Principles of genetic technology

Question Paper 2

Level	International A Level
Subject	Biology
Exam Board	CIE
Topic	Genetic Technology
Sub Topic	Principles of genetic technology
Booklet	Theory
Paper Type	Question Paper 2

Time Allowed : **45 minutes**

Score : **/ 37**

Percentage : **/100**

Grade Boundaries:

A*	A	B	C	D	E	U
>85%	'77.5%	70%	62.5%	57.5%	45%	<45%

1 **(a)** Describe the role of insulin in the regulation of blood glucose concentration.

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(b) State two advantages of treating diabetes with insulin produced by gene technology.

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2 .....

..... [2]

(c) One of the steps in the production of bacteria capable of producing human insulin is the insertion of the gene coding for human insulin into a plasmid vector.

Fig. 6.1 shows one of the artificial plasmids constructed to act as a vector.

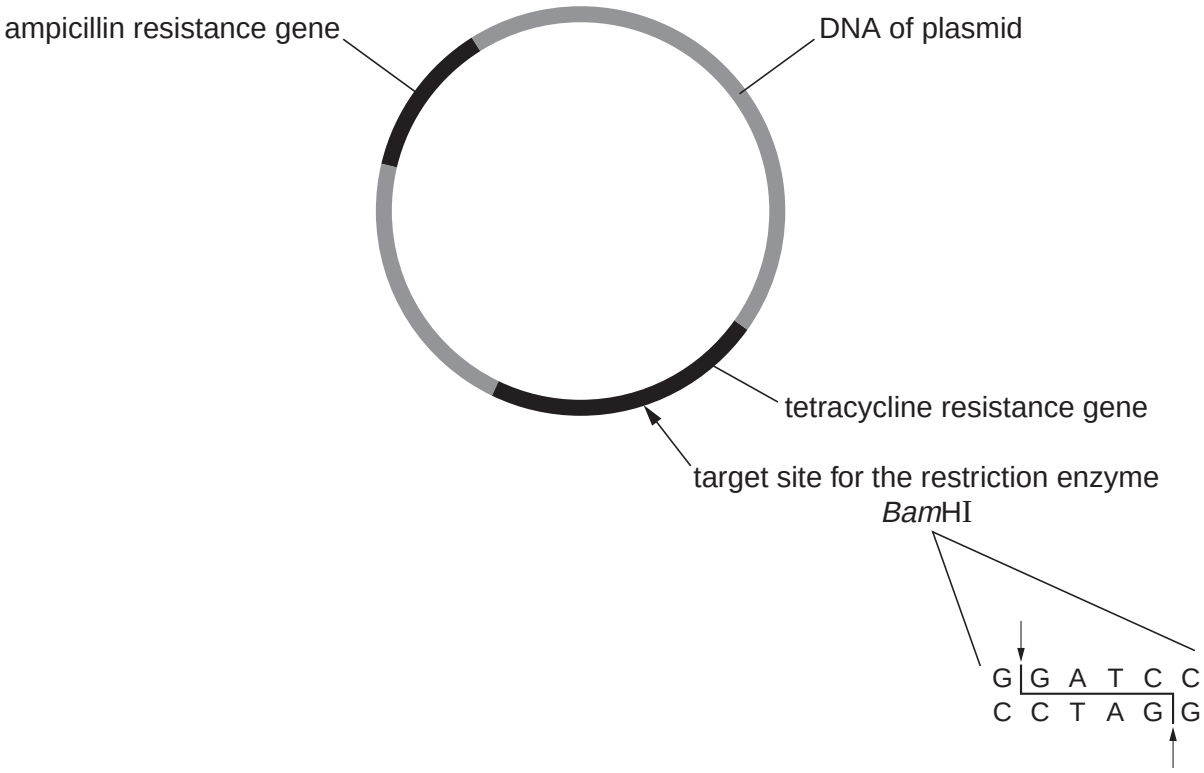

Fig. 6.1

(i) With reference to Fig. 6.1, explain the importance of the plasmid having a single target site for a particular restriction enzyme, such as *Bam*HI.

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(ii) The genes for ampicillin resistance and tetracycline resistance on the plasmid allow the genetic engineer to distinguish between bacteria that have taken up different circles of DNA.

Complete the table to show whether bacteria which have taken up each different circle of DNA are, or are not resistant to ampicillin, to tetracycline or to both. Show presence of resistance with a tick (✓) and absence of resistance with a cross (✗).

circle of DNA taken up by bacteria	bacteria resistant to ampicillin	bacteria resistant to tetracycline
unaltered plasmids		
recombinant plasmids that have taken up the wanted gene		
circles of the wanted gene		

[3]

(d) **(i)** Explain why genes for antibiotic resistance are now rarely used as markers in gene technology.

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(ii) Describe the use of **one** alternative marker gene that can be used instead of an antibiotic gene.

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[Total: 15]

2 **(a)** A husband and wife who already have a child with cystic fibrosis (CF) elected to have their second child tested for the condition while still a fetus in very early pregnancy. The results of the test, a DNA banding pattern, were discussed with a genetic counsellor.

The relevant DNA banding pattern produced by electrophoresis is shown in Fig. 6.1.

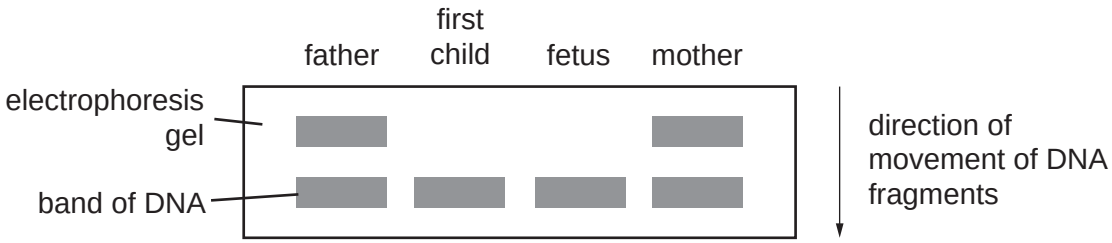

Fig. 6.1

With reference to Fig. 6.1, explain why,

(i) the fetus will develop CF,

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(ii) the positions of the bands of DNA of the first child and of the fetus indicate that the mutant allele for CF has a deletion in comparison with the normal allele.

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(b) Explain briefly the need to discuss the result of the test with a genetic counsellor.

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[Total: 7]

3 **(a)** Fig. 3.1 shows the male and female flowers of maize.

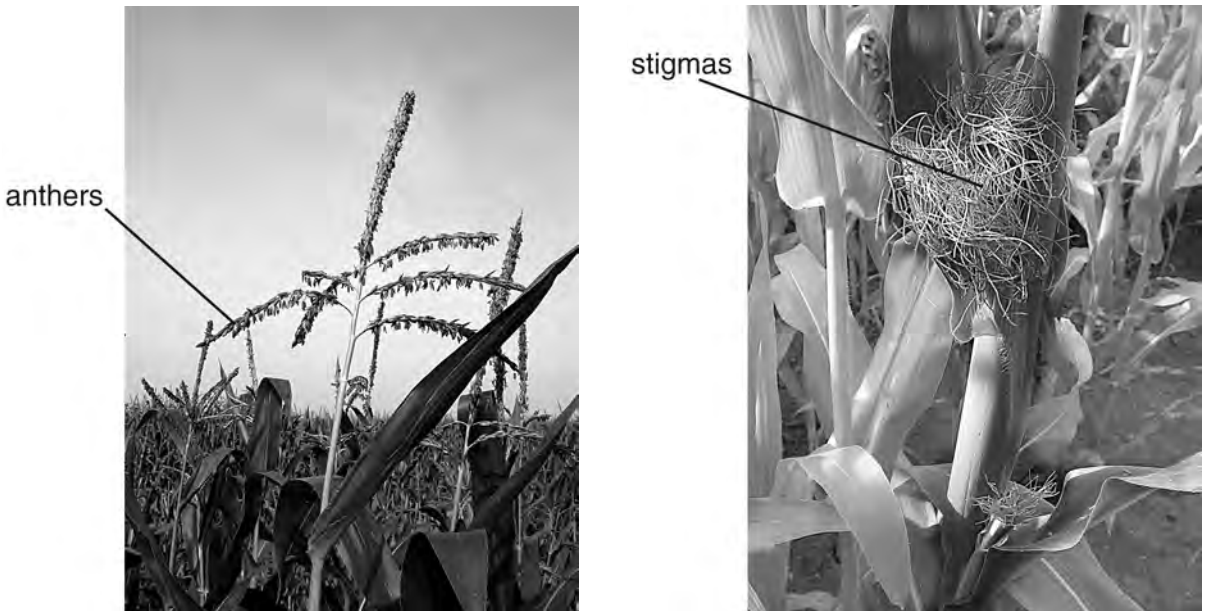

Fig. 3.1

(i) With reference to Fig. 3.1, describe how the flowering habit of maize encourages wind-pollination.

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(ii) In a maize plant, the anthers normally ripen before the stigmas are mature and ready to receive pollen. This encourages cross-pollination.

Explain the potential advantages of cross-pollination to a plant species.

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(b) Cultivated maize is related to a wild Mexican grass, teosinte. Teosinte looks very different from maize. In particular, teosinte has a very hard layer surrounding the fruit, making it impossible to use as an edible grain.

Archaeological excavations have found that maize in its edible form dates back at least 4000 years. It has been argued that the structural differences between teosinte and maize grains are so great that it is unlikely that maize could have been bred from teosinte so long ago.

Investigations have been carried out into the genetic differences between teosinte and maize. A gene on chromosome 4, *tga 1*, containing 1042 base pairs, was found to be responsible for all of the structural differences between teosinte and maize.

Fig. 3.2 shows the DNA base sequence of the only part of *tga 1* that always differs between teosinte and maize.

teosinte	GAT	TGG	GAT	CTC	AAG	GCG	GCG	GGC	GCG	TGG
maize	GAT	TGG	GAT	CTC	AAC	GCG	GCG	GGC	GCG	TGG

Fig. 3.2

(i) Outline the principles of electrophoresis as used in sequencing this DNA.

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(ii) Suggest how the difference in the base sequence of the *tga 1* gene shown in Fig. 3.2 could cause large differences in phenotype between teosinte and maize.

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(iii) With reference to Fig. 3.2, explain how these results support the suggestion that it would have been relatively easy for early farmers in Mexico to have bred maize from teosinte.

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[Total: 15]