

Surname						Other Names					
Centre Number						Candidate Number					
Candidate Signature											

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General Certificate of Education  
January 2005  
Advanced Subsidiary Examination



**BIOLOGY (SPECIFICATION A)**  
**Unit 2 Making Use of Biology**

**BYA2**

Monday 10 January 2005 Morning Session

**In addition to this paper you will require:**

- a ruler with millimetre measurements.

You may use a calculator.

For Examiner's Use			
Number	Mark	Number	Mark
1			
2			
3			
4			
5			
6			
7			
8			
9			
Total (Column 1)		→	
Total (Column 2)		→	
TOTAL			
Examiner's Initials			

Time allowed: 1 hour 30 minutes

**Instructions**

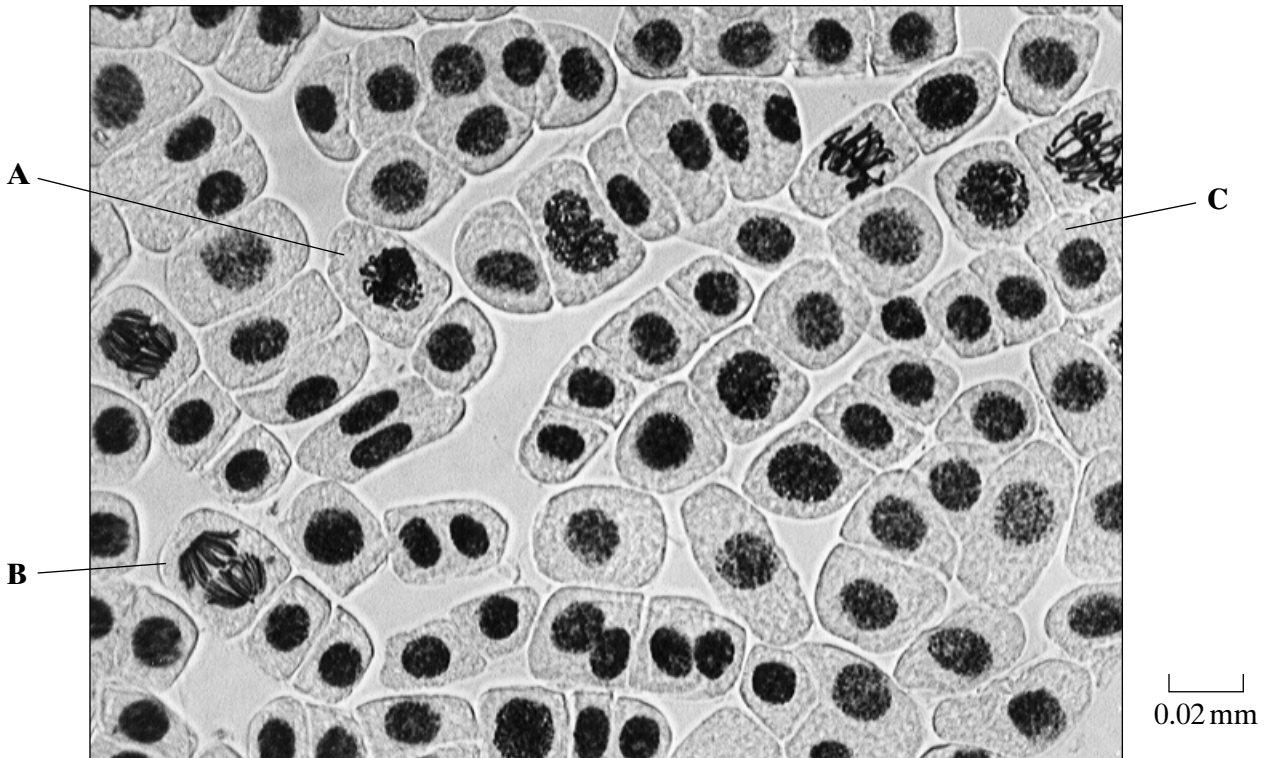
- Use blue or black ink or ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions in the spaces provided. All working must be shown.
- Do all rough work in this book. Cross through any work you do not want marked.

**Information**

- The maximum mark for this paper is 75.
- Mark allocations are shown in brackets.
- You will be assessed on your ability to use an appropriate form and style of writing, to organise relevant information clearly and coherently, and to use specialist vocabulary, where appropriate.
- The degree of legibility of your handwriting and the level of accuracy of your spelling, punctuation and grammar will also be taken into account.

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

- 1** The photograph shows cells from an onion root tip. The root tip has been squashed and stained to show the stages of mitosis.



- (a) (i) At what stage of mitosis is cell **A**?

.....  
(1 mark)

- (ii) What is the evidence that cell **B** is in anaphase?

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

- (iii) Cell **C** is in interphase. Give **two** processes which occur during interphase that enable cell division to occur.

1 .....

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2 .....

.....

(2 marks)

- (b) Explain how you would calculate the magnification of the photograph.

.....  
 .....

(1 mark)

- (c) The number of cells at each stage of mitosis was counted. The results are shown in the table.

Stage of mitosis	Number of cells
Interphase	123
Prophase	32
Metaphase	12
Anaphase	6
Telophase	27

One complete cell cycle takes 24 hours. The number of cells at each stage is proportional to the time spent at that stage. Calculate the length of time spent in metaphase. Show your working.

Answer ..... hours.  
(2 marks)

7

**TURN OVER FOR THE NEXT QUESTION**

Turn over 

2 Scientists are working to produce a genetically modified bacterium to treat patients suffering from a disease of the digestive system. They plan to collect mRNA from human cells. This will be used to produce the DNA of the gene for the protein interleukin. They will then transfer this human gene into the bacterium *Lactococcus*. The scientists intend patients to swallow the genetically modified bacteria. These bacteria will release interleukin inside the digestive system to treat the disease.

- (a) (i) Name the type of enzyme which will be used to produce the DNA from the mRNA.

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(1 mark)

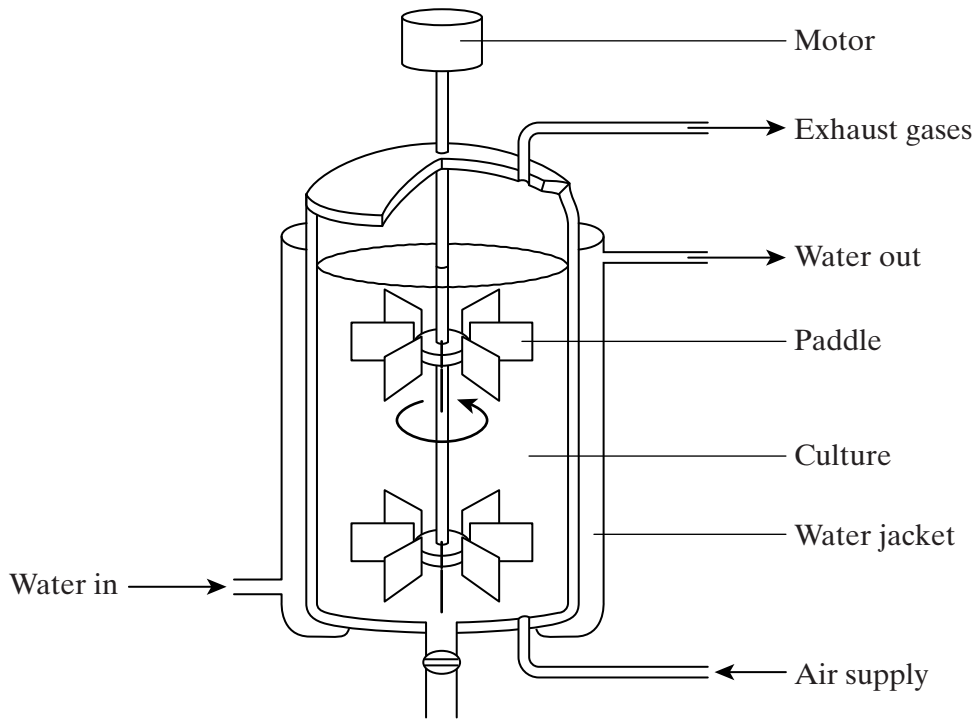
- (ii) It is easier to obtain the interleukin gene from mRNA rather than directly from the DNA removed from human cells. Explain why.

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

- (b) The scientists propose to put the gene directly into the DNA of *Lactococcus*. Describe the role of the enzyme ligase in this process.

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

- (c) The diagram shows a fermenter used to grow large numbers of bacteria for enzyme production.



- (i) The air supplied to the fermenter is passed through filters to remove very small particles. Suggest an explanation for removing these particles.

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.....  
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.....

(2 marks)

- (ii) Suggest **one** function of the water jacket shown.

.....  
.....

(1 mark)

3 A gene was broken into fragments using enzyme **Z**. The mixture of fragments produced was then separated by electrophoresis.

(a) What type of enzyme is enzyme **Z**?

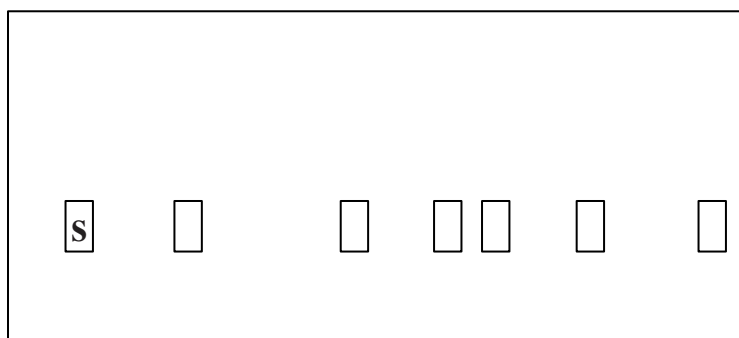
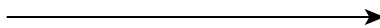
.....  
(1 mark)

The table shows the number of base pairs present in the fragments.

Fragment	Number of base pairs ( $\times 10^3$ )
1	4.65
2	5.72
3	10.71
4	2.39
5	5.35
6	7.53

The diagram shows the electrophoresis gel used. The mixture of fragments was placed at the start point marked **S** and the process started. The boxes indicate the positions reached by the different fragments.

Direction of movement of fragments



(b) Explain why base pairs are a suitable way of measuring the length of a piece of DNA.

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.....  
.....  
.....

(2 marks)

- (c) (i) Write **6** above the appropriate box on the diagram to show the position you would expect fragment **6** to have reached.

(1 mark)

- (ii) Explain how you arrived at your answer.

.....  
.....

(1 mark)

- (d) Enzyme **Z** recognises a particular sequence of bases in the gene. How many times does this sequence appear in the DNA of this gene?

.....

(1 mark)

6

**TURN OVER FOR THE NEXT QUESTION**

**Turn over** ►

4 (a) Give **two** effects of FSH on the ovary of a mammal.

1 .....

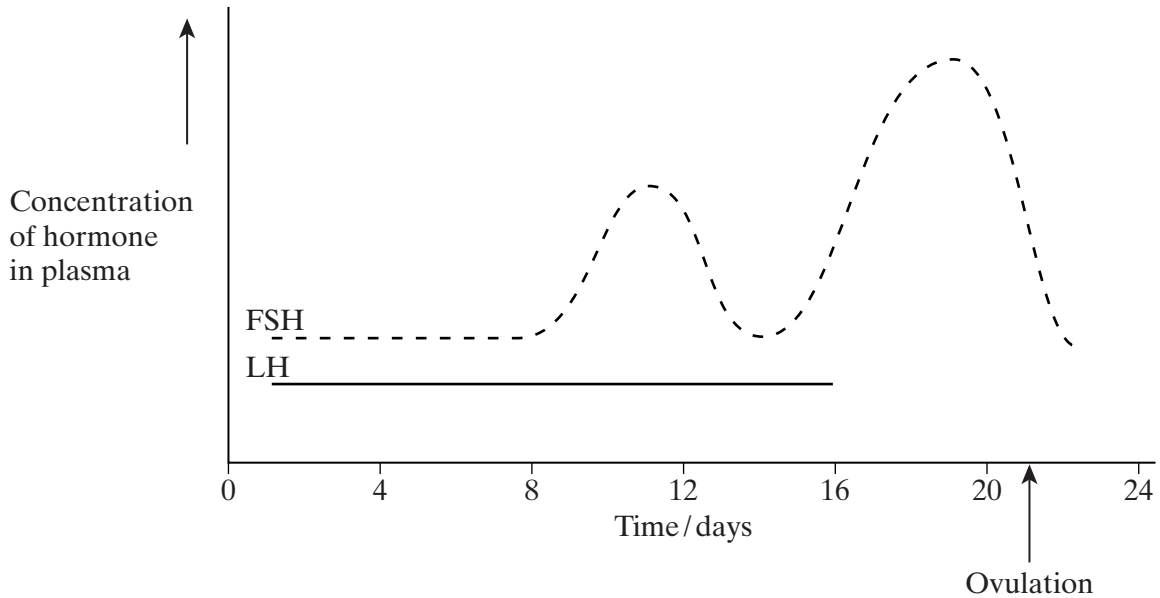
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2 .....

.....

(2 marks)

(b) The graph shows the concentration of FSH and LH during the oestrous cycle of a female horse (mare). The mare was not pregnant.



(i) Complete the curve on the graph to show the likely concentration of LH between days 16 and 24.

(2 marks)

(ii) What would happen to the concentration of FSH after day 24 if the mare became pregnant?

.....

.....

(1 mark)



(c) Breeders of racehorses can use progesterone to ensure mares come into oestrus at a particular time. Progesterone is given to the mare every day for 10 days. Ovulation occurs between 7 and 13 days after the last dose of progesterone.

(i) Explain why progesterone prevents oestrus.

.....  
.....  
.....  
.....

(2 marks)

(ii) Explain why the mare ovulates a few days after the last dose of progesterone.

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

9

**TURN OVER FOR THE NEXT QUESTION**

**Turn over** ▶

- 5 The effect of temperature on the rate of an enzyme-controlled reaction was investigated. The rate of reaction was determined when the enzyme was in solution and when it was immobilised. The results are shown in the table.

Temperature/°C	Rate of reaction/arbitrary units	
	Enzyme in solution	Immobilised enzyme
0	1	1
10	7	3
20	12	7
30	18	16
40	24	24
50	14	24
60	2	20
70	0	10

- (a) Explain the difference between

- (i) the rates of reaction at 70°C;

.....  
 .....  
 .....  
 .....

(2 marks)

- (ii) the rates of reaction at 20°C.

.....  
 .....  
 .....  
 .....

(2 marks)

- (b) Apart from their response to temperature, immobilised enzymes have other advantages in industrial processes. Give **two** of these advantages.







1 .....



2 .....

.....

(2 marks)

6 A sample of blood was found at a crime scene. The sample was tested using anti-A and anti-B antibodies and shown to be blood group A. The blood of three suspects was also tested. The results are shown in the table.

	Suspect 1	Suspect 2	Suspect 3
anti-A			
anti-B			
blood group			

Key	
	Agglutination
	No agglutination

(a) What is meant by *agglutination*?

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

(b) Complete the table to show the blood groups of the three suspects.

(2 marks)

(c) These results did not confirm that the blood from the crime scene came from one of the suspects. DNA from the blood samples given by the suspects was compared, using genetic fingerprinting, with DNA from the blood at the crime scene. Before this was carried out, the DNA was treated with the polymerase chain reaction (PCR).

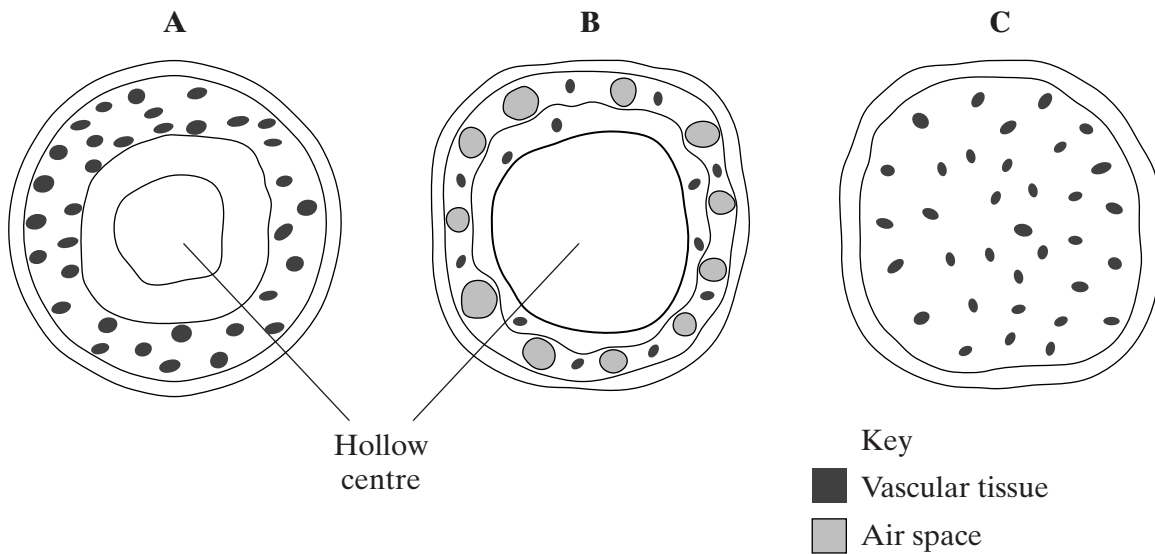
(i) What was the purpose of treating the DNA with the PCR?

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

(ii) From where in the blood sample would DNA be obtained? Give a reason for your answer.

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

7 (a) The diagrams show cross-sections of the stems of three cereal plants.



Which stem, **A**, **B** or **C**, is most likely to belong to a rice plant? Give a reason for your choice.

Stem .....

Reason .....

(1 mark)

(b) Give **one** feature of the roots of rice plants and explain how this feature enables rice plants to grow in swampy conditions.

Feature .....

Explanation .....

.....

.....

.....

(2 marks)

(c) Sorghum grows in hot, dry conditions. Give **two** ways in which its leaves are adapted to reduce water loss.

1 .....

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2 .....

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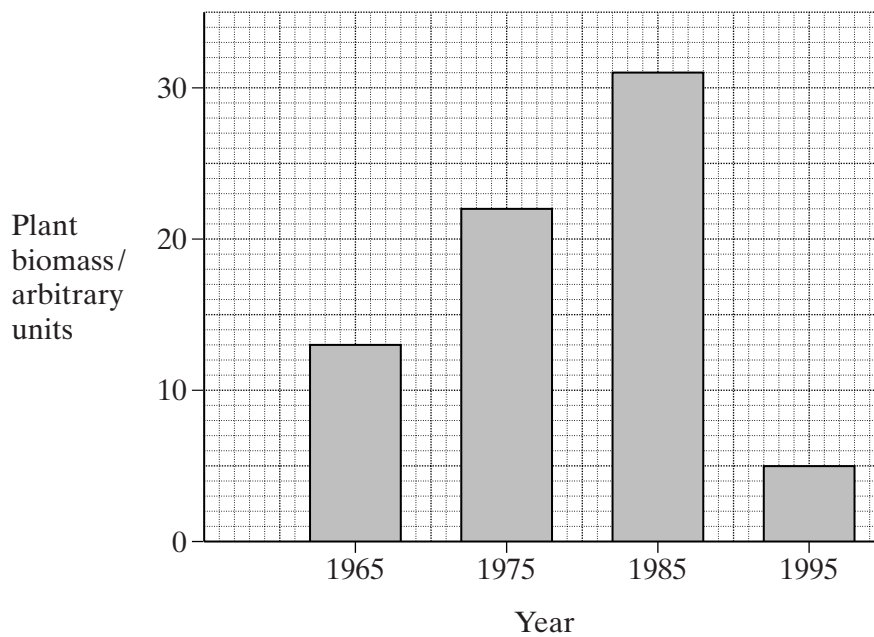
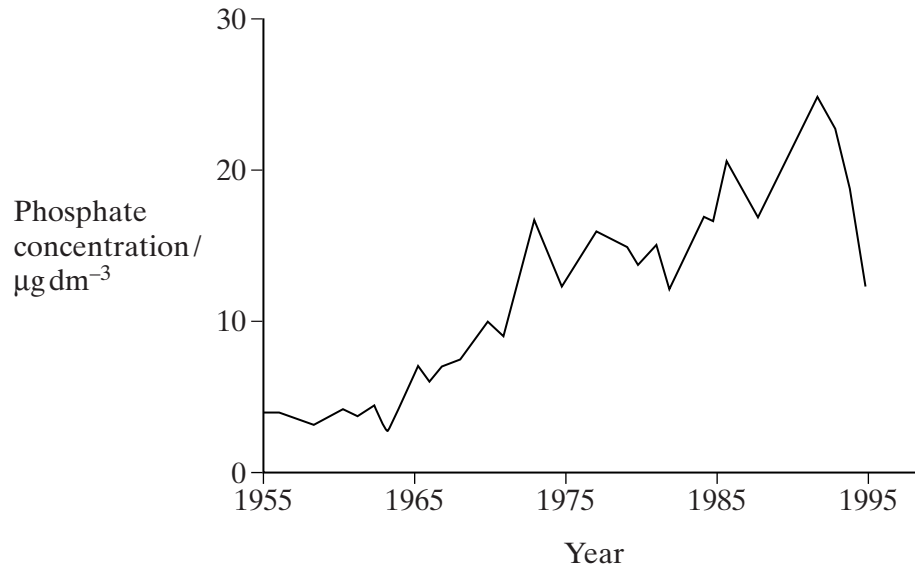
(2 marks)

5

**TURN OVER FOR THE NEXT QUESTION**

**Turn over** ▶

- 8 Since 1965 there has been a steady rise in the phosphate concentration in the water of Lake Windermere. Scientists have monitored the phosphate concentration and plant biomass over a period of time. The results are shown in the graphs.



- (a) Suggest **one** source of the phosphate in the lake.

.....

.....

(1 mark)



(e) (i) One plant which has grown in the lake is blanket weed. It could be controlled by the use of herbicides. Give **two** disadvantages of this method of control.

1 .....

.....

2 .....

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*(2 marks)*

(ii) Small freshwater shrimps could be added to eat the blanket weed. They would act as a biological control. Suggest **one** reason why adding the shrimps would not clear the lake of blanket weed.

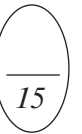
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*(2 marks)*





9 Read the following passage.

The sequence of bases in a molecule of DNA codes for proteins. Different sequences of bases code for different proteins. The genetic code, however, is degenerate. Although the base sequence AGT codes for serine, other sequences may also code for this same amino acid. There are four base sequences which code for the amino acid glycine. These are CCA, CCC, CCG and CCT. There are also four base sequences coding for the amino acid proline. These are GGA, GGC, GGG and GGT.

Pieces of DNA which have a sequence where the same base is repeated many times are called “slippery”. When “slippery” DNA is copied during replication, errors may occur in copying. Individual bases may be copied more than once. This may give rise to differences in the protein which is produced by the piece of DNA containing the errors.

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

(a) Different sequences of bases code for different proteins (lines 1 – 2). Explain how.

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(2 marks)

(b) The base sequence AGT codes for serine (lines 2–3). Give the mRNA codon transcribed from this base sequence.

.....

(2 marks)

(c) Glycine-proline-proline is a series of amino acids found in a particular protein. Give the sequence of DNA bases for these three amino acids which contains the longest “slippery” sequence.

.....

(2 marks)

**QUESTION 9 CONTINUES ON THE NEXT PAGE**

**Turn over** ►

(d) (i) Explain how copying bases more than once may give rise to a difference in the protein (lines 9 – 10).

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.....

(2 marks)

(ii) At what stage in the cell cycle would these errors in copying DNA bases occur?

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(1 mark)

(e) Starting with mRNA in the nucleus of a cell, describe how a molecule of protein is synthesised.

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(6 marks)

**END OF QUESTIONS**

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