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| Surname | | | | | | Other Names | | | | | |
| Centre Number | | | | | | Candidate Number | | | | | |
| Candidate Signature | | | | | | | | | | | |

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| For Examiner's Use |
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General Certificate of Education
 June 2007
 Advanced Subsidiary Examination



BIOLOGY (SPECIFICATION B)
Unit 2 Genes and Genetic Engineering

BYB2

Monday 4 June 2007 9.00 am to 10.00 am

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| <p>For this paper you must have:</p> <ul style="list-style-type: none"> a ruler with millimetre measurements. <p>You may use a calculator.</p> |
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Time allowed: 1 hour

Instructions

- Use blue or black ink or ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- Answer the questions in the spaces provided.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information

- The maximum mark for this paper is 54.
- The marks for questions are shown in brackets. One mark will be awarded for Quality of Written Communication.
- You are reminded of the need for good English and clear presentation in your answers.
- Use accurate scientific terminology in your answers.
- Answers for **Questions 1 to 6** are expected to be short and precise.
- Answer **Question 7** in continuous prose. Quality of Written Communication will be assessed in the answer.

| For Examiner's Use | | | |
|----------------------------------|------|----------|------|
| Question | Mark | Question | Mark |
| 1 | | | |
| 2 | | | |
| 3 | | | |
| 4 | | | |
| 5 | | | |
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| 7 | | | |
| Total (Column 1) → | | | |
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| Quality of Written Communication | | | |
| TOTAL | | | |
| Examiner's Initials | | | |

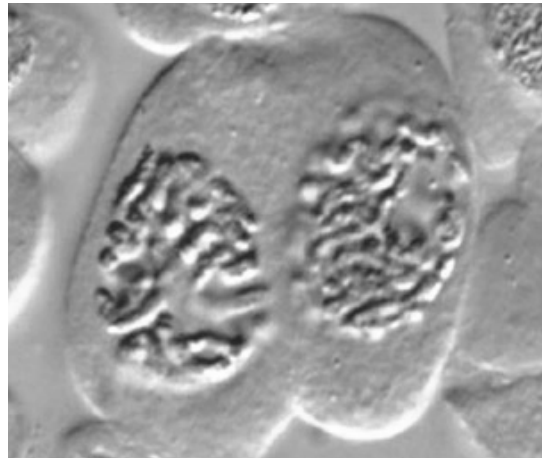
Answer **all** questions in the spaces provided.

1 (a) The photographs show two stages in mitosis.

A



B



Name stages **A** and **B**. Describe what is happening to the chromosomes in each stage.

(i) Stage **A**

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(2 marks)

(ii) Stage **B**

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(2 marks)

(b) A clone of genetically identical animals can be obtained from one embryo.
Explain how.

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2 (a) A large number of copies of DNA can be made using the polymerase chain reaction (PCR). Explain how.

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(4 marks)

(b) Give **one** explanation for using bacteria in genetic engineering.

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(2 marks)

6

Turn over for the next question

3 (a) During gamete formation in animals, diploid cells undergo cell division to produce haploid gametes.

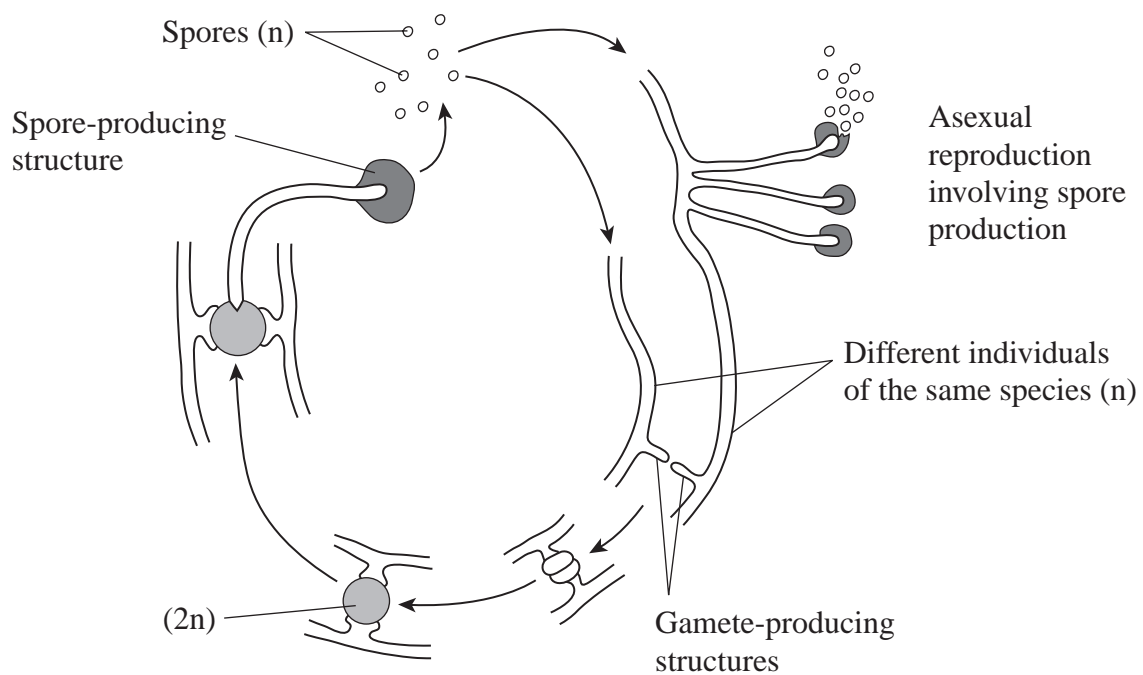
(i) Name the type of cell division which produces haploid gametes from diploid cells.

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(1 mark)

(ii) Describe what happens to the chromosomes during this cell division.

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(2 marks)

The diagram shows the life cycle of a fungus.



(b) On the diagram mark with

(i) the letter **F** where fertilisation takes place

(ii) the letter **M** where meiosis takes place.

(2 marks)

- (c) When large amounts of nutrients are present, the fungus reproduces asexually. Explain **one** advantage of this.

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(2 marks)

7

Turn over for the next question

4 Malaria is a disease which is spread by mosquitoes. Malaria is caused by a single-celled organism. In an investigation, a gene from a bee was transferred into mosquitoes using a plasmid. This gene prevented the mosquitoes and their offspring from spreading malaria.

(a) Describe how the bee gene could have been inserted into the plasmid.

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(3 marks)

(b) These plasmids were injected into fertilised eggs of mosquitoes rather than into adult mosquitoes. Explain why.

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(2 marks)

(c) The plasmid contained a genetic marker. This was a gene for a fluorescent protein that produces green light. Explain why this marker gene was used in this experiment.

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(2 marks)

(d) Many years ago humans accidentally introduced a species of mosquito to some Hawaiian islands. This species of mosquito carries a type of malaria that only infects birds. Some of these birds are rare. It has been suggested that the control of malaria using genetically-engineered mosquitoes with the bee gene should be tested on these Hawaiian islands. Suggest **one** advantage of using this approach.

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(1 mark)

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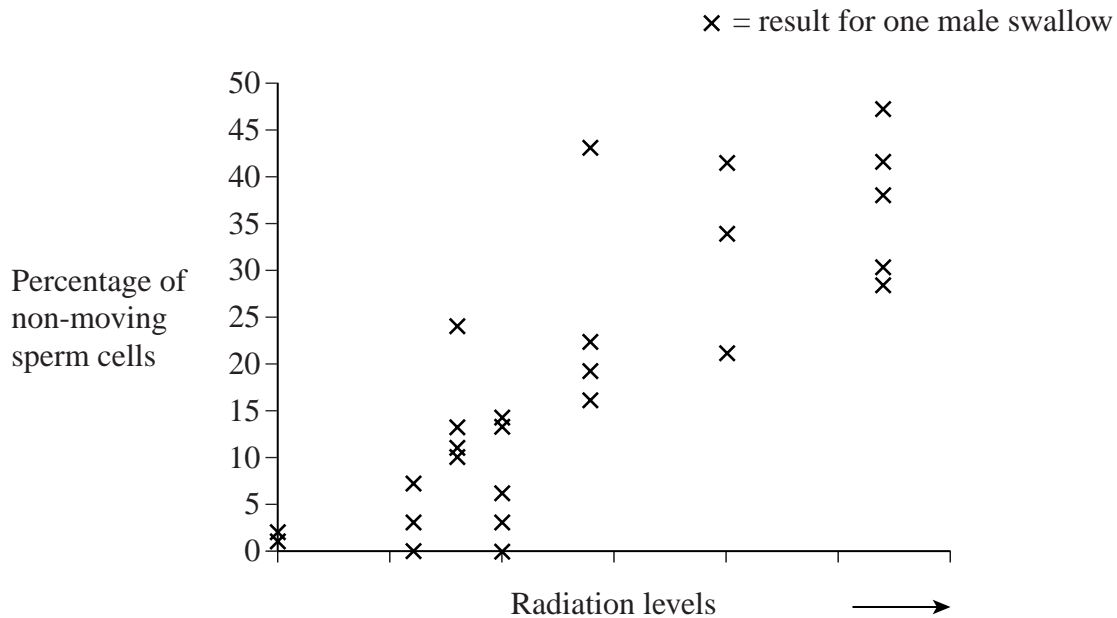
Turn over for the next question

5 Swallows are birds. In 1986, there was a fire at a nuclear reactor in Chernobyl. This caused large amounts of radioactive material to be released into the environment. In 2003, swallows were collected from different areas around the reactor site.

- (a) The percentage of non-moving sperm cells produced by each male swallow was measured. The level of radiation at the site of collection was also measured.

The results are shown in **Figure 1**.

Figure 1



Describe and suggest an explanation for the relationship between the percentage of non-moving sperm cells and the level of radiation.

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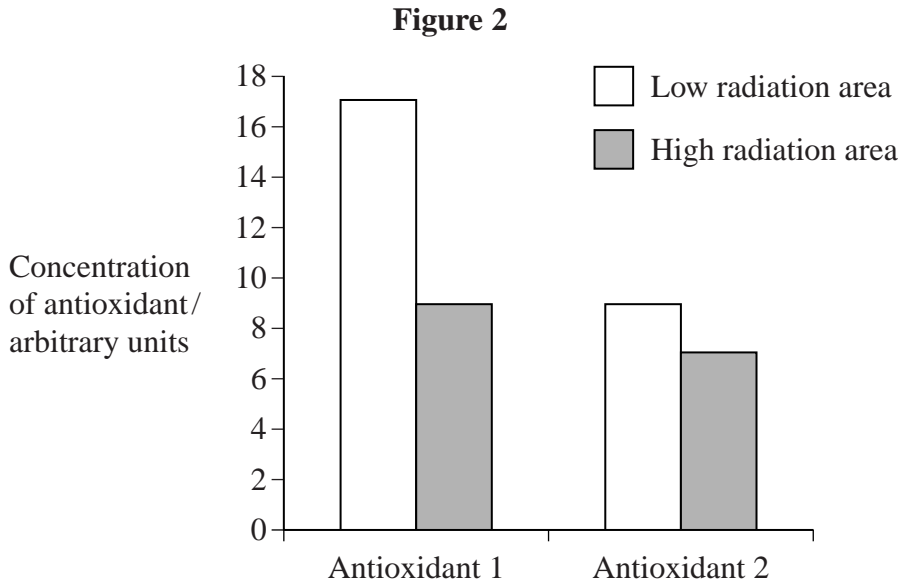
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(3 marks)

- (b) Substances called antioxidants are found in the eggs of female swallows. Antioxidants reduce damage to DNA. The concentration of two antioxidants was measured in the eggs of female swallows.

Figure 2 shows results for eggs from two areas, one with very low levels of radiation and the other with very high levels of radiation.



Describe the effects of radiation on the concentration of these two antioxidants.

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(2 marks)

- (c) High levels of radiation may reduce the size of swallow populations. Use information from **Figure 1** and **Figure 2** to explain how.

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(3 marks)

6 Alpha-1-antitrypsin deficiency (AAD) leads to the development of emphysema. AAD is caused by a particular allele of a gene. This allele codes for a non-functional protein.

(a) Explain how an allele of a gene may produce a non-functional protein.

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(3 marks)

(b) Alleles of the gene for alpha-1-antitrypsin could be introduced into epithelial cells in the lungs of a person with AAD. Explain how.

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(3 marks)

(c) People with only one AAD allele in each of their cells show no symptoms of emphysema. Explain why.

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(2 marks)

Answer **Question 7** in continuous prose.
Quality of Written Communication will be assessed in the answers.

7 (a) Describe the role of nucleic acids in the synthesis of a polypeptide.

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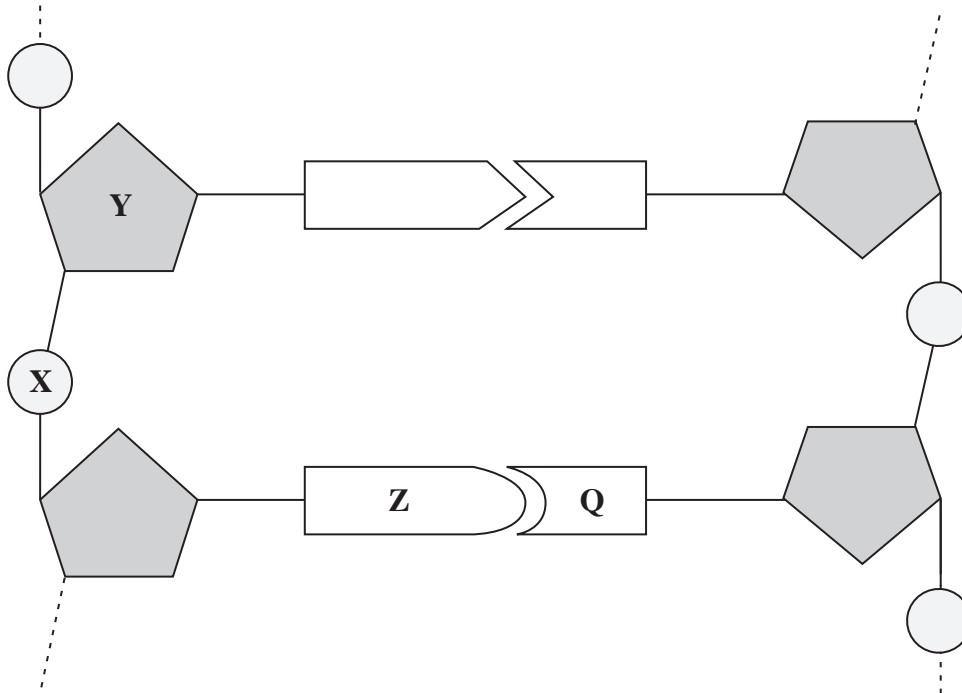
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(6 marks)

Question 7 continues on the next page

(b) **Figure 3** shows two nucleotide pairs of a DNA molecule.

Figure 3



(i) Name **X** and **Y**.

X

Y

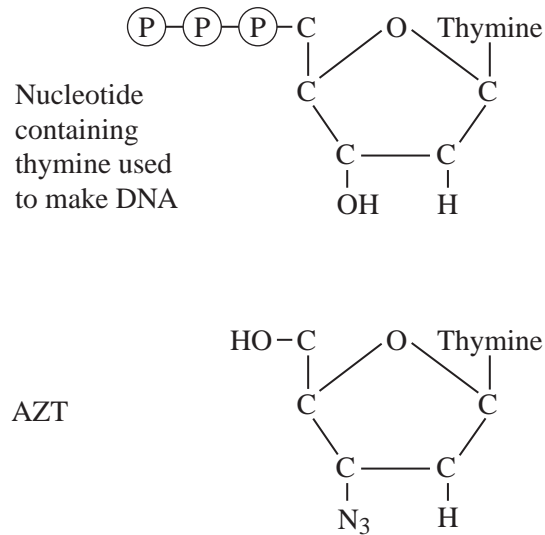
(ii) Which type of bond holds together **Z** and **Q**?

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(2 marks)

- (c) **Figure 4** show the structure of the nucleotide containing the base thymine and the structure of the drug AZT. This drug is used to prevent the replication of human immunodeficiency virus (HIV) inside human cells.

Figure 4



Suggest **one** way that AZT prevents replication of DNA from HIV.

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(2 marks)

END OF QUESTIONS

QWC

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ACKNOWLEDGEMENT OF SOURCES AND COPYRIGHT HOLDERS

Question 1 Permission given by Prof S Russell Oklahoma University see also <http://www.botany.org/plantimages>