Human Biology

Unit: F225: Genetics, Control and Ageing: High 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 *homeostasis.*

[2]

Candidate style answer	*Examiner's commentary*
The body uses homeostasis to control its own internal conditions and ensure they stay in narrow limits. If a factor goes above or below the set limit e.g. temperature then the .homeostatic process will start and using negative feedback it will bring the factor back to within the correct range. It will use glands and muscles to do this.	Two marks can be awarded for providing evidence for mark points 1 and 3.

(b) In the table below, list <u>four</u> differences between the endocrine and nervous systems.

[4]

Candidate style answer

endocrine system	nervous system
1 Messages are sent around the body in the form of chemicals in the plasma	*The messages are sent as impulses which travel in and between nerve cells*
2 The body responds slowly	*The body is quick to respond and this is good when the body is in danger*
3 The chemicals last a long time in the plasma so the effect is long term until they are broken down	*The impulses travel at a rate of 100 ms^{-1} and their effect is very short lived*
4 The hormones only react with one specific cell	*The impulse can travel down different nerve cells*

Examiner's commentary

Some marks can be awarded for the answers provided in the first three rows. The last response is too vague. A lack of use of scientific terminology has limited the marks in this question. In row 1, this candidate could have gained more marks had they referred to *<u>electrical</u>* impulses in their response.

(c)(i) State the exact site of insulin secretion in the pancreas.

[1]

Candidate style answer	*Examiner's commentary*
β cells	Correct answer

(ii) State the stimulus which causes insulin secretion.

[1]

Candidate style answer	*Examiner's commentary*
Hyperglycaemia	Correct answer

(d) Suggest three **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]

Candidate style answer	*Examiner's commentary*
1 To maintain a BMI in the normal range *2 To eat small meals and frequent*	These three clear statements would be awarded high marks.

meals with more slow release CBH than fast release CBH *3 Take lot of exercise on a regular basis*	

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.

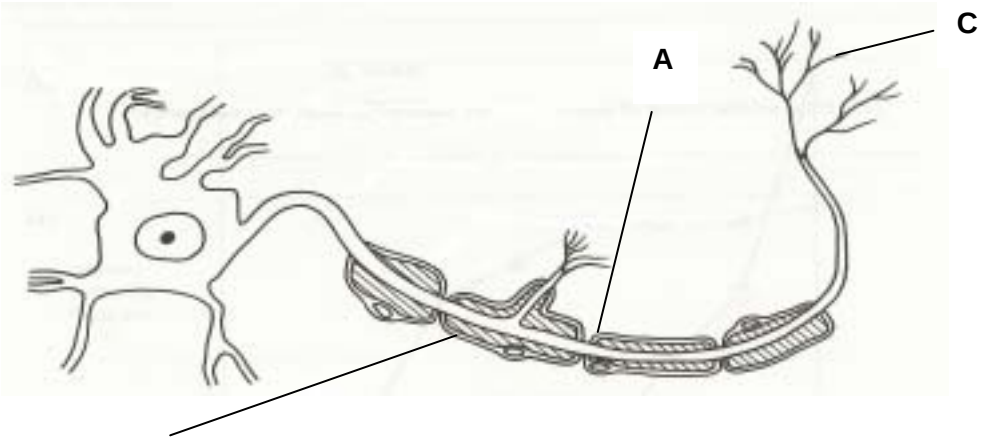
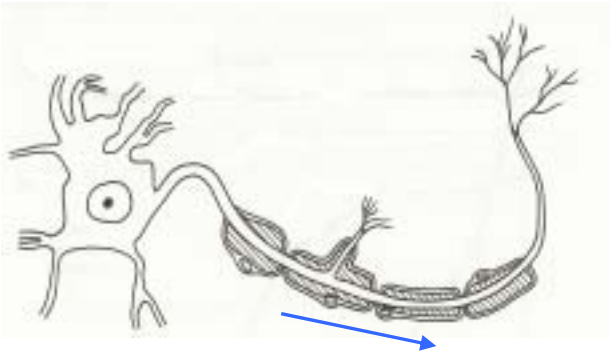


Fig. 2.1

(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*
	One mark would be awarded.

(ii) Name the structures labelled A to C.

[3]

Candidate style answer	*Examiner's commentary*
A..*Node of Ranvier* **B..***Synaptic bulb* **C..***Schwann cell nucleus*	A and C have been correctly identified and some marks would be awarded.

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

[2]

Candidate style answer	*Examiner's commentary*
1. The axon is much longer than the dendrons in a motor neurone (they are more similar in a sensory neurone *2. It has a large cell body at the end of the neurone and not small and in the middle*	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]

Candidate style answer	*Examiner's commentary*
In the cell membrane	Correct answer.

(ii) What is the immediate source of energy used to drive the sodium-potassium pumps?

[1]

Candidate style answer	*Examiner's commentary*
ATP	Correct answer.

(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]

Candidate style answer	*Examiner's commentary*
Answer = *.90.8*	An excellent answer gaining high marks.

(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.

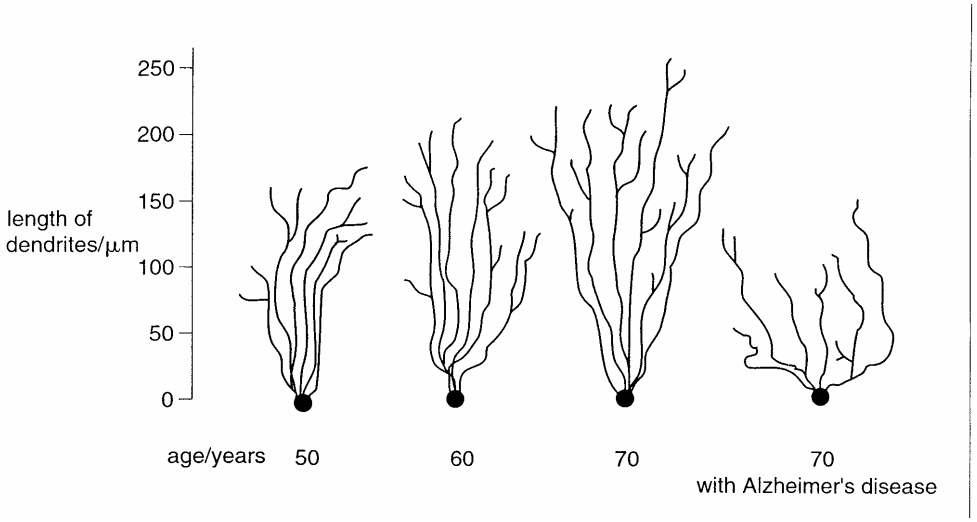


Fig. 2.2

Using the information in Fig. 2.2

(i) describe the change in the appearance of dendrites in healthy **people with increasing age**;

[2]

Candidate style answer	*Examiner's commentary*
In a healthy person as they get older the dendrites get longer. They increase from approximately 175μm at 40 years of age to approximately 250μm when they are 70. There are also more dendrites in total.	Basic answer.

(ii) comment on the appearance of the dendrites in the person with Alzheimer's disease.

[2]

Candidate style answer	*Examiner's commentary*
The pattern of the dendrites is more branched in the person without Alzheimer's. The dendrites are also much shorter (even shorter than that of a 40 year old person)	Again two mark points have been met (mark point 1 and 4).

(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]

Candidate style answer	*Examiner's commentary*
Alzhimer's disease has many different symptomsthat will affect how a person is able to cope in society for example: ** they have a short term memory and can not do as much for themselves* ** they lose the ability to control their hands and fingers which means they can do less jobs in their own home* ** they forget who their friends and family are which means they have a poorer social life* ** they lose the ability to speak clearly and so they become more withdrawn from society* ** they are more forgetful and become more dependent on other people* *All of these symptoms mean that society has to change to cope with more people*	The candidate has made a very good attempt at answering the two aspects of the questions. They have split their answer into two sections tackling both aspects equally and also showing a good use of bullet points and scientific terms. This answer would gain high marks for describing the effects on the person in society, and also high marks for the effect on society. As they have linked more than one problem to a social problem they also gain the QWC mark.

with Alzheimer's diseases such as: ** building more care homes and residential homes to look after them* ** putting more funding into the NHS to enable them to be treated and looked after* **..the family of the person also has to cope with the situation and they may need support and counselling which also costs money*	

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

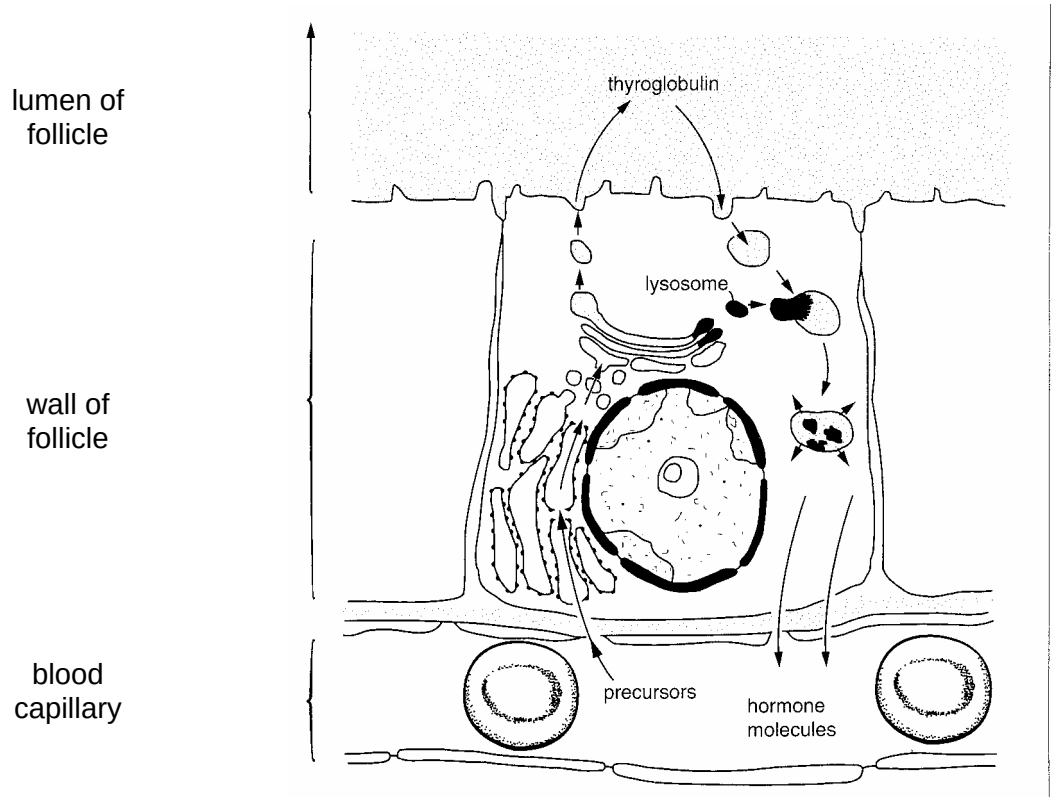


Fig. 3.1

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

[2]

Candidate style answer	*Examiner's commentary*
1..*amin oacids* **2..***carbohydrate*	Correct answer.

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

[3]

Candidate style answer	*Examiner's commentary*
After the Thyroglobulin has entered the cell (by endocyostosis) it will be broken down by a specific enzyme. I think it will hydrolyse the molecule into smaller molecules which can then be reused to save energy.	Some marks can be awarded.

(iii) Explain why thyroxine is stored as thyroglobulin.

[2]

Candidate style answer	*Examiner's commentary*
Thyroxine is a reactive molecule whereas thryoglobulin is not and so it means it can be stored by the body rather than excreted which would be wasteful.	Two marks can be awarded for mark point 1 and 3.

(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]

Candidate style answer	*Examiner's commentary*
Answer = *7.6%*	Correct answer.

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

[4]

Candidate style answer	*Examiner's commentary*
BMR *A person's BMR will be increased by thyroxine. It will make the body temperature increase as well which will*	In the BMR section the candidate provides evidence for some points in the body mass section they provide the correct answer. Overall they will gain high marks.

also make the rate at which chemical reactions occur go faster e.g. respiration. It will also increase the rate at which enzymes and proteins are made. body mass If the BMR increases then the cells will need more respiratory substrates which will use up glucose and lipids faster and if necessary protein. This means the cells will store less fat and the person is less likely to be obese and hence they will have. a lower BMI	

(iii) Explain the relationship between BMR and body temperature.

[2]

Candidate style answer	*Examiner's commentary*
The relationship between the BMR and body temperature is that as the BMR increases so does the body temperature which is because most chemical reactions such as respiration are exothermic and release heat which causes the temperature of the surroundings to go up.	Clear and concise answer showing a good level of understanding.

(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]

Candidate style answer	*Examiner's commentary*
There may be ethical objections as well a problem with getting enough of the extract to meet the demand required. If it is made by genetic engineering the product will always be of the same standard and also much more of it can be made.	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]

Candidate style answer	*Examiner's commentary*
Ultrafiltration	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*
protein *If the person has high blood pressure this may damage the Bowmans Capsule and the basement membrane may also be damaged. This might mean that some proteins can get out into the proximal convoluted tubule and enter the urine.* *glucose.* *If the person is diabetic then they do not make enough insulin and so any glucose in the blood is not controlled in the same way. Some of the glucose then passes out into the filtrate as there is too much of it in the blood to be able to be controlled.*	Good answer for the protein question, and some marks awarded for the glucose question.

(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*
1. A person must be taken into hospital to ensure there is proper care for them *2. A surgeon will sew an artery and vein together to make a pocket* *3. The blood is then taken out of the vein and passed into the machine* *4. The machine warms the blood to 37^{0}C and also pumps it to keep it moving* *5. The blood passes over a semi-permeable membrane which keeps the blood one* *.side and the dialysis fluid on the other – it must not be allowed to mix.* *6. Any large molecule such as red blood cells and protein will not pass through the membrane but any extra water or extra ions or extra glucose will pass down their concentration gradients out of the blood into the dialysis fluid.* *Depending on how much gluose, water and ions are in the dialysis fluid it will draw more* *or less out of the blood which can be made right for each patient* *7. When this has happened many times the blood is filtered and returned to the body* *8. The blood is also mixed with an anticoagulant to stop it from clotting in the machine. The machine has several alarms on it which will tell the nurse if anything goes wrong e.g. if there is a clot, if there is an air bubble, if it is too cold, if it is flowing too fast or slow or if there is a fault with the machine.*	This candidate has made an excellent attempt at the question providing evidence for many mark points and gaining high marks as well as the QWC mark.

(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]

Candidate style answer	*Examiner's commentary*
An EM has a higher resolution than an LM and bacteria are smaller and human cells	There is good evidence of scientific terminology from the AS units F221.

(ii) suggest one type of treatment that could reduce the risk of kidney stones.

[1]

[Total: 17]

Candidate style answer	*Examiner's commentary*
Antibiotics	One mark can be awarded.

5 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.

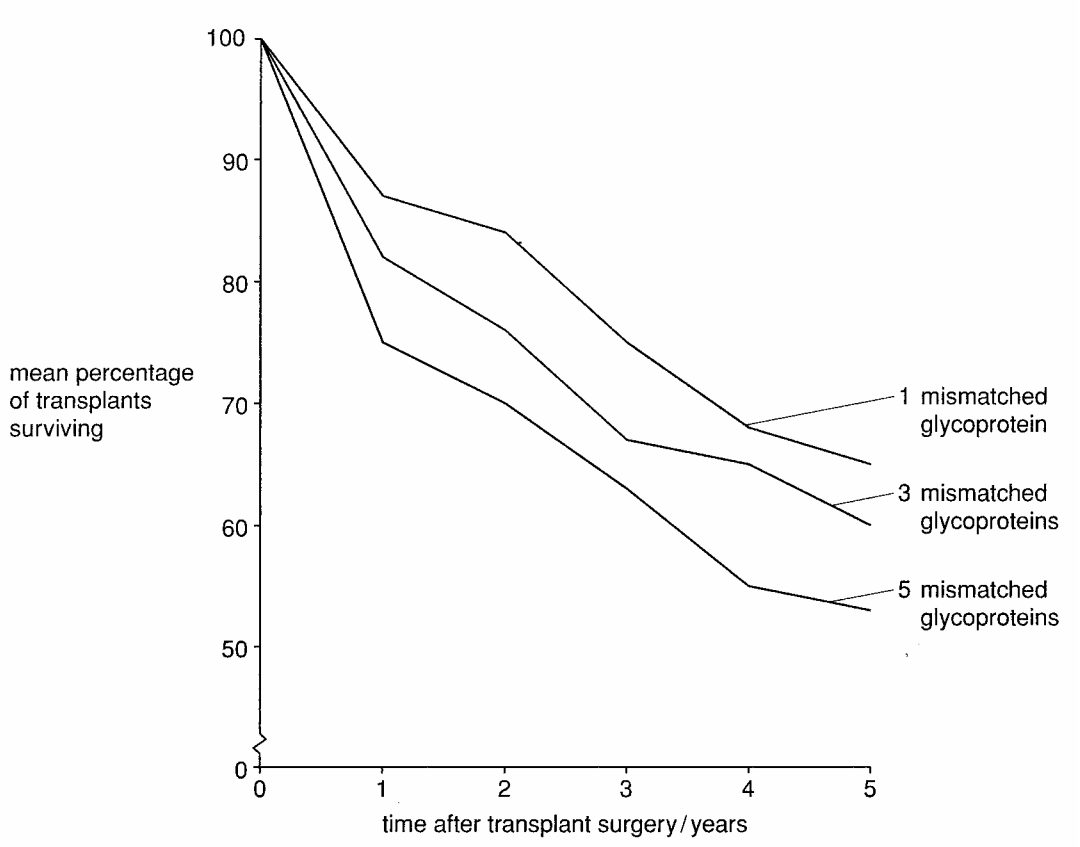


Fig. 5.1

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

[3]

Candidate style answer	*Examiner's commentary*
Glycoproteins act as antigens which promote an immune response in the body. They are found in the cell membrane of all human cells. The immune system will react by clonal selection and clonal expansion of the specific B lymphocyte which will then make and release antibodies at a rate of 2000 per second..	This is an excellent answer showing good recall of synoptic facts and correct use of appropriate scientific terminology.

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

[4]

Candidate style answer	*Examiner's commentary*
There is a lower chance of survival if there is poorer match in the glycoproteins because there will be more glycoproteins acting as antigens. This means more B cells will be selected by clonal selection. Each one that is selected will then divide by mitosis to make specific plasma cells which then each make one specific antibody. This them means there will be more antibodies in the patients blood which will bind to the antigens on the new organ and so there is a higher chance of rejection and the patient not surviving even if they do take immunosuppressants.	Some marks can be awarded. It should be noted that this answer cannot be credited with mark point 1 as this was awarded in (i).

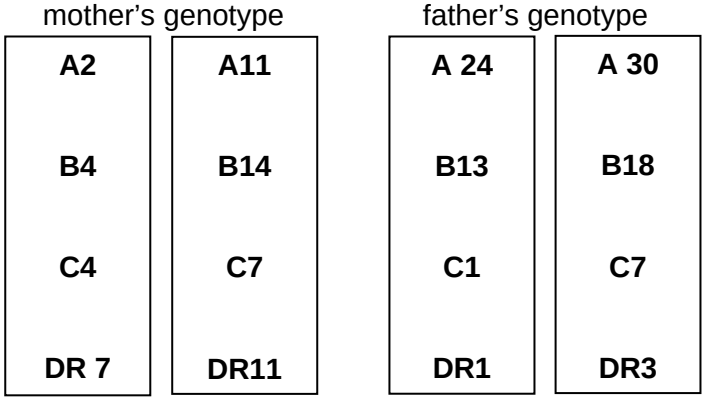
(iii) If the first transplant fails, a second transplant is necessary

Suggest why individuals who had received a second transplant were not included in the survey.

[3]

Candidate style answer	*Examiner's commentary*
If they are having a second transplant then they are likely to be very ill and have a weaker immune system. Also any operation has a risk associated with it if it requires an anaesthetic.	This has been thought through by the candidate.

(a) q 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]

Candidate style answer	*Examiner's commentary*

haplotype	Correct answer.

(ii) Complete Fig. 5.2 to show <u>one</u> possible HLA genotype of a child of the couple.

[1]

Candidate style answer	*Examiner's commentary*
A…*2..* **B…***4..* **C…***4..* **DR…***7.* **A..***24.* **B..***13..* **C…***1..* **DR..***1..* **Fig. 5.2**	One mark can be awarded.

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

[1]

Candidate style answer	*Examiner's commentary*
25%	Correct answer.

(c) Explain why the number of possible HLA genotypes of the child is very limited.

[2]

[Total: 15]

Candidate style answer	*Examiner's commentary*
HLA genes are all found close together on chromosome 6 which means there is little chance of any crossing over occurring One is always inherited from the mother and one from the father.	Some marks can be awarded as evidence is present for. However it is unclear if the candidate is talking about a haplotype or a gene.

6 The risk of developing breast cancer increases in post menopausal women.

(a) Outline the methods used to treat **cancer of the breast.**

[4]

Candidate style answer	*Examiner's commentary*
Breast cancer can be treated by using surgery. Depending on the stage at which it is detected, the woman may have a lumpectomy, where the lump and the tissues around it is removed, or a mastectomy, where the whole breast is removed. After surgery a patient can be given radiation therapy. Chemotherapy is another treatment for breast cancer but this can affect other parts of the body. The drug tamoxifen is also used. It helps to stop the disease	The candidate has demonstrated a good knowledge of the topic and can be awarded high marks.

from spreading.	

(b)(i) Explain the use of HRT in treating symptoms of the menopause.

[5]

Candidate style answer	*Examiner's commentary*
The menopause can be treated by using HRT tablets and patches. The patches are better as they given a more consistent dose and are less likely to be forgotten. They work by replacing the oestrogen and progesterone in the woman's blood. This then means she will be less likely to get the symptoms associated with the disorder such as hot flushes, night sweats and mood swings.	Candidate has named the two correct symptoms and some marks can be awarded for the explanation.

(ii) Explain the link between the use of HRT and the prevalence of breast cancer.

[2]

Candidate style answer	*Examiner's commentary*
The prevalence and incidence of breast cancer go up if women take HRT as there is a correlation between the level of oestrogen and the risk of breast cancer.	The candidate shows good use of HSW as in the correct use of the term correlation.

(c) One cause of ageing involves changes in the chromosomes.
The ends of chromosomes are protected by identical repeating lengths of DNA called telomeres.

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.

(i) Suggest why it may be an advantage if *'the ability of the cell to divide decreases'*.

[2]

Candidate style answer	*Examiner's commentary*
If a person has cancer then it is less likely to spread and become mestastic and if .they do not have cancer they are less likely to develop a tumour	Correct answer.

(ii) Explain how an enzyme, such as telomerase, adds repeating units of DNA to the telomere.

[4]
[Total: 17]
[Paper Total 100]

Candidate style answer	*Examiner's commentary*
The telomerase enzyme will have an active site that is specific for DNA and	This is a good effort by the candidate showing good recall from F221 and good use of key terms. More detail on DNA synthesis could

an extra section of nucleotides. If a successful collision occurs between the active site and the substrates then an ESC will form. The enzyme will then join the DNA to the nucleotide length so the DNA helix will be longer.	have been applied here to gain higher marks.

Overall Rating: High standard.

Overall Comments: This candidate has gained a mark typical of a high ability candidate There are key areas in which this candidate can improve. Use of use of synoptic terminology from F221, F22 and F224. The ability to apply knowledge and understanding to suggest questions which do not require recall but the proposal of a suitable and plausible biological answer to the question. Underlining command questions and key words in the question to focus the answer in the correct area. Use of bullet points and flow diagrams to aid the construction of clear and concise answers.