hippocampus in people aged 50, 60 and 70 years, and in a 70 year old with Alzheimer's disease.	
Fig. 2.2	
Using the information in Fig. 2.2	
(i) describe the change in the appearance of dendrites in <u>healthy</u> people with increasing age;	
[2]	
<i>Candidate style answer</i>	<i>Examiner's commentary</i>

At 50 the dendrites are about 140µm, at 60 they are longer at about 200µm and at 70 they are even longer at about 250µm . However a person with Alzheimer's has shorter dendrites and they are only about 110µm	Some mark points have been met.
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(ii) comment on the appearance of the dendrites in the person with Alzheimer's disease.	
[2]	
<i>Candidate style answer</i>	<i>Examiner's commentary</i>
<i>They are more spaced out and less dense as well as being shorter</i>	Some mark points have been met.

(e) Outline the <u>social</u> problems to the individual <u>and</u> to society of a patient with Alzheimer's disease.	
In your answer, you should make clear how the problems for an individual result in problems for society.	
[9]	
[Total: 23]	
<i>Candidate style answer</i>	<i>Examiner's commentary</i>
<i>Alzheimer's is a long term and degenerative disease. At the moment there is no genetic known cause. If a person has Alzheimer's they are often muddled and not sure what they are doing. They forget who their family is and do not remember how to carry out normal things such as how to make a cup of tea. They can not remember things such as which day of the week it is and other things that have happened that day. This makes it hard for their family as it is hard to find your parent does not know who you are and often the child has to become the parent and look after the person with Alzheimer's. If they have their own children and a full time job then they may have to decide if they should put the person into a care home. They may have to take more days off work to be able to look after them and then they may lose their job and not be able to look after their own children. Also different people in the family may disagree about who has to look after them or if they should be put into a home which may cause an argument in the family.</i>	<p>The candidate has made a fair attempt at answering the two aspects to the question. For the first part they have provided evidence of some of the problems for the individual. However, they have misunderstood the second part of the question and focussed on the effect on the family rather than the wider society, hence only one mark is given for the reference to the anguish for the family. The QWC mark cannot be awarded in this case.</p> <p>To improve this answer the candidate could be encouraged to answer in bullet points, segregate their answer into two sections. Teachers are also advised to spend time clarifying and reinforcing the terms ethical, social and moral as this is an area in which many candidates struggle.</p>

3 The thyroid gland is composed of numerous follicles. Each follicle consists of a single layer of epithelial cells surrounding a lumen.

The lumen is filled with a large glycoprotein, known as thyroglobulin.

Lysosomes degrade thyroglobulin to produce thyroxine which is released into the blood.

Fig. 3.1 shows an epithelial cell in the wall of the thyroid follicle with an adjoining capillary

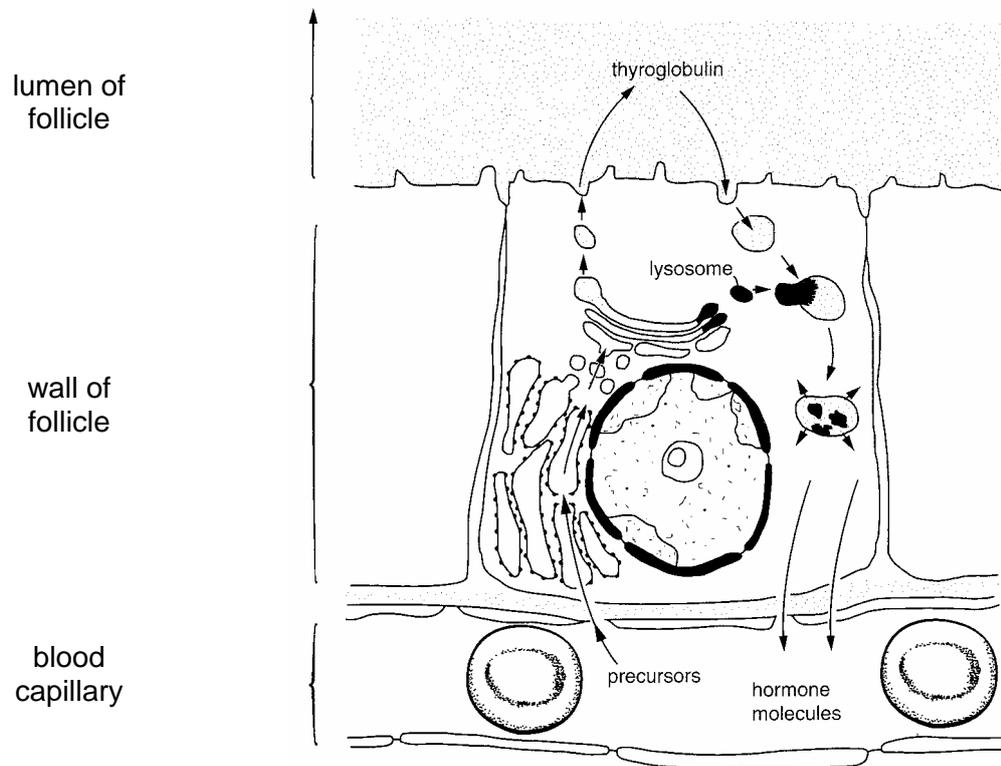


Fig. 3.1

(a)(i) Suggest two substances that must enter the epithelial cell of the follicle to form thyroglobulin

[2]

<i>Candidate style answer</i>	<i>Examiner's commentary</i>
<p>1 <i>protein</i> 2 <i>carbohydrate</i></p>	<p>Full marks cannot be awarded as only 1 answer correct.</p>

(ii) Suggest how the lysosomes degrade the thyroglobulin to form thyroxine.

[3]

<i>Candidate style answer</i>	<i>Examiner's commentary</i>
<p><i>Thyroglobulin will be broken down by enzymes which are found in the lysosomes. Then the useful substances are reused and the waste products are removed from the cell.</i></p>	<p>No marks are awarded as there is insufficient detail on the type of enzymes or detail of how thyroglobulin is broken down. This is a synoptic question as well as an application question and is targeted at the higher ability candidates. Middle ability candidates should be encouraged to think about what they know from units F221 and F222 regarding enzymes and cell organelles.</p>

(iii) Explain why thyroxine is stored as thyroglobulin.		[2]
<i>Candidate style answer</i>	<i>Examiner's commentary</i>	
<i>This means it can be stored in the body and not broken down and wasted</i>	Some marks awarded.	

(a) Myxoedema occurs in adults when the thyroid gland is not producing enough thyroxine. The effect of this condition is a lowered Basal Metabolic Rate (BMR), and poor resistance to cold environmental temperatures.

Table 3.1 shows the effect on BMR, resting pulse rate and body mass of administering a single dose of thyroxine on day 0 to an adult with myxoedema.

Table 3.1

	time after administering thyroxine / days					
	0	4	8	12	16	20
BMR / percentage of normal	55	70	95	100	95	85
body mass / kg	65	62	62	61	61	60

(i) Calculate the % change in body mass between day 0 and day 20.

[2]

<i>Candidate style answer</i>	<i>Examiner's commentary</i>
Answer = 7%	No marks are awarded as the candidate has rounded down incorrectly and as no working has been shown then the method mark cannot be awarded.

(ii) Outline how the changes in BMR and body mass result from the administration of thyroxine.

[4]

<i>Candidate style answer</i>	<i>Examiner's commentary</i>
<p><i>BMR</i> <i>Thyroxine increases the rate of respiration as it usually produces heat as a waste product which can be used to raise the body temperature. It also makes the heart rate increase</i></p> <p><i>body mass</i> <i>If a person is carrying out more respiration then the glucose and fat will be used up quicker which means they will not store as much and so the person will not have as high body mass.</i></p>	High marks are awarded for this clear and concise answer:

(iii) Explain the relationship between BMR and body temperature.		[2]
<i>Candidate style answer</i>	<i>Examiner's commentary</i>	
<i>As the BMR goes up the body temperature also goes up as heat is produced as a waste product. This can be used in homeostasis to help regulate the body temperature</i>	Good answer.	

(iv) At one time this condition was treated with thyroid gland extract rather than manufactured thyroxine.		
Suggest the <u>disadvantages</u> of using thyroid gland extract to treat myxoedema		
		[2]
[Total: 17]		
<i>Candidate style answer</i>	<i>Examiner's commentary</i>	
<i>Different glands may have different amounts of thyroxine and so it might not be enough or it might be too much for one person e.g. a child. Some people may object to being given somebody else's tissue for example for religious reasons.</i>	Good answer.	

4 Analysis of the substances contained in a urine sample is useful in monitoring kidney function.			
(a) Table 4.1 shows the mean concentration of some of the substances in blood plasma, the glomerular filtrate and urine of an individual, over 24 hours.			
Table 4.1			
	mean concentration / g dm ⁻³		
solutes	plasma	glomerular filtrate	urine
protein	80.00	10.00	10.00
glucose	3.00	3.00	2.00
(i) Name the process which forms <u>the glomerular filtrate</u> in the Bowman's capsule.			[1]
<i>Candidate style answer</i>	<i>Examiner's commentary</i>		
<i>Ultrafiltration</i>	One mark can be awarded.		

(ii) Table 4.1 shows an abnormally high concentration of protein and glucose in the urine.

Suggest an explanation for the abnormal concentration of:

[6]

Candidate style answer	Examiner's commentary
<p><i>protein</i></p> <p><i>The proteins must be getting through the basement membrane but as they are large it must mean the membrane has been damaged</i></p> <p><i>glucose.</i></p> <p><i>The person may have diabetes which means they can not control their sugar levels properly and any extra glucose comes out in the urine. This is because they may have a poor diet with too much sugar in it and there is no insulin to control it.</i></p>	<p>Some mark points have been met for the protein question, and high mark points for the glucose question.</p>

(b) Chronic kidney failure can be caused by inflammation that damages the glomeruli (glomerulonephritis).

Describe the process of haemodialysis as a treatment for kidney failure

 **In your answer, you should make clear how the steps in the process are sequenced.**

[7]

Candidate style answer	Examiner's commentary
<p><i>Haemodialysis involves the blood being diverted into a machine from the person's vein. The machine then makes sure that the blood flows at the right speed and that no clots occur by passing it through a clot trap which acts as a filter. There is also a bubble trap that makes sure no air gets passed back into the person which could be fatal. When the blood is in the machine it passes over a permeable membrane. Any extra salt and glucose is removed down their concentration gradient and then the right level is restored. Water is also able to move by osmosis until it is at its correct concentration. When the blood is returned to the patient it has been kept warm at body temperature and had all the waste material removed from it. The blood has to go through the machine lots of times to make sure it is cleaned properly. It can be very expensive and also time consuming. However, without this the patient is likely to die before a</i></p>	<p>This candidate has made a fair attempt at the question providing evidence.</p> <p>As with F221 and F222 the nature of the A2 specification is to be based on 'real-world' Human Biology. This means that procedures and techniques from learning outcomes can be examined in all units. Candidates can be encouraged to have a separate notebook to make notes for such procedures. Candidates should be encouraged to make bullet point methods of ~15 steps which can be followed by another student. If this is collated during the course of the GCE it will not only become a useful revision resource but an invaluable reference book for general use.</p>

<i>transplant can be found so it improves their life span and quality of life for a while.</i>	
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(c) Kidney stones can result in a reduction in the flow of urine along the ureter. Analysis of kidney stones using electron microscopes has shown that many contain bacteria. The bacteria cause calcium salts to precipitate out, forming the kidney stone.
(i) suggest why electron microscopes are needed to see the bacteria. [2]

<i>Candidate style answer</i>	<i>Examiner's commentary</i>
<i>They are too small to see without it</i>	No mark can be awarded as the answer is too vague.

(ii) suggest one type of treatment that could reduce the risk of kidney stones. [1]
[Total: 17]

<i>Candidate style answer</i>	<i>Examiner's commentary</i>
<i>Antibiotics can be given by a doctor.</i>	One mark can be awarded.

5 (a) Genes of the major histocompatibility (HLA) system code for glycoproteins. In transplant surgery, a mismatch occurs when a glycoprotein is present in the transplant but not in the recipient.

Fig. 5.1 shows the mean percentage of first transplants surviving the first five years after transplant surgery. The transplants have one, three or five glycoprotein mismatches with the recipient.

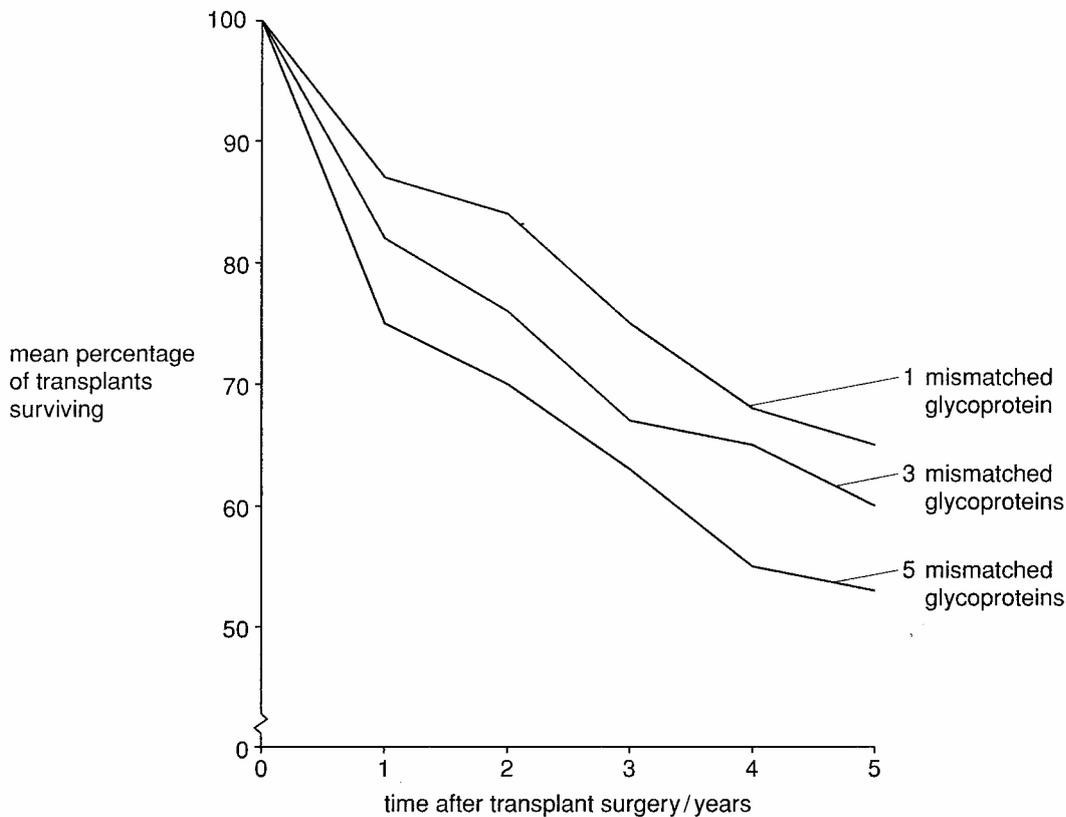


Fig. 5.1

(i) Describe the roles of the glycoproteins coded for by the HLA loci.

[3]

Candidate style answer	Examiner's commentary
<i>Glycoproteins act as cell surface markers and antigens. They are specialised types of ptoeins which have had a carbohydrate molecule added onto them. This is normally carried out by the golgi apparatus and occurs after the cell has made the protein in the ribosomes.</i>	Basic mark can be awarded. This is a sound attempt at the answer but the candidate has focused on the wrong aspect of cell biology.

(ii) Explain the differences in the percentage survival of transplants shown in Fig. 5.1.

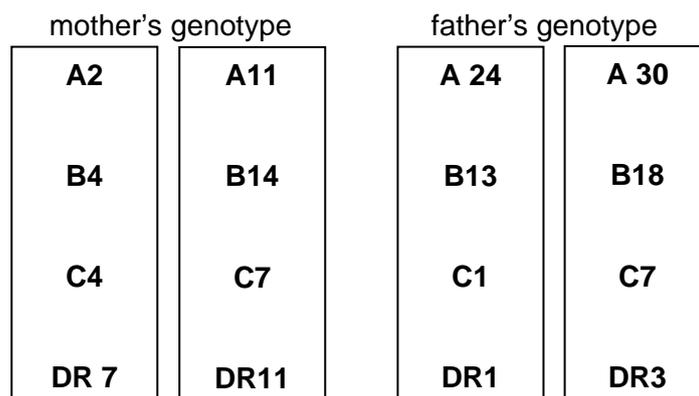
[4]

Candidate style answer	Examiner's commentary
<i>The more glycoproteins that are mismatched then the more transplants fail and the survival rate goes down. For example after 4 years if there is one</i>	Same marks can be awarded. However the candidate has only really touched on the surface of this answer – candidates should be encouraged to give details using key

<p><i>mismatched then 70% survive, but if there are 5 mismatched then only 55% survive. This is because more of the cells are recognised as foreign and this makes the immune system attack the transplanted tissue/organ. The doctors must make sure that there is as close a match as possible to increase the chance of survival. All patients will have to take immunosuppressants for the rest of their lives to try and prevent rejection from happening.</i></p>	<p>terminology from the AS unit such as memory cells, antigen, clonal selection and clonal expansion and the role of specific cells within the immune system such as T and B lymphocytes.</p> <p>It should also be noted that initially the candidate has misinterpreted the command word of the question and focused their answer on describing the data rather than explaining the reasons for the trends in the data. Students should be referred to the list of command questions in the appendix of the specification by their teacher(s). A suitable task to reinforce this is to provide students with a graph from a previous paper and ask them to write two different mark schemes: one for a describe question and one for an explain question. This can then be discussed to reinforce not only the content but also the differences in outcomes required.</p>
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<p>(iii) If the first transplant fails, a second transplant is necessary</p>	
<p>Suggest why individuals who had received a second transplant were not included in the survey.</p>	
<p style="text-align: right;">[3]</p>	
<p><i>Candidate style answer</i></p> <p><i>Their immune systems will already be weakened because of the immunosuppressants and so they are more likely to get an infection and die anyway. Also the immune system will react quicker this time.</i></p>	<p><i>Examiner's commentary</i></p> <p>This has been well thought through by the candidate and some marks can be supported. This is a good attempt at such a question.</p>

(b) The diagram below shows a mother's and father's HLA genotypes at four of the six HLA loci.



(i) State the term given to one haploid HLA genotype.

[1]

<i>Candidate style answer</i> <i>haplotype</i>	<i>Examiner's commentary</i> One mark can be awarded.
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(ii) Complete Fig. 5.2 to show one possible HLA genotype of a child of the couple.

[1]

<i>Candidate style answer</i>	<i>Examiner's commentary</i>								
<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="border: 1px solid black; padding: 5px; width: 50%; text-align: center;">A...2..</td> <td style="border: 1px solid black; padding: 5px; width: 50%; text-align: center;">A..24.</td> </tr> <tr> <td style="border: 1px solid black; padding: 5px; text-align: center;">B...4..</td> <td style="border: 1px solid black; padding: 5px; text-align: center;">B..13..</td> </tr> <tr> <td style="border: 1px solid black; padding: 5px; text-align: center;">C...4..</td> <td style="border: 1px solid black; padding: 5px; text-align: center;">C...1..</td> </tr> <tr> <td style="border: 1px solid black; padding: 5px; text-align: center;">DR...7.</td> <td style="border: 1px solid black; padding: 5px; text-align: center;">DR..1..</td> </tr> </table> <p style="text-align: center; margin-top: 10px;">Fig. 5.2</p>	A...2..	A..24.	B...4..	B..13..	C...4..	C...1..	DR...7.	DR..1..	<p>Correct answer.</p>
A...2..	A..24.								
B...4..	B..13..								
C...4..	C...1..								
DR...7.	DR..1..								

(iii) State the probability of the child having the HLA genotype chosen in (ii).

[1]

<i>Candidate style answer</i> 1:4	<i>Examiner's commentary</i> No marks can be awarded. This is actually a ratio, which in itself is incorrect (benefit of the doubt may have been given had the answer been given as 1:3). Ratios should be given as a value of less than 1 or as a percentage.
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(c) Explain why the number of possible HLA genotypes of the child is very limited.		[2]
		[Total: 15]
<i>Candidate style answer</i>	<i>Examiner's commentary</i>	
<i>They are all on chromosome 6 which is a certain size. They are also very close together which means they take up a small amount of space on the chromosome</i>	As evidence is present for mark points, high mark awarded.	

6 The risk of developing breast cancer increases in post menopausal women.		
(a) Outline the methods used to treat cancer of the breast.		[4]
<i>Candidate style answer</i>	<i>Examiner's commentary</i>	
<i>Breast cancer can be treated by a drug called Tamoxifen which affects oestrogen. Surgery can also be carried out.</i>	Basic answer The candidate would have gained more marks if their second statement had outlined the types of surgery possible.	

(b)(i) Explain the use of HRT in treating symptoms of the menopause.		[5]
<i>Candidate style answer</i>	<i>Examiner's commentary</i>	
<i>Replacement hormones are given in HRT including oestrogen and progesterone. This is to stop the symptoms which occur when a woman has the menopause such as mood swings, a dry vagina and night sweats. The woman takes the hormones either as a patch or as a tablet and may have to be one them for a very long time which can cause the risk of other diseases but it may also protect her from osteoporosis.</i>	Only basic marks can be awarded for two correct symptoms and the explanation. More detail on the reason why it is administered was required for higher marks..	

(ii) Explain the link between the use of HRT and the prevalence of breast cancer.		[2]
<i>Candidate style answer</i>	<i>Examiner's commentary</i>	
<i>If a woman uses HRT for too long she will have a higher risk of breast cancer</i>	The candidate should have used the number of marks available to guide their answer in terms of the level of detail required.	

<p>(c) One cause of ageing involves changes in the chromosomes. The ends of chromosomes are protected by identical repeating lengths of DNA called <u>telomeres</u>.</p> <p>These prevent the chromosomes unravelling during cell division. Each time a cell divides, the length of the telomeres shortens and the ability of the cell to divide decreases. This is part of the ageing process.</p> <p>(i) Suggest why it may be an advantage if ‘the ability of the cell to divide decreases’.</p> <p style="text-align: right;">[2]</p>	
<i>Candidate style answer</i>	<i>Examiner’s commentary</i>
<i>If a cell is less likely to divide it will decrease the chance of getting cancer.</i>	To gain more marks, the candidate should have used the number of marks available to guide their answer in terms of the level of detail required.

<p>(ii) Explain how an <u>enzyme</u>, such as telomerase, adds repeating units of DNA to the telomere.</p> <p style="text-align: right;">[4]</p> <p style="text-align: right;">[Total: 17]</p> <p style="text-align: right;">[Paper Total 100]</p>	
<i>Candidate style answer</i>	<i>Examiner’s commentary</i>
<i>A telomerase enzyme will bind the DNA in its active site and then cause a reaction which will join on extra DNA units to the DNA strand. This will make the DNA longer and will mean the next time that the cell divides even if it loses a telomere its overall length will still be longer as it has had extra units already added on. This will then mean it is less likely to keep dividing.</i>	This is a weak answer in which the candidate has failed to focus on the main point of the question which is how the enzyme is likely to work rather than the advantage of the process.

Overall Rating: Medium standard.

Overall Comments: This candidate has gained a mark typical of a good, middle ability candidate. There are key areas in which this candidate can improve.

Use of more specific key terms. Some of these are indicated by bold font in the specification. Increased detail using the number of marks available as a guide to the number of points required. Underlining command questions and key words in the question to focus the answer in the correct area.

More use of synoptic knowledge from F221, F222 and F224.

Care to show the mathematical workings and rounding of numbers.

Ensuring all questions have been attempted and not overlooked.

Use of bullet points and flow diagrams to aid the construction of clear and concise answers, especially in areas which are conceptually hard to visualise and learn.