

**ADVANCED GCE****HUMAN BIOLOGY**

Genetics, Homeostasis and Ageing

**2867**

Candidates answer on the Question Paper

**OCR Supplied Materials:**

None

**Other Materials Required:**

- Electronic calculator
- Ruler (cm/mm)

**Thursday 28 January 2010**  
**Morning**

**Duration: 2 hours**

Candidate Forename		Candidate Surname	
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Centre Number						Candidate Number				
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**INSTRUCTIONS TO CANDIDATES**

- Write your name clearly in capital letters, your Centre Number and Candidate Number in the boxes above.
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure that you know what you have to do before starting your answer.
- Answer **all** the questions.
- Do **not** write in the bar codes.
- Write your answer to each question in the space provided, however additional paper may be used if necessary.

**INFORMATION FOR CANDIDATES**

- The number of marks is given in brackets [ ] at the end of each question or part question.
- The total number of marks for this paper is **120**.
- You will be awarded marks for the quality of written communication where this is indicated in the question.
- You may use an electronic calculator.
- You are advised to show all the steps in any calculations.
- This document consists of **24** pages. Any blank pages are indicated.

Examiner's Use Only:

1			
2			
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7			
<b>Total</b>			

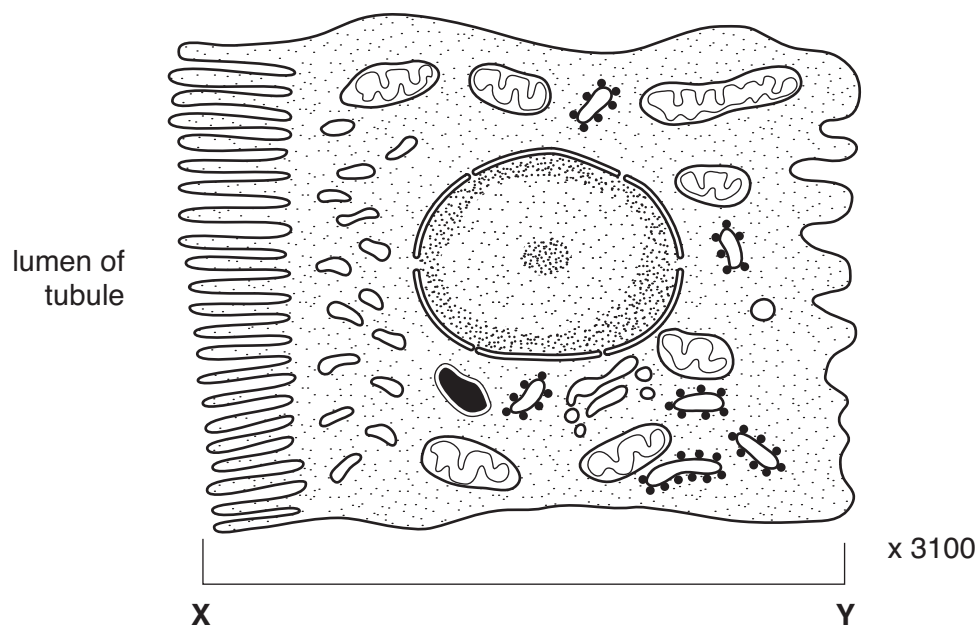
Answer **all** the questions.

1 The kidneys are one of the most important organs in the body.

(a) State **three** functions of the kidney.

- 1 .....
- 2 .....
- 3 ..... [3]

(b) Fig. 1.1 is a diagram of a cell from the proximal convoluted tubule of the nephron.



**Fig. 1.1**

(i) Calculate the actual size of the cell between **X** and **Y**.

Use **appropriate** units for your answer.

Answer = ..... [2]

- (ii) Explain how the cell in Fig. 1.1 is adapted to its function.

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..... [2]

- (iii) Suggest why a diagram of the proximal tubule cell, such as that shown in Fig. 1.1, may be more helpful than a photograph of this cell as seen by an electron microscope when studying cell structure.

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..... [2]

- (c) (i) Explain how blood (hydrostatic) pressure is **increased** in the kidney tubules to produce the glomerular filtrate.

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..... [3]

- (ii) State **two** components that do not normally leave the blood to enter the glomerular filtrate.

1 .....

2 ..... [2]

..... [2]

**2** Diabetes is a chronic disease.

**(a)** Explain what is meant by a *chronic disease*.

..... [2]

**(b)** In this question, one mark is available for the quality of use and organisation of scientific terms.

Individuals who have Type 2 diabetes cannot control their blood glucose concentration.

Outline how the alpha ( $\alpha$ ) **and** beta ( $\beta$ ) cells in the pancreas control blood glucose concentration in people who are not diabetic.

This image shows a full page of white paper with ten horizontal dashed lines, typical of primary school handwriting practice paper. The lines are evenly spaced and extend across the entire width of the page. There is no text or other markings on the paper.

**(c)** Uncontrolled diabetes may cause long-term damage to many body organs. Therefore, individuals with diabetes undergo regular medical tests.

- (i)** Explain why the patient's weight and height are checked.

..... [2]

- (ii) Name **two** substances that will be tested for in the urine of a diabetic patient **and** explain why it is important to know if these substances are present.

*substance 1* .....

*importance if present* .....

.....

.....

*substance 2* .....

*importance if present* .....

.....

..... [4]

- (d) A patient who is diabetic will also be asked to attend a retinopathy clinic once a year. At the clinic a high power photograph is taken of the retina.

- The photograph is examined for any sign of bleeding from the capillaries supplying blood to the retina.
- The retina is also examined to check the health of the macula (fovea).

- (i) Suggest the effect of bleeding from the capillaries supplying the retina.

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..... [3]

- (ii) Explain why the health of the macula (fovea) is particularly important.

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..... [3]

[Total: 22]

- 3 The fossil remains of adult cave dwellers, only three feet tall, have been discovered in Indonesia.

It is thought that they are either:

- an undiscovered species of human (hominid);
- or
- fossils of *Homo sapiens sapiens* who suffered from iodine deficiency during their lives.

(a) The origin of the fossils could be decided by analysing their DNA.

(i) Suggest **one** reason why analysing DNA from fossil remains could be difficult.

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

(ii) Explain why analysis of the DNA would decide whether the fossils are a new species or the same species as *Homo sapiens sapiens*.

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

(b) Iodine is necessary for the production of thyroxine.

Explain why iodine deficiency throughout life could result in humans who are only three feet tall.

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

- (c)** Variations in the concentration of iodine in the urine can be an indication of whether the thyroid gland is working properly.

The efficiency of the thyroid gland was measured in two individuals, **P** and **Q**, by giving a known dose of radioactive iodine.

The percentage of the dose that appeared in the thyroid gland and in the urine was then measured every six hours. The results are shown in Fig. 3.1, opposite.

Look at the two graphs in Fig. 3.1, opposite.

Using the data taken at 6 hours after the dose was given, describe the results for individual **P** and individual **Q** in Fig. 3.1 **and** suggest an explanation for these results.

..... [5]

- (d)** Thyroxine is also involved in the control of body temperature.

The control of body temperature is a homeostatic mechanism.

- (i) Describe the main features of a homeostatic mechanism.**

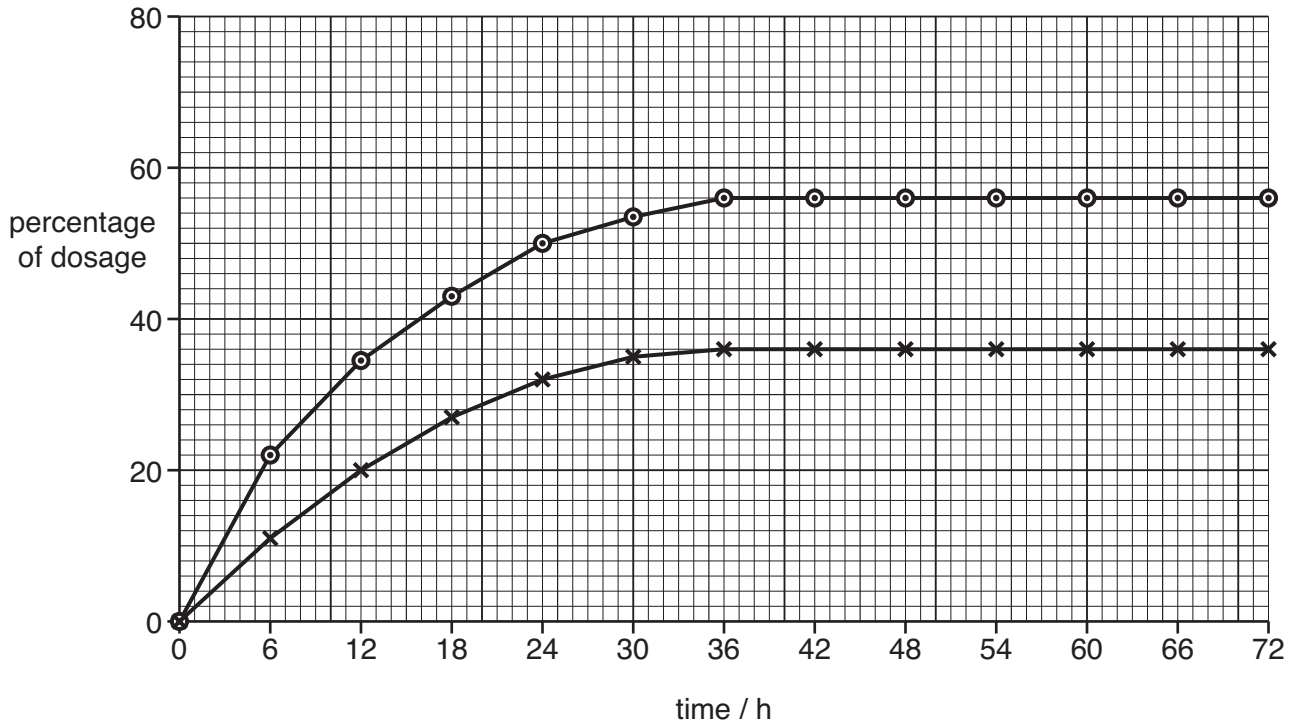
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Key:

—○— in thyroid gland    —×— in urine

individual P



individual Q

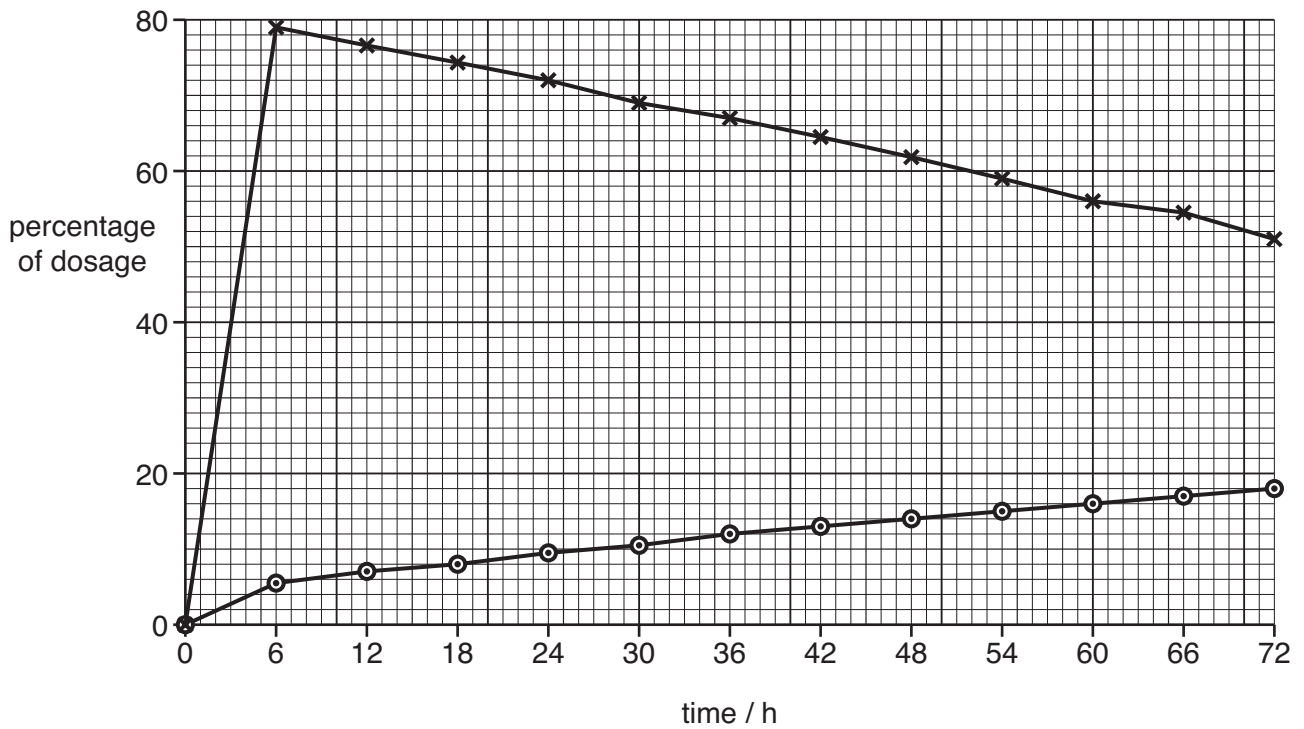


Fig. 3.1

- (ii) Poor control of body temperature can be fatal.

Explain the reasons for this.

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..... [3]

[Total: 15]

- 4 Sickle cell anaemia is caused by a mutation in the gene controlling the synthesis of haemoglobin.

- (a) In this question, one mark is available for the quality of spelling, punctuation and grammar.

Describe how sickle cell anaemia is inherited **and** describe the signs and symptoms of sickle cell **disease**.

You may use labelled genetic diagrams if it makes your answer clearer.

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Quality of Written Communication [1]

- (b) Describe the mutation in DNA that produces the sickle cell allele.

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..... [2]

- (c) The malarial parasite, *Plasmodium*, is less likely to infect erythrocytes containing sickle cell haemoglobin.

The sickle cell allele increases in frequency in areas where malaria is endemic.

- (i) Suggest **one** reason why *Plasmodium* is less likely to infect erythrocytes containing sickle cell haemoglobin.

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..... [1]

- (ii) Explain why the frequency of the sickle cell allele increases in areas where malaria is endemic.

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..... [4]

[Total: 16]

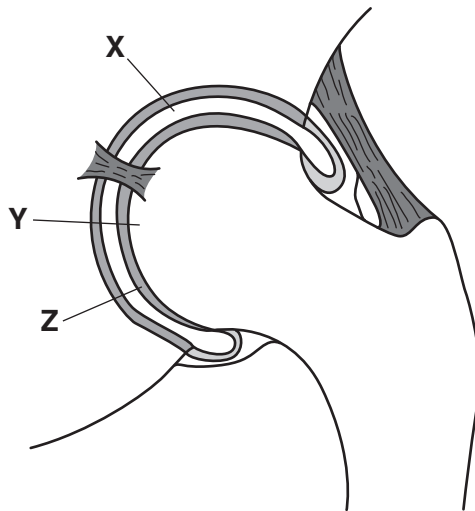
- 5 The effect of ageing on the skeletal system may reduce the quality of life significantly in the elderly.

(a) Suggest **two** ways in which the health of the skeleton can be improved when an individual is **younger**, to reduce the effects of ageing.

1 .....

2 ..... [2]

(b) Fig. 5.1 shows a healthy hip joint with no abnormalities. This joint may become very painful in age-related **osteoarthritis**.



**Fig. 5.1**

(i) With reference to Fig. 5.1, describe the changes that take place in the areas labelled **X**, **Y** and **Z** in an elderly patient with **osteoarthritis**.

**X** .....

.....

**Y** .....

.....

**Z** .....

..... [3]

(ii) State **two** risk factors, **other than ageing**, for osteoarthritis.

1 .....

2 ..... [2]

- (c) Another type of arthritis, **rheumatoid arthritis**, is an autoimmune disease.

The immune system attacks the collagen in the joints as though it was a foreign protein rather than the body's own tissue.

Describe how antibodies recognise **and** destroy the body's own collagen.

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..... [3]

- (d) Suggest how arthritis could be treated.

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..... [2]

- (e) **Osteoporosis** is another bone disease that may occur in older women.

Table 5.1 shows the relationship between age in women and the incidence of fractures of the radius and femur. The data are shown as a percentage of women in each age group, over a five year period.

The results were collected before treatments for osteoporosis were available.

**Table 5.1**

age of women/years	percentage of women with fractures	
	radius	femur
45-49	0.8	0.1
50-54	1.6	0.2
55-59	3.1	0.4
60-64	3.4	0.7
65-69	3.9	1.1
70-74	3.9	2.2
75-79	3.9	3.0
80+	4.2	5.7

- (i) **Explain** the trends shown in Table 5.1.

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..... [3]

- (ii) Suggest why the percentage of fractures for the radius is higher than those for the femur in most age groups.

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..... [1]

**[Total: 16]**

- 6** Advances in medicine have extended human life expectancy and it is no longer unusual to meet individuals who are in their ninetieth year.

However, elderly people may feel frustrated to discover that they react much more slowly than when they were younger.

- (a)** A study was carried out to investigate the speed at which action potentials were transmitted to the jaw muscle in two age groups.

The size of the mean electrical discharge as the jaw muscle contracted was used as an indication of the speed of action potentials.

Table 6.1 shows the results of this study.

**Table 6.1**

age group/years	gender	mean electrical discharge /mV	standard deviation /mV
18-24	male	1.03	0.17
	female	2.11	0.31
78-84	male	0.26	0.04
	female	0.71	0.15

- (i)** Suggest why the standard deviation was included in these data.

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

- (ii)** As an individual ages, the efficiency of the respiratory system is also reduced.

Outline how the reduced efficiency of the respiratory system could account for the results shown in Table 6.1.

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



- (iii) Not all 78 to 84-year-olds develop the slowing of action potentials shown in this study.

Suggest **two** reasons for this.

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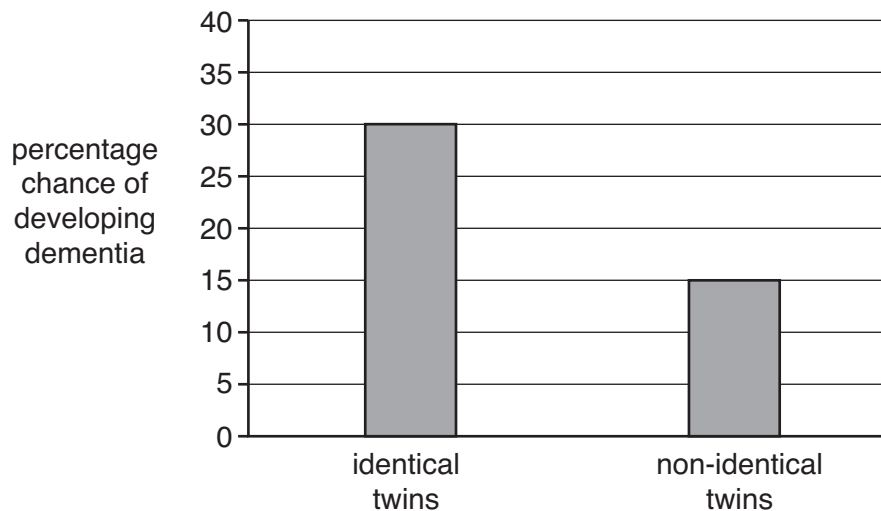
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..... [2]

- (b) Fred lives with his daughter and her family. Fred is worried. He and his twin brother are 86. Fred's twin, who lives alone, has just been diagnosed with dementia.

Fred is frightened that he might soon get dementia himself.

Fig. 6.1 shows the likelihood of the second twin getting dementia if the first twin develops dementia. Data are shown for identical and non-identical twins.



**Fig. 6.1**

- (i) Explain the meaning of the terms,

*identical twin* .....

.....

.....

*non-identical twin.* .....

.....

..... [3]

- (ii) Fred is advised to consult a genetic counsellor about his concerns.

Using the information in the introduction to **(b)** and Fig. 6.1, describe what a genetic counsellor might tell Fred about the chances of **him** getting dementia too.

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..... [3]

- (iii) Describe the changes that Fred could make to his lifestyle and behaviour that could reduce his chances of developing dementia.

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..... [2]

- (c) Recently a new treatment for Alzheimer's disease hit the news headlines around the world.

- At a clinic in America, a patient in the early stages of Alzheimer's disease was first given a range of cognitive tests to assess his memory.
- A drug was then injected directly into the spinal column in the neck region.
- The cognitive tests were then repeated.

An improvement in the test scores was observed after only ten minutes.

- (i) Describe **one** type of cognitive test that could be used to assess the patient's memory.

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..... [1]

- (ii) Explain why injecting the drug directly into the spinal column is a better way to deliver the drug to the brain than injecting it into the general circulation.

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- (iii) Describe **one** ethical problem that should have been considered before this news was made public.

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..... [2]

[Total: 19]

- 7 Prostate cancer is one of the most common cancers in men. Like all cancers, the earlier it is diagnosed the better the chances of recovery.

The prostate specific antigen (PSA) test is the initial test for prostate cancer.

PSA is a protein produced by the prostate gland, which is found in the blood in normal concentrations of  $4 \text{ ng cm}^{-3}$ . This concentration increases as the prostate enlarges.

60% of the men who have a PSA level above  $10 \text{ ng cm}^{-3}$  have prostate cancer.

- (a) Suggest why there is not a national screening programme for prostate cancer.

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..... [3]

- (b) The number of deaths from breast cancer has reduced considerably. However, there has **not** been such a dramatic reduction in the number of deaths from prostate cancer.

Discuss the reasons for this.

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..... [3]

(c) Cells taken from a cancer in the prostate gland are very similar in appearance to stem cells.

(i) Describe **two** similarities and **two** differences between cancer cells and stem cells.

*similarities* .....

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.....

.....

*differences* .....

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..... [4]

(ii) Stem cells may be involved in the development of many cancers.

Suggest why this is likely to be so.

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..... [2]

(d) (i) Explain why stem cells can be used to replace damaged tissues.

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..... [2]

(ii) List **two** sources of human stem cells.

1 .....

2 .....

[2]

[Total: 16]

**END OF QUESTION PAPER**

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