

Surname						Other Names					
Centre Number						Candidate Number					
Candidate Signature											

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General Certificate of Education
 January 2003
 Advanced Subsidiary Examination



BIOLOGY (SPECIFICATION A)
Unit 2 Making Use of Biology

BYA2

Thursday 9 January 2003 Morning Session

<p>No additional materials are required. You may use a calculator.</p>
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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.

For Examiner's Use			
Number	Mark	Number	Mark
1			
2			
3			
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Total (Column 1)	→		
Total (Column 2)	→		
TOTAL			
Examiner's Initials			

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

- 1 (a) (i) List the following phases of the cell cycle in the correct sequence.

anaphase interphase metaphase prophase telophase

- 1 interphase
2
3
4
5

(1 mark)

- (ii) During which phase does the replication of DNA occur?

.....
(1 mark)

- (b) Draw a single chromosome attached to a spindle fibre as it would appear during metaphase of mitosis. Label the following on your drawing:

centromere chromatid spindle fibre

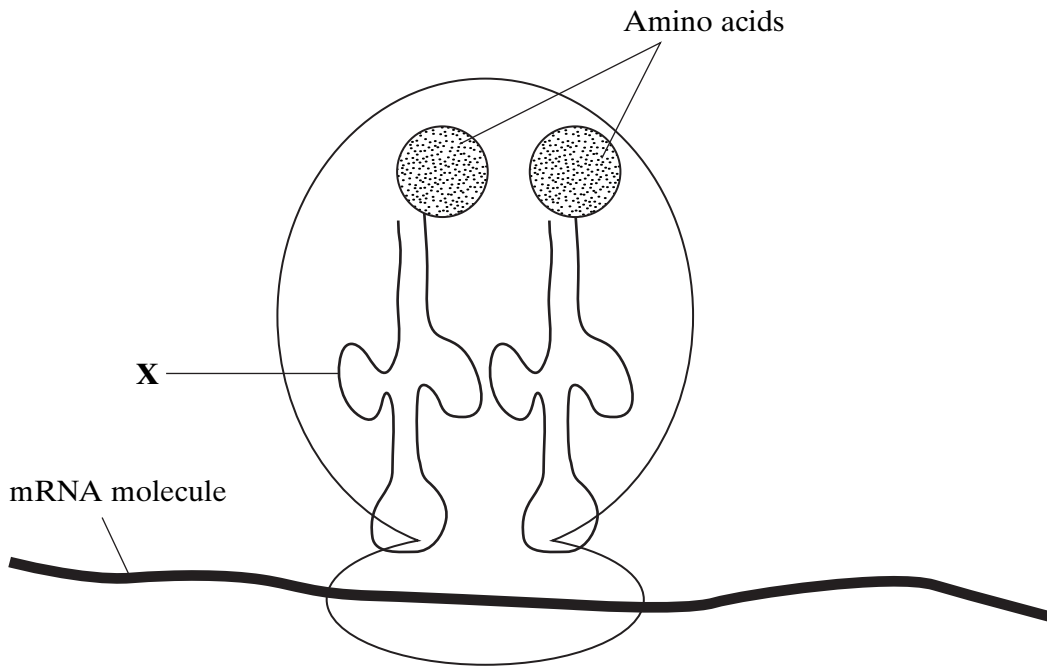
(3 marks)

- (c) The diploid chromosome number of the fruit fly is 8. How many chromosomes would be present in the nucleus of

- (i) a cell from the gut lining;
(ii) a sperm cell?

(1 mark)

2 The diagram shows part of a molecule of mRNA bound to a ribosome.



(a) (i) Molecule **X** carries an amino acid molecule to the ribosome. Name molecule **X**.

.....
(1 mark)

(ii) The mRNA codon below molecule **X** is AUC. Give the sequence of bases in molecule **X** which would bind to the mRNA at this site.

.....
(1 mark)

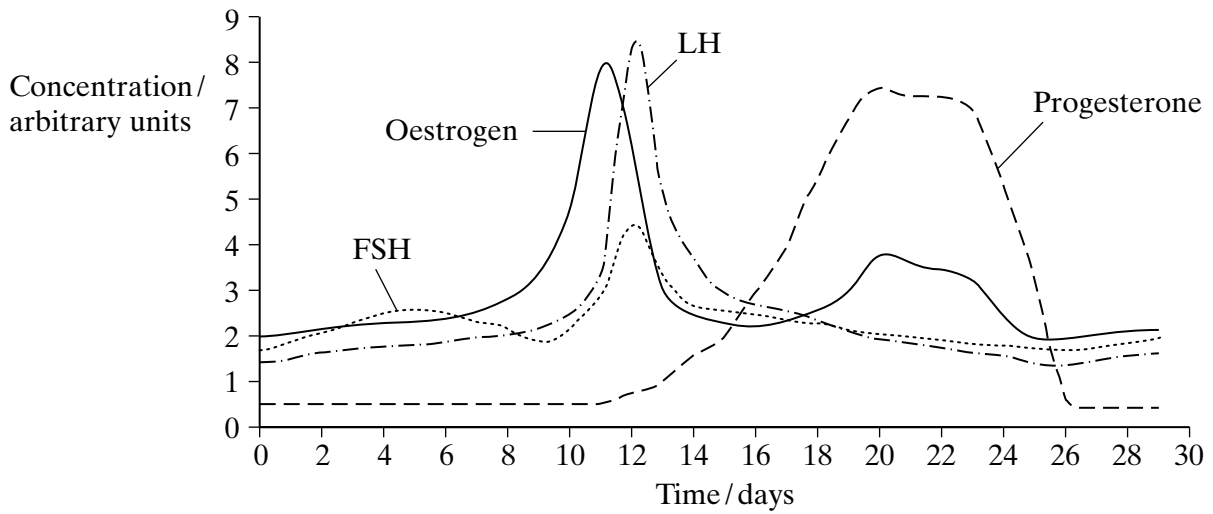
(b) Explain the roles of mRNA and molecule **X** in producing a particular type of protein.

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(3 marks)

Turn over ►

3 The graph shows how the concentrations of various hormones in a woman's blood varied during one menstrual cycle.



(a) (i) In *this* cycle, ovulation occurred on day 12. Give **one** piece of evidence from the graph which supports this.

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(1 mark)

(ii) Suggest why sexual intercourse at any time between days 10 and 13 could have resulted in fertilisation of an ovum.

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(2 marks)

(b) (i) Oestrogen is present in some contraceptive pills. Explain how oestrogen acts as a contraceptive.

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(2 marks)

(ii) Apart from oestrogen, which of the other hormones shown in the graph may be included in oral contraceptives?

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(1 mark)

6

4 (a) An immobilised enzyme called glucose oxidase is used in a biosensor for detecting glucose. Explain why glucose oxidase acts on glucose and not on any other substance.

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(2 marks)

(b) Immobilised enzymes are used in many industrial processes. Give **three** advantages of using immobilised enzymes in these processes.

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(3 marks)

5

TURN OVER FOR THE NEXT QUESTION

Turn over ▶

- 5 The table shows the effect of a fertiliser on the amounts of straw and grain produced by wheat plants.

Amount of fertiliser added/ g m^{-2}	Dry mass of straw (= stems and leaves)/ g m^{-2}	Dry mass of grain/ g m^{-2}	Total dry mass of straw plus grain/ g m^{-2}
0	458	252	710
2.8	465	250	715
5.6	475	247	722
11.2	497	238	735
16.8	520	223	743

- (a) (i) Calculate the percentage increase in the total dry mass of straw plus grain when the amount of fertiliser was increased from 5.6 to 16.8 g m^{-2} . Show your working.

..... %
(2 marks)

- (ii) Use the data in the table to describe the effect of increased application of fertiliser on the growth of wheat plants.

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

- (b) (i) Explain how fertiliser applied to the land could enter streams and rivers.

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(2 marks)

(ii) Explain how pollution of river water with fertiliser can cause the death of fish.

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(3 marks)

8

TURN OVER FOR THE NEXT QUESTION

Turn over ▶

6 (a) What is an antibody?

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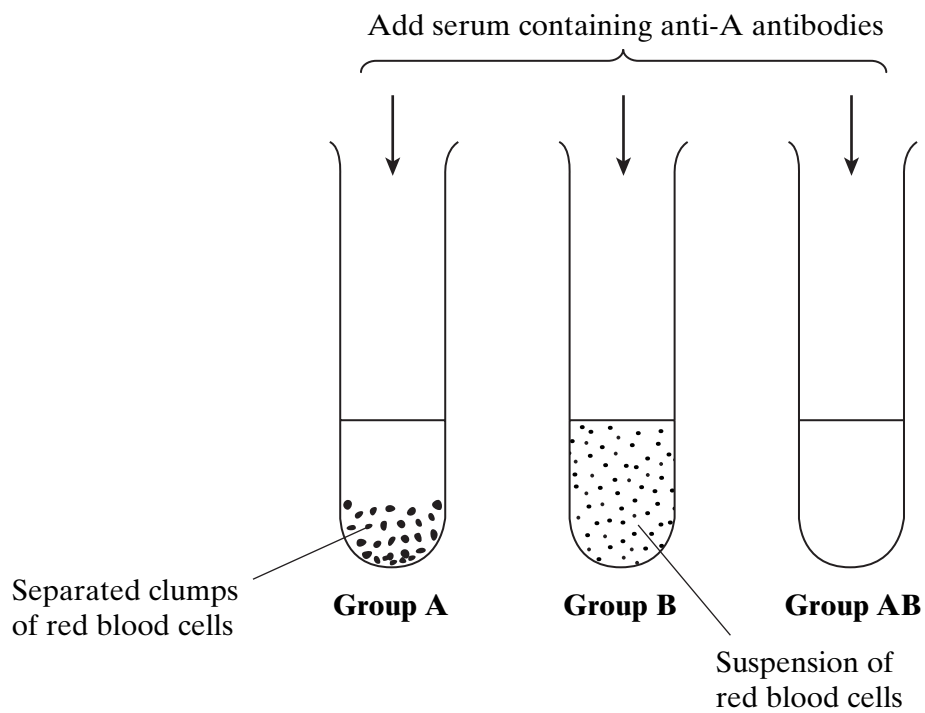
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(2 marks)

(b) Serum containing anti-A antibodies was added to blood from people of different blood groups. The results for blood groups A and B are shown in the diagram. The result for blood group AB has been left blank.



(i) Explain why the results for blood groups A and B were different.

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(2 marks)

(ii) Describe and explain what result you would expect with the group AB blood.

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(2 marks)



TURN OVER FOR THE NEXT QUESTION

Turn over 

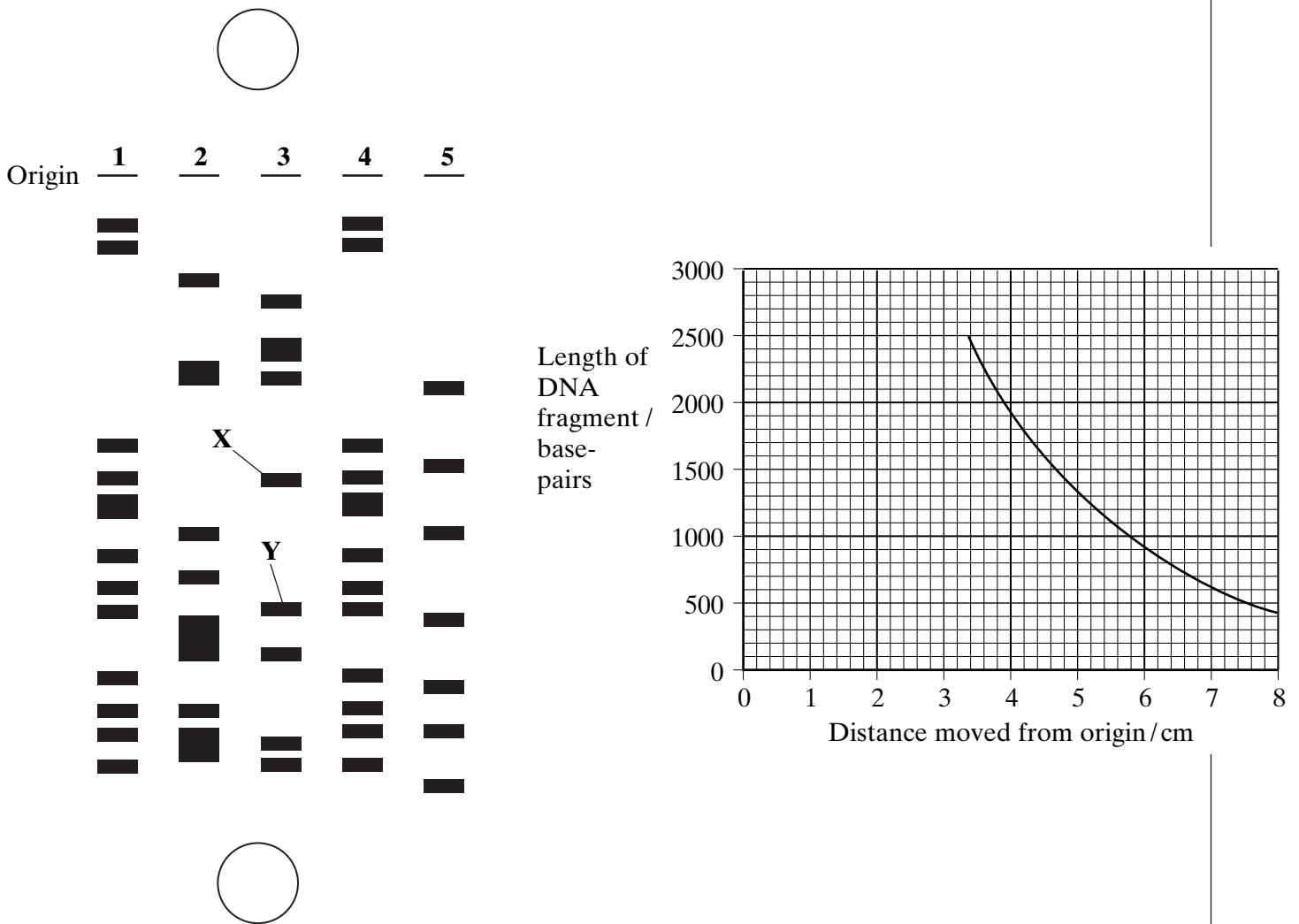
7 (a) Give **two** components of DNA, other than the bases.

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(2 marks)

Pieces of DNA of different lengths can be separated by electrophoresis. The diagram shows the results of electrophoresis of DNA fragments from four blood samples. It is drawn the same size as the actual results. The fifth result is for a mixture of marker fragments of DNA of known sizes. The graph shows the relationship between the length of the DNA fragments and the distance moved during electrophoresis.



(b) (i) The DNA fragments carry a negative charge. Write the symbols '+' and '-' in the circles on the diagram to show the positions of the positive and negative electrodes. Explain your answer.

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(1 mark)

- (ii) Use the diagram and the graph to estimate the difference in length (in base-pairs) between DNA fragments 'X' and 'Y'. Show your working.

Difference = base-pairs
(2 marks)

- (iii) Explain why 'base-pairs' is a suitable unit for measuring the length of a piece of DNA.

.....

(2 marks)

- (iv) Explain why 'base-pairs' would **not** be a suitable unit for measuring the length of a piece of mRNA.

.....

(1 mark)

- (c) In the diagram, the DNA in sample **1** came from some blood on a broken window at the scene of a burglary. Samples **2, 3** and **4** came from three different suspects. Which sample came from the suspect most likely to have committed the burglary?

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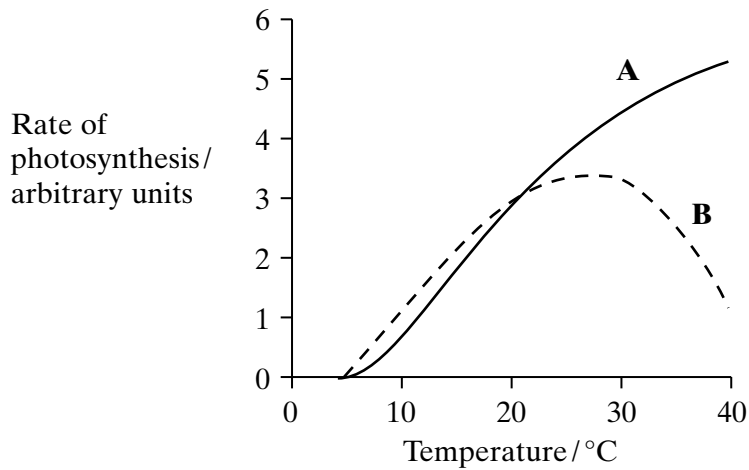
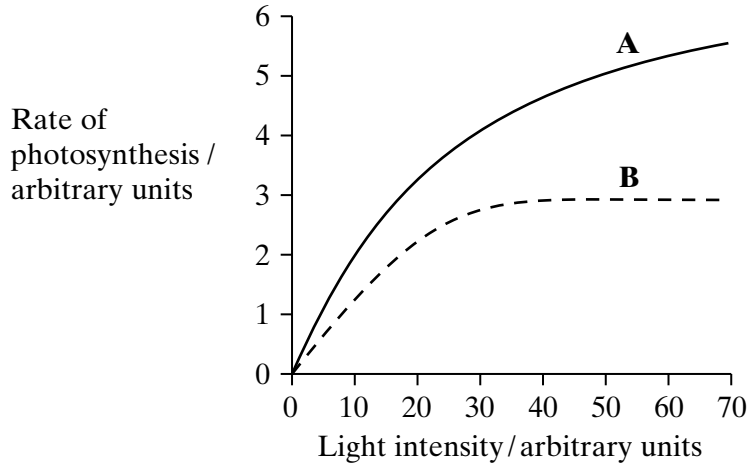
(1 mark)



TURN OVER FOR THE NEXT QUESTION

Turn over ►

8 The graphs show the effects of light intensity and temperature on the rate of photosynthesis in two species of plant, **A** and **B**.



(a) (i) Over what range of light intensities is light a limiting factor for photosynthesis in species **B**?

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(1 mark)

(ii) Species **A** normally grows in tropical areas. Give **two** pieces of evidence from the graphs which support this.

1

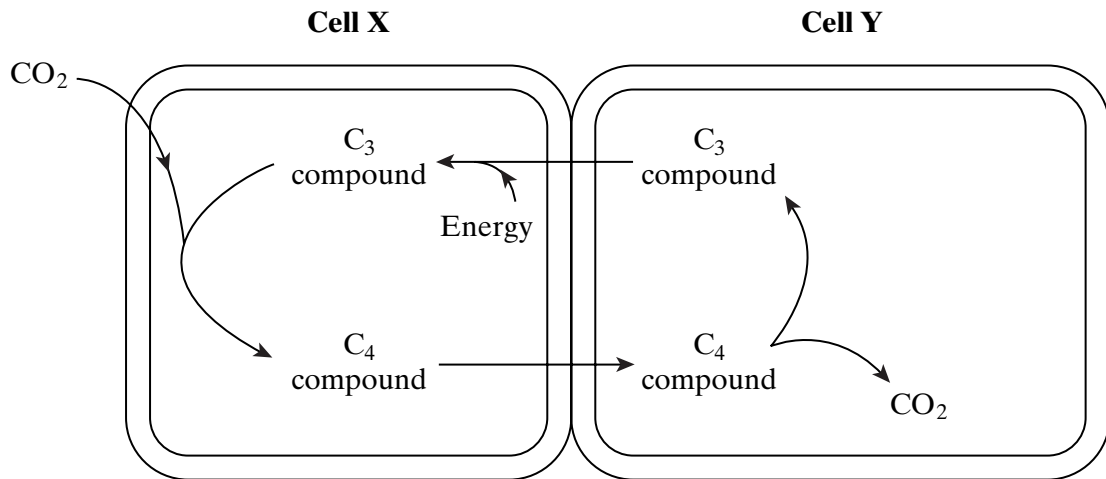
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(2 marks)

- (b) Species **A** has a specialised method of photosynthesis which helps it to concentrate carbon dioxide in some types of cells. The diagram shows the interconversion of some organic compounds, which contain either three carbon atoms (C_3) or four carbon atoms (C_4). It also shows the transfer of these compounds between two cells in a leaf of species **A**.



- (i) When carbon dioxide enters cell **X**, it combines with the C_3 compound to produce a C_4 compound. Explain how this causes a large amount of carbon dioxide to enter cell **X**.

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(2 marks)

- (ii) Use information from the diagram to explain how a high concentration of carbon dioxide is built up in cell **Y**.

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(2 marks)

QUESTION 8 CONTINUES ON THE NEXT PAGE

Turn over ►

(iii) Why is it useful for plants growing in tropical areas to be able to build up a high concentration of carbon dioxide in their photosynthesising tissues?

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(2 marks)

(c) Rice and sorghum are two types of cereal which are adapted to live under different environmental conditions. Explain how rice is adapted to grow in swamps while sorghum is adapted for growth in hot, dry conditions.

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(6 marks)

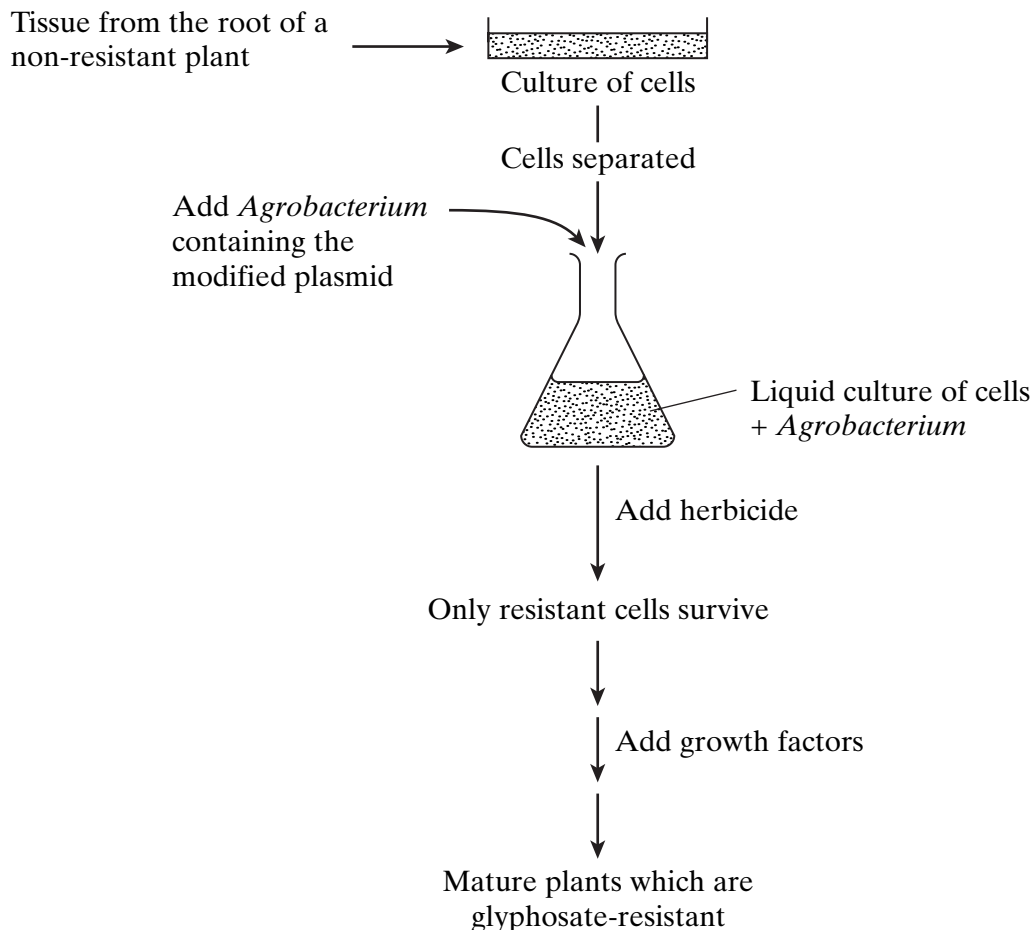
9 Read the following passage.

Genetic engineering is a technique for improving crop plants. It is a process by which a single new gene can be added to the genes already present in the plants.

- 5 One way of doing this is to use a natural genetic engineer, a soil microorganism called *Agrobacterium*. This bacterium possesses a plasmid which can be modified in the laboratory so that it becomes the carrier of new genetic information. For example, a gene coding for the ability to break down the herbicide glyphosate can be introduced with the assistance of the enzymes restriction endonuclease and ligase.

Once inside the crop plant, the gene for glyphosate breakdown makes the plant resistant to the effects of this herbicide. All surrounding weeds are destroyed when sprayed with glyphosate.

- 10 The flow-chart shows how the plasmid carrying this gene can be used to produce glyphosate - resistant plants.



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

- (a) Describe how restriction endonuclease and ligase enzymes can be used in the formation of the modified plasmid (lines 4 – 7).

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(6 marks)

- (b) One mature plant grows from each glyphosate-resistant plant cell. Explain why *all* the cells of the mature plant contain the gene for glyphosate resistance.

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(2 marks)

QUESTION 9 CONTINUES ON THE NEXT PAGE

Turn over ▶

(c) Often in genetic engineering, plasmids containing genes for antibiotic resistance are used. These genes act as ‘markers’.

(i) Explain why these markers are used.

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(2 marks)

(ii) Use information from the flow-chart to explain why the use of such markers is **not** needed in the example described in the passage.

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(1 mark)

(d) Suggest and explain **one** benefit and **one** possible problem associated with the use of herbicides together with genetically modified, herbicide-resistant crop plants.

Benefit

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Problem

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(4 marks)

END OF QUESTIONS