

Centre Number						Candidate Number				
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Other Names										
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For Examiner's Use	
Examiner's Initials	
Question	Mark
1	
2	
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10	
TOTAL	



General Certificate of Education
Advanced Subsidiary Examination
June 2010

Human Biology

HBIO2

Unit 2 Humans – their origins and adaptations

Tuesday 8 June 2010 9.00 am to 10.30 am

For this paper you must have:

- a ruler with millimetre measurements
- a calculator.

Time allowed

- 1 hour 30 minutes

Instructions

- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- You may ask for extra paper. Extra paper must be secured to this booklet.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information

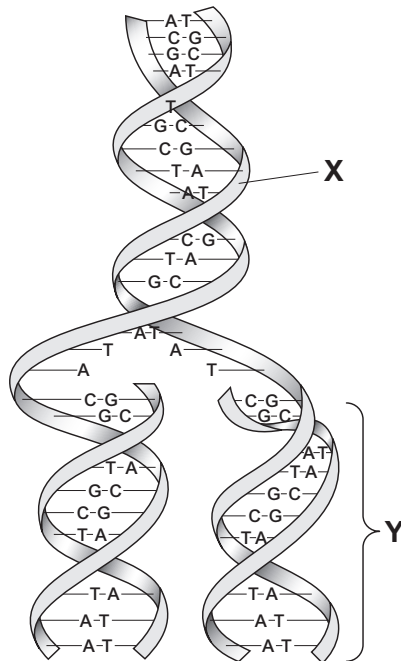
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 80.
- You will be marked on your ability to:
 - use good English
 - organise information clearly
 - use scientific terminology accurately.



JUN10HBIO201

Answer **all** questions in the spaces provided.

1 The diagram shows a molecule of DNA. It is replicating.



1 (a) Name **two** substances in the region labelled **X**.

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(1 mark)

1 (b) Describe how, after the parent DNA strands separated, the second strand of DNA in region **Y** was formed.

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(3 marks)

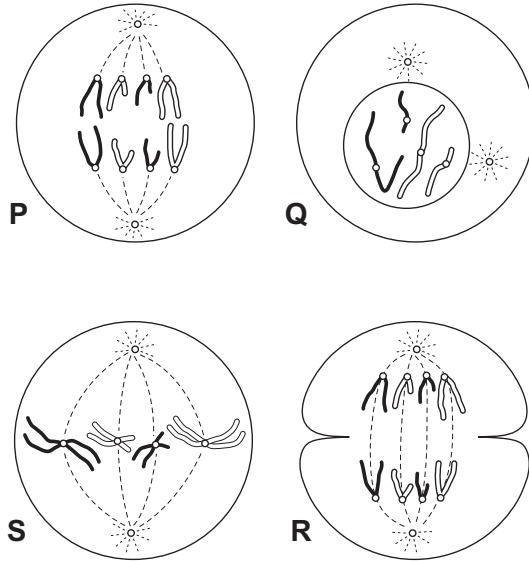
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2 The diagrams show the main stages of mitosis in a cell. The diagrams are not in the correct order.



2 (a) (i) Write the letters representing the stages of mitosis in the correct order in the boxes. The first box has been completed for you.

(1 mark)

2 (a) (ii) Describe **two** differences between the cells formed by mitosis and the cells formed by meiosis.

Cells formed by mitosis	Cells formed by meiosis

(2 marks)

2 (b) An error during meiosis can lead to a child being born with Down's syndrome. Explain how.

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(2 marks)



3 *Toxocara canis* is a parasite of dogs. It can also infect humans.

3 (a) (i) What is a parasite?

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(2 marks)

3 (a) (ii) Describe **two** adaptations of *Toxocara* that allow it to survive in the intestines of a human.

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(2 marks)

3 (b) Explain how each of the following measures would prevent *Toxocara* infecting humans.

Keep dogs out of living areas

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Treat dogs regularly to kill worms in their intestines

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(2 marks)

6



4 (a) Complete the table to show **two** differences between the structure of DNA and RNA.

DNA	RNA

(2 marks)

4 (b) Explain how a gene codes for a protein.

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(2 marks)

4 (c) What are homologous chromosomes?

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(2 marks)

6

Turn over ►



5 (a) Name the substance that muscles use as their immediate energy source.

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(1 mark)

5 (b) Sports scientists investigated the change in energy sources used during exercise. They measured the percentage of energy obtained from carbohydrate and the percentage of energy obtained from fat in two groups of athletes.

- **Group A** exercised at different intensities for the same time.
 - **Group B** exercised at the same intensity for different times.
- They calculated the intensity of the exercise as a percentage of VO_2 max. VO_2 max is the maximum volume of oxygen the athletes can take in per minute.

The results for **Group A** are shown in **Figure 1** and the results for **Group B** are shown in **Figure 2**.

Figure 1

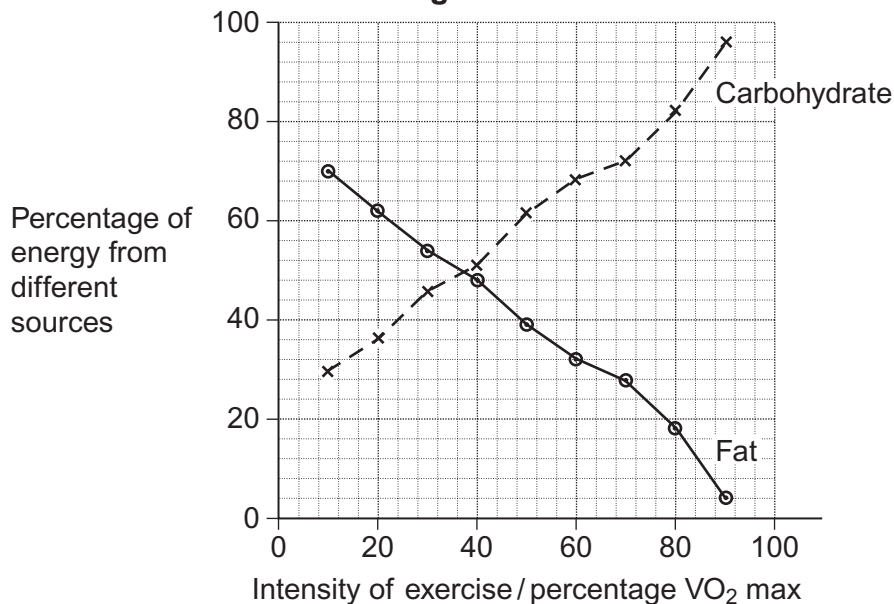
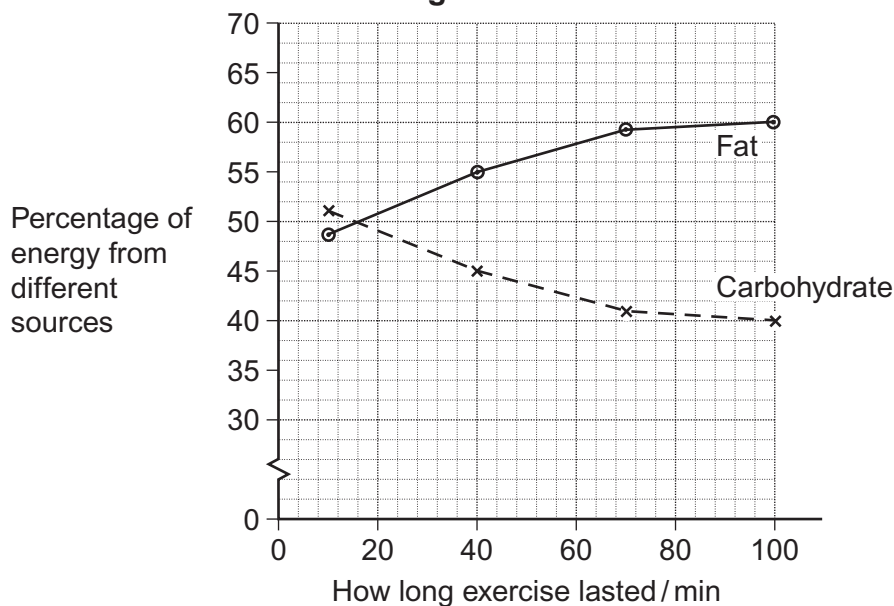


Figure 2



5(b) (i) Calculate the ratio of the percentage of energy from carbohydrate to the percentage of energy from fat when the intensity of exercise is 70% VO_2 max. Show your working.

Answer
(2 marks)

5 (b) (ii) A person wishes to lose some body fat by exercising. What sort of exercise would be most effective? Use the information in **Figures 1** and **2** to explain your answer.

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(3 marks)

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6

Turn over ►



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6 Approximately 12 000 years ago, some humans changed their lifestyle from being hunter-gatherers and became farmers.

6 (a) Describe **four** consequences of this change in lifestyle.

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(4 marks)

6 (b) Some biologists believe that modern cattle have developed from aurochs that lived about 8000 years ago. Modern cattle are more docile than aurochs. This change has been brought about by selective breeding. Suggest how and why.

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(3 marks)

(Extra space)

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7

Turn over ►



7 (a) Modern humans belong to the species *Homo sapiens*. *Homo habilis* and *Homo erectus* are humans that existed before *Homo sapiens*.

7 (a) (i) Explain why all three share the name *Homo*.

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(1 mark)

7 (a) (ii) Give **two** ways in which *Homo erectus* differed physically from *Homo habilis*.

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(2 marks)

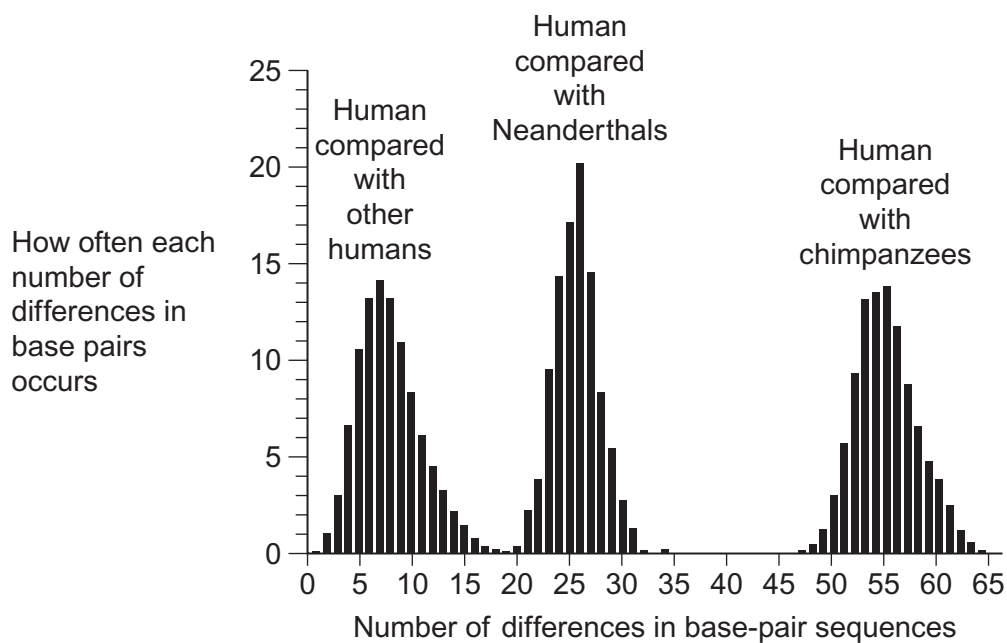
7 (b) Similarities and differences in DNA base sequences can be used to classify organisms. Scientists obtained samples of DNA from 600 people, 3 fossil Neanderthals and 9 chimpanzees. The DNA they used was from just one gene found in all three species. They compared each person's DNA with:

- the other peoples' DNA
- the Neanderthals' DNA
- the chimpanzees' DNA.

For each comparison, they recorded the number of differences in the base sequences of the two DNA samples.

They also recorded how often each number of differences occurred.

The graph shows their results.



7 (b) (i) The biologists concluded that Neanderthals are more closely related to modern humans than are chimpanzees. Do these results support this conclusion? Give reasons for your answer.

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(2 marks)

7 (b) (ii) Explain why the results may **not** be reliable.

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(2 marks)

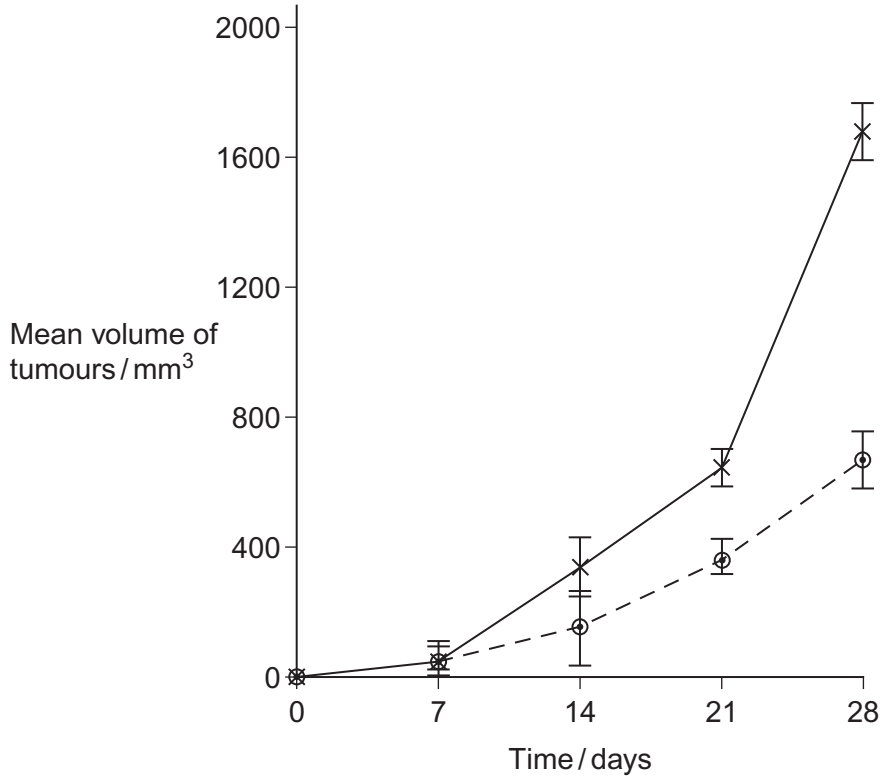
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Turn over ►



- 8 (a)** Doctors used mice to investigate prostate cancer. They found that mice with this cancer had low concentrations of the substance PEDF in their blood. The doctors genetically altered prostate cancer cells from mice so that they would secrete PEDF. The doctors then injected cancer cells into two groups of five mice.
- Group 1 was injected with PEDF-secreting prostate cancer cells.
 - Group 2 was injected with normal prostate cancer cells that did not secrete PEDF.

The researchers measured the total volume of tumours in the two groups of mice every seven days for 28 days. Their results are shown in the graph. The error bars show the standard deviations of their results.



Key

x ——— x Mice injected with normal prostate cancer cells

o - - - - o Mice injected with PEDF secreting prostate cancer cells

8 (a) (i) They used mice with very little natural immunity in the investigation. Why was this important?

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(2 marks)



8 (a) (ii) Describe the results.

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(3 marks)

(Extra space)

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8 (b) The doctors concluded that PEDF might slow the growth of prostate cancers in humans. Explain **two** reasons why this conclusion may **not** be valid.

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(4 marks)

9

Turn over ►



9 (a) An opposable thumb and skin colour are anatomical adaptations of modern humans to their environment. Explain how each adaptation gives an advantage.

Opposable thumb

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Skin colour

.....

(2 marks)

9 (b) One hypothesis suggests that bipedalism is an adaptation that saves energy. To test this hypothesis, scientists measured the oxygen intake of:

- 4 chimpanzees walking on two legs and also walking on four legs
- 4 humans walking on 2 legs.

Chimpanzees usually walk on four legs.

Table 1 shows results for individual chimpanzees. **Table 2** shows mean results for humans and chimpanzees.

Table 1 (individual chimpanzees)

Age of chimpanzee / years	Oxygen intake / cm ³ kg ⁻¹ min ⁻¹	
	Walking on two legs	Walking on four legs
6	0.28	0.18
9	0.26	0.18
27	0.15	0.21
33	0.16	0.29

Table 2 (mean values for humans and chimpanzees)

Group tested	Oxygen intake / cm ³ kg ⁻¹ min ⁻¹	
	Walking on two legs	Walking on four legs
Chimpanzees	0.21	0.22
Humans	0.05	Not tested



9 (b) (i) Explain why the oxygen intake during walking is shown for a specific mass (one kilogram).

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(2 marks)

9 (b) (ii) What do the data suggest about the effect of age on the oxygen chimpanzees use during walking?

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(2 marks)

9 (b) (iii) Use these data to explain why using mean results can sometimes be misleading.

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(2 marks)

9 (b) (iv) Do these data support the hypothesis that bipedalism is an adaptation that saves energy? Give reasons for your answer.

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(2 marks)

10

Turn over ►



10 Read the passage below:

In 2009, a group of celebrities climbed Mount Kilimanjaro in Africa to raise money for the Comic Relief charity. The summit of Kilimanjaro is nearly 6000 metres above sea level. Some of the celebrities developed a condition called acute mountain sickness. Two symptoms of this condition are muscle fatigue and a faster than normal resting heart rate.

5

Populations of people who live permanently at high altitudes have physiological adaptations to the low partial pressure of oxygen in the air. People in some populations have a larger than normal number of red blood cells in their blood. People in other populations synthesise larger than normal amounts of nitric oxide in their lungs. Nitric oxide causes arteries to widen.

10

Recently, scientists studied a population living at high altitudes in Ethiopia. They have a normal number of red blood cells and synthesise a normal amount of nitric oxide in their lungs. Their resting heart rate and ventilation rate do not differ from those of people in populations living at sea level. However, they are able to perform vigorous exercise of the same intensity as people in other populations who are adapted to living at high altitudes.

15

Use information from the passage and your own knowledge to answer the questions.

10 (a) Mountain sickness causes muscle fatigue. Explain why (line 4).

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(3 marks)

(Extra space)
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10 (b) (i) What is a population (line 6)?

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(1 mark)



10 (b) (ii) Natural selection might have resulted in larger than normal numbers of red blood cells being widespread in a population living at high altitudes (lines 7 to 8). Explain how.

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(6 marks)

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Question 10 continues on the next page

Turn over ►



10 (c) A high concentration of nitric oxide in the lungs is an adaptation to living at a high altitude (lines 9 to 10). Explain how.

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(3 marks)

(Extra space).....

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10 (d) Suggest **one** way in which people in the Ethiopian population may be adapted to increase their oxygen uptake at high altitudes (lines 11 to 16). Explain your answer.

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(3 marks)

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10 (e)

Athletes competing at events at sea level sometimes train at high altitudes for several weeks. They return to sea level just before the event. Suggest an explanation for this type of training.

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(4 marks)

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END OF QUESTIONS

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