

Surname						Other Names					
Centre Number						Candidate Number					
Candidate Signature											

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General Certificate of Education
June 2006
Advanced Subsidiary Examination



BIOLOGY (SPECIFICATION B)
Unit 2 Genes and Genetic Engineering

BYB2

Monday 5 June 2006 9.00 am to 10.00 am

For this paper you must have:

- a ruler with millimetre measurements

You may use a calculator.

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 marked.

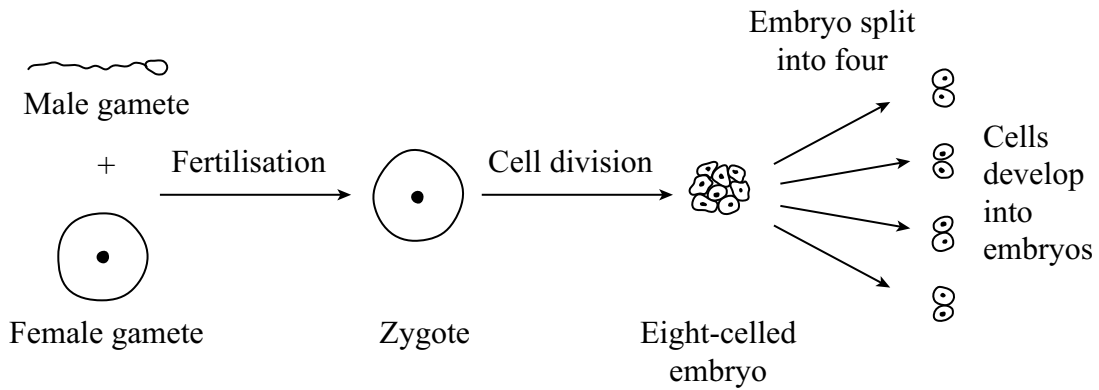
Information

- The maximum mark for this paper is 54.
- The marks for questions are shown in brackets.
- 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			
Number	Mark	Number	Mark
1			
2			
3			
4			
5			
6			
7			
Total (Column 1) →			
Total (Column 2) →			
Quality of Written Communication			
TOTAL			
Examiner's Initials			

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

- 1 An egg cell from a cow was fertilised in a laboratory and allowed to develop into an eight-celled embryo. This was split into four parts, each of which developed into a new embryo. This is shown in the diagram. The new embryos were later transferred into different surrogate cows.



- (a) Explain why the new embryos produced are a clone.

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.....

(2 marks)

- (b) If embryos with more than eight cells are split up, the separated cells fail to develop into new embryos. Suggest why.

.....

.....

(1 mark)

- (c) Give **two** advantages to a farmer of using embryos produced by this procedure.

Advantage 1

.....

Advantage 2

.....

(2 marks)

2 (a) Boxes **A** to **E** show some of the events of the cell cycle.

A Chromatids separate

B Nuclear envelope disappears

C Cytoplasm divides

D Chromosomes condense and become visible

E Chromosomes on the equator of the spindle

(i) List these events in the correct order, starting with **D**.

D
.....

(1 mark)

(ii) Name the stage described in box **E**.

.....
.....

(1 mark)

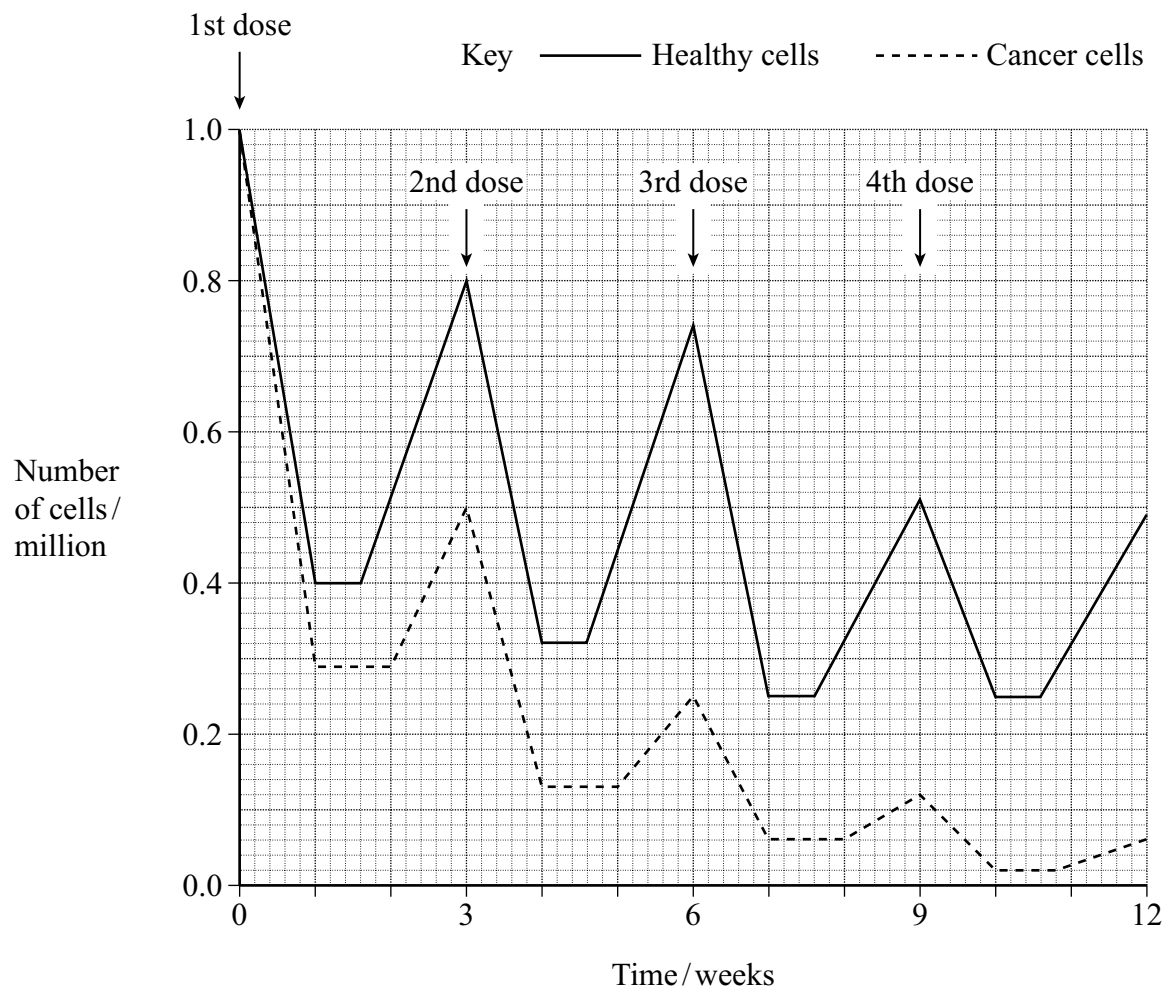
(b) Name the phase during which DNA replication occurs.

.....
.....

(1 mark)

Question 2 continues on the next page

- (c) Bone marrow cells divide rapidly. As a result of a mutation during DNA replication, a bone marrow cell may become a cancer cell and start to divide in an uncontrolled way. A chemotherapy drug that kills cells when they are dividing was given to a cancer patient. It was given once every three weeks, starting at time 0. The graph shows the changes in the number of healthy bone marrow cells and cancer cells during twelve weeks of treatment.



- (i) Using the graph calculate the number of cancer cells present at week 12 as a percentage of the original number of cancer cells. Show your working.

Answer %
(2 marks)

- (ii) Suggest **one** reason for the lower number of cancer cells compared to healthy cells at the end of the first week.

.....
.....
(1 mark)

- (iii) Describe **two** differences in the effect of the drug on the cancer cells, compared with healthy cells in the following weeks.

1
.....
2
.....
(2 marks)

Turn over for the next question

3 (a) (i) What is the role of RNA polymerase in transcription?

.....

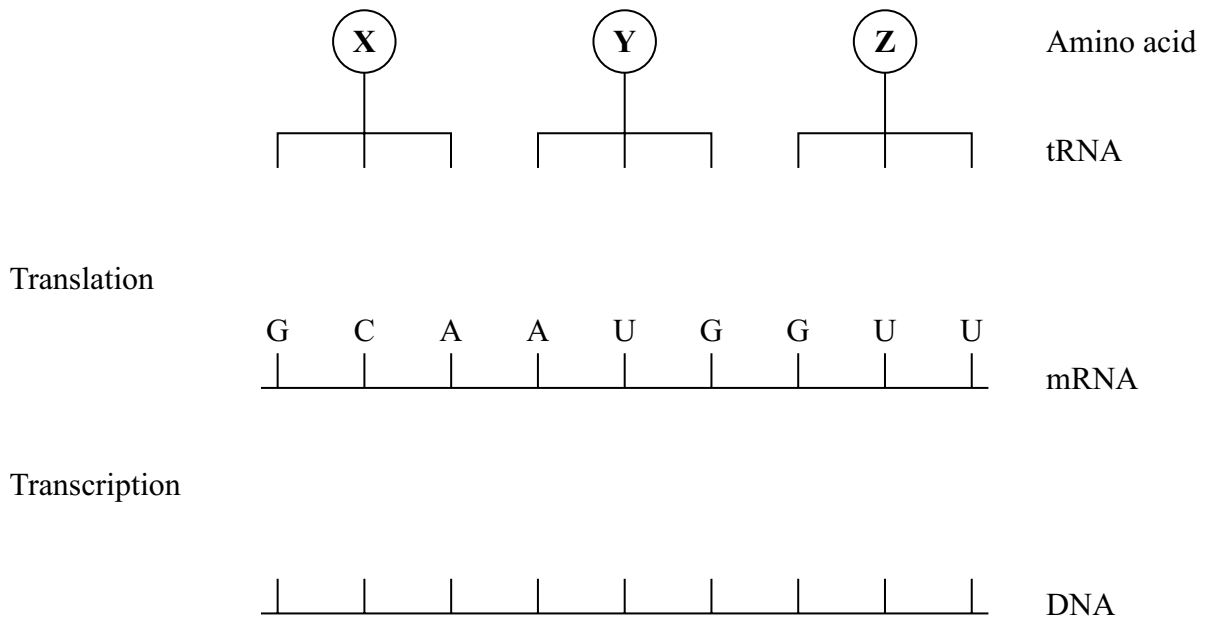
 (1 mark)

(ii) Name the organelle involved in translation.

.....
 (1 mark)

(b) **Figure 1** shows some molecules involved in protein synthesis.

Figure 1



Translation

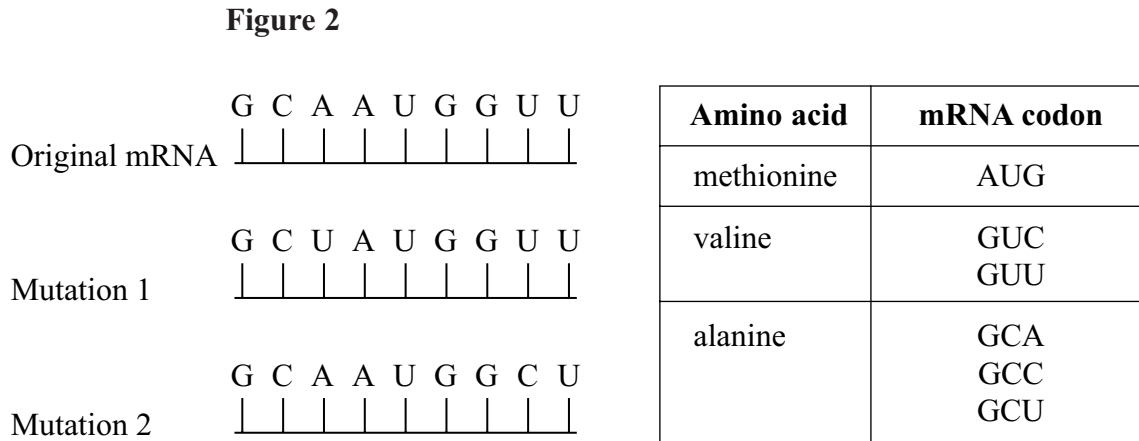
Transcription

Complete **Figure 1** to show

- the bases on the DNA strand from which the mRNA was transcribed;
- the bases forming the anticodons of the tRNA molecules.

(2 marks)

Figure 2 shows the effects of two different mutations of the DNA on the base sequence of the mRNA. The table shows the mRNA codons for three amino acids.



(c) Name the type of mutation represented by mutation 1.

.....
(1 mark)

(d) Use the information in the table to

(i) identify amino acid **X** in **Figure 1**;

.....
(1 mark)

(ii) explain how each mutation may affect the polypeptide for which this section of DNA is part of the code.

Mutation 1

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.....

.....
(2 marks)

Mutation 2

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.....

.....
(2 marks)

- 4 (a) Explain why the replication of DNA is described as semi-conservative.

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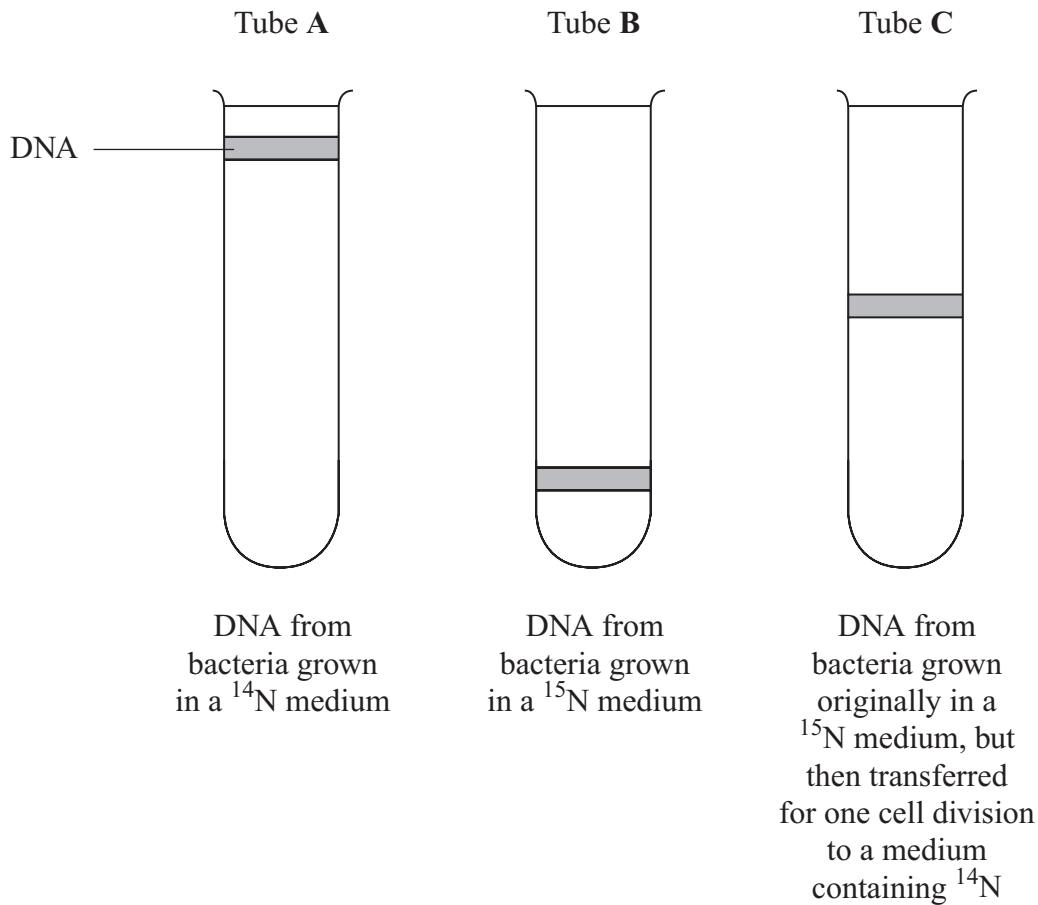
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(2 marks)

- (b) Bacteria require a source of nitrogen to make the bases needed for DNA replication. In an investigation of DNA replication some bacteria were grown for many cell divisions in a medium containing ^{14}N , a light form of nitrogen. Others were grown in a medium containing ^{15}N , a heavy form of nitrogen. Some of the bacteria grown in a ^{15}N medium were then transferred to a ^{14}N medium and left to divide once. DNA was isolated from the bacteria and centrifuged. The DNA samples formed bands at different levels, as shown in the diagram.



- (i) What do tubes **A** and **B** show about the density of the DNA formed using the two different forms of nitrogen?

.....

.....

(1 mark)

- (ii) Explain the position of the band in tube **C**.

.....

.....

.....

.....

(2 marks)

- (c) In a further investigation, the DNA of the bacterium was isolated and separated into single strands. The percentage of each nitrogenous base in each strand was found. The table shows some of the results.

DNA sample	Percentage of base present			
	Adenine	Cytosine	Guanine	Thymine
Strand 1	26		28	14
Strand 2	14			

Use your knowledge of base pairing to complete the table.

(2 marks)

7

- 5 (a) Apart from increasing genetic variation, explain why meiosis is important in organisms which reproduce sexually.

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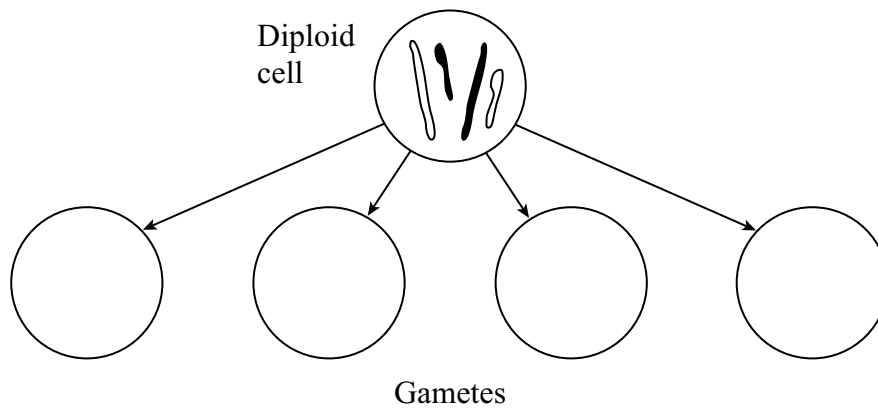
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(2 marks)

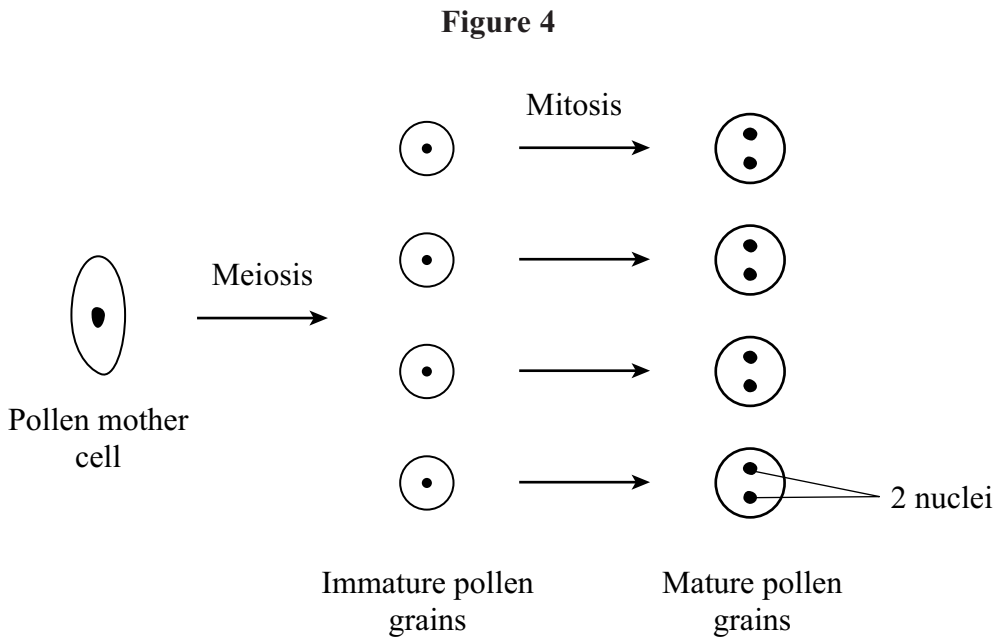
- (b) **Figure 3** shows the chromosomes in a diploid cell.

Figure 3



Complete **Figure 3** to show the four different combinations of these chromosomes in the gametes produced by meiosis. (2 marks)

(c) **Figure 4** shows the main stages in the production of pollen grains in a flowering plant.



The diploid number of chromosomes in this plant is sixteen. How many chromosomes would there be in

- (i) the nucleus of an immature pollen grain;
 - (ii) one of the nuclei of a mature pollen grain?
- (2 marks)*

(d) In tissues that produce gametes, there is a greater proportion of cells undergoing meiosis in male tissue than in female tissue. Suggest **one** advantage of this.

.....
.....
(1 mark)

6 (a) Plasmids are often used as vectors in genetic engineering.

(i) What is the role of a vector?

.....

 (1 mark)

(ii) Describe the role of restriction endonucleases in the formation of plasmids that contain donor DNA.

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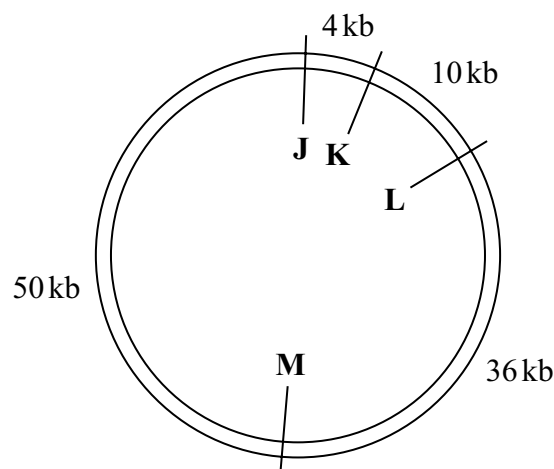
 (2 marks)

(iii) Describe the role of DNA ligase in the production of plasmids containing donor DNA.

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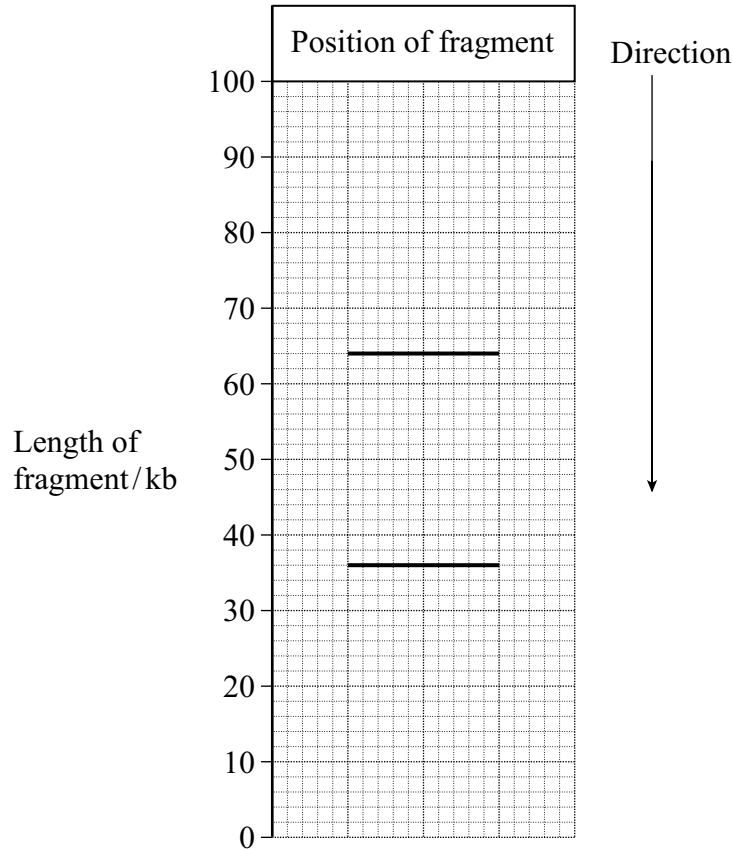
 (1 mark)

(b) There are many different restriction endonucleases. Each type cuts the DNA of a plasmid at a specific base sequence called a restriction site. The diagram shows the position of four restriction sites, **J**, **K**, **L** and **M**, for four different enzymes on a single plasmid. The distances between these sites is measured in kilobases of DNA.



1 kb = 1 kilobase

The plasmid was cut using only two restriction endonucleases. The resulting fragments were separated by gel electrophoresis. The positions of the fragments are shown in the chart below.



(i) Which of the restriction sites were cut?

.....
(1 mark)

(ii) Explain your answer.

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(1 mark)

- (b) About twenty percent of the DNA produced by the PCR is copied inaccurately. Suggest and explain why it is not safe to use the PCR to clone the CFTR gene for use in treating cystic fibrosis.

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(4 marks)

10

END OF QUESTIONS

QWC

1

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