

# OXFORD CAMBRIDGE AND RSA EXAMINATIONS

**Advanced GCE** 

HUMAN BIOLOGY 2867

Genetics, Homeostasis and Ageing

Friday 23 JUNE 2006 Afternoon 2 hours

Candidates answer on the question paper.
Additional materials:
Electronic calculator
Ruler (cm/mm)

| Candidate Name | Centre Number | Candidate<br>Number |
|----------------|---------------|---------------------|
|                |               |                     |

#### TIME 2 hours

### **INSTRUCTIONS TO CANDIDATES**

- Write your name in the space above.
- Write your Centre number and Candidate number in the boxes above.
- Answer all the questions.
- Write your answers, in blue or black ink, in the spaces provided on the question paper.
- Read each question carefully before starting your answer.

### **INFORMATION FOR CANDIDATES**

- The number of marks is given in brackets [] at the end of each question or part question.
- 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.

| FOR EXAMINER'S USE |      |      |  |  |  |
|--------------------|------|------|--|--|--|
| Qu.                | Max. | Mark |  |  |  |
| 1                  | 16   |      |  |  |  |
| 2                  | 21   |      |  |  |  |
| 3                  | 12   |      |  |  |  |
| 4                  | 16   |      |  |  |  |
| 5                  | 18   |      |  |  |  |
| 6                  | 19   |      |  |  |  |
| 7                  | 18   |      |  |  |  |
| TOTAL              | 120  |      |  |  |  |

## Answer all the questions.

| _         | . 1.1 is a diagram of the islets of Langerhans, surrounded by the cells of the pancreas at secrete digestive enzymes. |
|-----------|---|
|           |   |
|           | A diagram has been removed due to third party copyright restrictions  |
| !         | Details:  |
|           | A diagram of the islets of Langerhans, surrounded by the cells of the pancreas that secrete digestive enzymes         |
|           |   |
| <br> <br> |   |
|           |   |
|           |   |
|           | Fig. 1.1  |
| (i)       | Fig. 1.1  Calculate the magnification of Fig. 1.1. Show your working. Give your answer to the nearest whole number.   |
| (i)       | Calculate the magnification of Fig. 1.1.  |
| (i)       | Calculate the magnification of Fig. 1.1.  |
| (i)       | Calculate the magnification of Fig. 1.1.  |
| (i)       | Calculate the magnification of Fig. 1.1.  |
| (ii)      | Calculate the magnification of Fig. 1.1. Show your working. Give your answer to the nearest whole number.             |

| (iii) | Explain how the islets of Langerhans prevent the blood glucose concentration from falling too low. |
|-------|--|
|       |  |
|       |  |
|       |  |
|       |  |
|       |  |
|       | [3]  |
|       |  |

**(b)** Glucose is the main respiratory substrate in cells. Fig. 1.2 shows the molecular structure of alpha glucose.

Fig. 1.2

| Explain why the source of <b>store</b> ( | glucose molecule | e makes it suitat | ole to convert into a |
|--|------------------|-------------------|-----------------------|
|  | <br>             |                   |                       |
|  |                  |                   |                       |
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|  | <br>             |                   |                       |
|  | <br>             |                   |                       |
|  |                  |                   | [31                   |

| ;) | may occur in the body that are characteristic of diabetes mellitus.                           |  |  |  |  |  |  |
|----|---|--|--|--|--|--|--|
|    | Explain how an excess of blood glucose may cause the signs and symptoms of diabetes mellitus. |  |  |  |  |  |  |
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|    | [6]   |  |  |  |  |  |  |
|    | [Total: 16]   |  |  |  |  |  |  |

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**2** (a) Fig. 2.1 shows the mean differences in fertility between men and women from 20 to 80 years of age.

Fertility is expressed as a percentage of the maximum fertility achieved at 30 years of age.

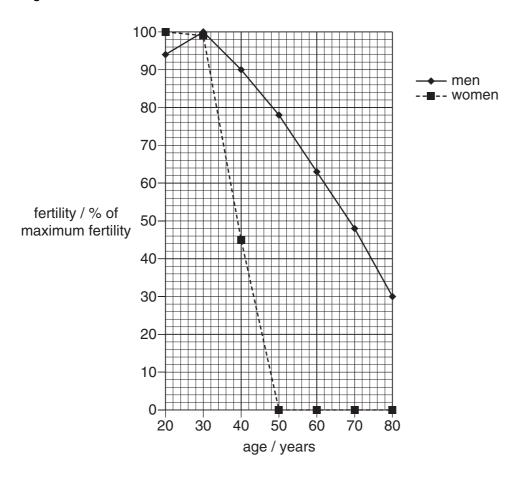


Fig. 2.1

| Using the information in Fig. 2.1, describe the changes in fertility of men and women as they become older. |
|---|
|   |
|   |
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| [3]   |

|     | (ii)    | Suggest reasons for the difference in fertility between men and women aged 40.   |
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|     |         |  |
|     | <b></b> | [3]  |
| (b) | (1)     | As a woman ages, she is more likely to have twins than a younger woman.  |
|     |         | Suggest a reason for this.   |
|     |         |  |
|     |         |  |
|     |         | [1]  |
|     | (ii)    | Identical twins are produced when one zygote splits into two, whilst non-identical twins are produced from two separate zygotes. |
|     |         | Many studies have been conducted comparing non-identical twins with identical twins.   |
|     |         | Explain why these studies are useful.  |
|     |         |  |
|     |         |  |
|     |         |  |
|     |         |  |
|     |         | [3]  |
| (c) | (i)     | Describe three signs or symptoms of the menopause.   |
|     |         | 1  |
|     |         |  |
|     |         | 2  |
|     |         |  |
|     |         | 3  |
|     |         | [3]  |

| Explain how HRT helps to relieve the symptoms of the menopause.      |
|--|
|  |
|  |
|  |
| Explain how the hormones used in HRT cross cell membranes.           |
|  |
| [  |
| Describe the cyclic <b>and</b> the continuous methods of taking HRT. |
| cyclic   |
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| appliqueus   |
| continuous   |
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| [Total: 2  |

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|     | The name given to modern humans is <i>Homo sapiens sapiens</i> . |  |  |     |  |  |  |
|-----|--|--|--|-----|--|--|--|
| (a) | (i)  | Explain the  | Explain the meaning of the term <b>species</b> . |     |  |  |  |
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|     |  |  |  | [3] |  |  |  |
|     | (ii)   | State the complete taxonomic grouping of Homo sapiens sapiens. |  |     |  |  |  |
|     |  | Kingdom  |  |     |  |  |  |
|     |  | Phylum   |  |     |  |  |  |
|     |  | Class  |  |     |  |  |  |
|     |  | Order  |  |     |  |  |  |
|     |  | Family   |  |     |  |  |  |
|     |  | Genus  |  |     |  |  |  |
|     |  | Species  | sapiens sapiens                                  | [3] |  |  |  |

|     | 11   |   |                                   |                |                  |                |          |
|-----|------|---|-----------------------------------|----------------|------------------|----------------|----------|
| (b) |      | A number of biochemical techniques are used to determine how closely related humans are to other primates such as gorillas, orangutans and gibbons. |                                   |                |                  |                |          |
|     | (i)  | Albumin is found in the blood plasma of all primates including humans.  |                                   |                |                  |                |          |
|     |      | Explain why differences in the albumin of primates are useful in working out how closely related primates are.                                      |                                   |                |                  |                |          |
|     |      |   |                                   |                |                  |                |          |
|     |      |   |                                   |                |                  |                |          |
|     |      |   |                                   |                |                  |                | •••••    |
|     |      |   |                                   |                |                  |                |          |
|     | (ii) |   | s for human albuse albumin of clo |                |                  | umin from bloo | d plasma |
|     |      |   | shows the result                  | -              |                  |                | albumin  |
|     |      | from the bl   | ood plasma of h                   | umans and thre | e other primates | 5.             |          |
|     |      | r   |                                   | Table 3.1      |                  |                | 1        |
|     |      |   | human                             | gorilla        | orangutan        | gibbon         |          |
|     | 1 -  | %<br>ecipitation<br>albumin   | 100                               | 95             | 85               | 82             |          |
|     |      | Evolain the   | results shown i                   | n Tahle 3 1    |                  |                | l        |
|     |      | Lxpiairi trie   | results shown i                   | ii iabie 5.1.  |                  |                |          |
|     |      |   |                                   |                |                  |                |          |
|     |      |   |                                   |                |                  |                |          |
|     |      |   |                                   |                |                  |                |          |
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|     |      |   |                                   |                |                  |                |          |

.....[4]

[Total: 12]

4 Nail patella syndrome is a rare genetic disease, which causes deformity or absence of some or all of the nails and the absence of the patella (knee-cap).

Fig. 4.1 shows a pedigree from an affected family. The ABO blood groups of the members of the family are also shown.

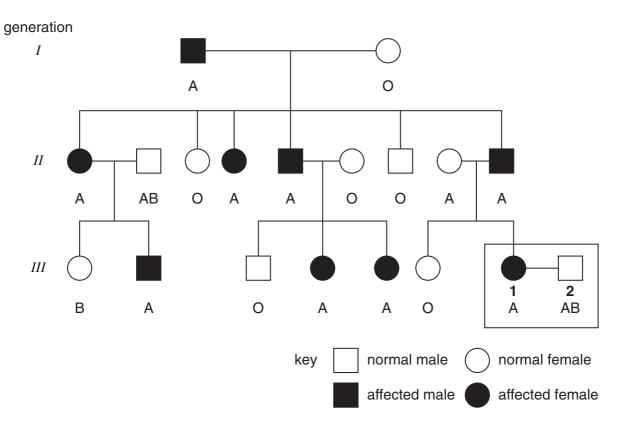


Fig. 4.1

(a)

| (i)  | i) Using the symbols <b>N/n</b> for the nail patella locus and <b>I<sup>A</sup></b> / <b>I<sup>B</sup></b> / <b>I<sup>O</sup></b> for the ABO b group locus, state the genotype of the parents in <i>generation I</i> . |  |     |  |  |
|------|---|--|-----|--|--|
|      | male  |  |     |  |  |
|      | female  |  | [4] |  |  |
| (ii) | State an  | nd explain the type of inheritance shown by nail patella syndrome. |     |  |  |
|      |   |  |     |  |  |
|      |   |  |     |  |  |
|      |   |  |     |  |  |
|      |   |  |     |  |  |
|      |   |  | [3] |  |  |

| (b) | In this question, one mark is available for the quality of spelling, punctuation and grammar.  |
|-----|--|
|     | The individuals in <i>generation III</i> , shown in the box on Fig. 4.1, are hoping to have children. They decide to consult a genetic counsellor before they do so. Individual 1 has nail patella syndrome and this condition has occurred several times in her family. |
|     | Describe the information that the genetic counsellor could give individuals <b>1</b> and <b>2</b> about the inheritance of this condition <b>and</b> the advice that they might be given before starting a family.   |
|     | You will gain marks if you use information given in Fig. 4.1.  |
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|     | F03  |
|     | Overlity of Written Communication [1]  |
|     | Quality of Written Communication [1]   |
|     | [Total: 16]  |

5

| The         | The kidney helps to regulate blood chemistry and removes toxic waste from the body. |   |     |
|-------------|---|---|-----|
| (a)         | Fig.  | 5.1 shows a vertical section through a kidney.                    |     |
|             |   |   |     |
| į           | Ad  | iagram has been removed due to third party copyright restrictions |     |
| į           |   | Details:  |     |
|             |   | A diagram of a kidney   |     |
| <br> <br> - |   |   |     |
|             |   | Fig. 5.1  |     |
|             | (i)   | State which of the letters indicate the                           |     |
|             |   | medulla   |     |
|             |   | pelvis  | [2] |

|     | (11) | The arrows of Fig. 5.1 indicate tiffee types of fluid that flow tiffought the kidney.   |
|-----|------|---|
|     |      | Identify the <b>fluid</b> indicated by each arrow <b>and</b> explain the importance of this fluid.  |
|     |      | <b>—</b>  |
|     |      |   |
|     |      | importance  |
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|     |      | importance  |
|     |      |   |
|     |      | [6]   |
| (b) | To f | unction efficiently, the kidney must maintain a high blood pressure in the glomerulus.  |
|     | (i)  | Explain how high blood pressure in the glomerulus is maintained.  |
|     | (-)  |   |
|     |      |   |
|     |      |   |
|     |      | [2]   |
|     | (ii) | Suggest <b>two</b> circumstances that could cause the blood pressure in the glomeruli to fall low enough to prevent the kidneys working normally. |
|     |      | 1   |
|     |      |   |
|     |      | 2   |
|     |      | [2]   |
|     |      |   |

| OII | trolled by the nervous system.   |
|-----|--|
| ig. | 5.2 is a diagram of a reflex arc.  |
|     |  |
| 4   | A diagram has been removed due to third party copyright restrictions   |
|     | Details:   |
|     | A diagram of a reflex arc  |
|     |  |
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|     | Fig. 5.2   |
| _   | Fig. 5.2   |
| m   | Fig. 5.2 all babies do not have conscious control of their bladders.   |
|     |  |
|     | all babies do not have conscious control of their bladders.  Using the information in Fig. 5.2, describe how a small baby removes urine from its |
|     | all babies do not have conscious control of their bladders.  Using the information in Fig. 5.2, describe how a small baby removes urine from its |
|     | all babies do not have conscious control of their bladders.  Using the information in Fig. 5.2, describe how a small baby removes urine from its |
|     | all babies do not have conscious control of their bladders.  Using the information in Fig. 5.2, describe how a small baby removes urine from its |
|     | all babies do not have conscious control of their bladders.  Using the information in Fig. 5.2, describe how a small baby removes urine from its |
|     | all babies do not have conscious control of their bladders.  Using the information in Fig. 5.2, describe how a small baby removes urine from its |
| i)  | Using the information in Fig. 5.2, describe how a small baby removes urine from its bladder.   |

[Total: 18]

.....[2]

- 6 The function of growth hormone is to regulate growth in all parts of the body.
  - Children with a growth hormone deficiency do not increase their height at the normal rate.
  - Unless the deficiency is treated before puberty, they remain unusually short throughout life.
  - The children are treated with regular doses of genetically engineered growth hormone.
  - (a) In this question, one mark is available for the quality of use and organisation of scientific terms.

Outline how the human growth hormone gene may be inserted into a bacterium such as

| gene need not be given. |  |
|-------------------------|--|
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| [8]                     |  |

Quality of Written Communication [1]

**(b)** A six-year-old boy was brought to an outpatient clinic by his mother, to be investigated for growth hormone deficiency.

The boy's height was below the height at the tenth centile on a growth chart.

The doctor ordered the following investigations:

- the family history regarding their height
- blood tests to test for malnutrition
- CT scans to check for tumours or brain trauma

| (i)   | Explain the meaning of the phrase 'below the height at the tenth centile'.            |
|-------|---|
|       |   |
|       | [2]   |
| (ii)  | Suggest the importance of each of the investigations ordered by the doctor.           |
|       | family history  |
|       |   |
|       |   |
|       | tests for malnutrition  |
|       | tests for maintainion   |
|       |   |
|       |   |
|       | CT scans of the brain   |
|       |   |
|       |   |
| /!!!\ |   |
| (iii) | Explain why it is important to diagnose and treat the boy's condition before puberty. |
|       |   |
|       |   |
|       | [2]   |

[Total: 19]

7 (a) The brains of patients with Alzheimer's disease contain amyloid plaques. The plaques are made from an **abnormal** form of the protein called *tau*. It is not known what the function of the **normal** form of this protein is.

Scientists have been developing a vaccine to prevent or destroy amyloid plaques. One type of vaccine prevented plaque formation or reduced the size of existing plaques in mice that had been genetically engineered to form amyloid plaques.

| (i)  | Vaccines stimulate the production of antibodies.   |
|------|--|
|      | Explain how a vaccine could prevent or destroy amyloid plaques.                                    |
|      |  |
|      |  |
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|      |  |
|      | [4]  |
| (ii) | Describe the risks involved in using this vaccine on humans to prevent or destroy                  |
| (")  | Describe the risks involved in using this vaccine on humans to prevent or destroy amyloid plaques. |
| (,   |  |
| ()   |  |
| (,   |  |
| ()   |  |
| ()   |  |
|      | amyloid plaques.   |
| Age  | amyloid plaques  |
| Age  | ing is one factor which increases the risk of developing Alzheimer's disease.                      |

Question 7 continues on page 20

(b)

| (c) |      | In the United Kingdom, life expectancy has shown a steady increase. As the body ages there is a reduction in the efficiency of some organs and tissues. |  |  |
|-----|------|---|--|--|
|     | (i)  | Outline the effect of ageing on the sense organs and peripheral nervous system.   |  |  |
|     |      |   |  |  |
|     |      |   |  |  |
|     |      |   |  |  |
|     |      |   |  |  |
|     |      |   |  |  |
|     |      | [4]   |  |  |
|     | (ii) | Discuss the <b>social</b> consequences of an ageing population to society.  |  |  |
|     |      |   |  |  |
|     |      |   |  |  |
|     |      |   |  |  |
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|     |      |   |  |  |
|     |      | [5]   |  |  |
|     |      | [Total: 18]   |  |  |
|     |      | END OF QUESTION PAPER   |  |  |
|     |      |   |  |  |

Copyright Acknowledgements:

Question 1 Fig. 1.1 Atlas of Histology p74 © Freeman and Bracegirdle 1996 Second Edition Heinemann London 1967

Question 5 Fig. 5.1 A Level Biology Phillips and Chilton P152 OUP 1991 ISBN 0199140898

Question 5 Fig. 5.2 Foundation Biology Mary Jones and Dennis Taylor P76 CUP 1994 ISBN 052 41993

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