Genetic technology applied to medicine

Question Paper 5

Level	International A Level
Subject	Biology
Exam Board	CIE
Topic	Genetic Technology
Sub Topic	Genetic technology applied to medicine
Booklet	Theory
Paper Type	Question Paper 5

Time Allowed : **66 minutes**

Score : **/ 55**

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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..... [3]

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

1 .....

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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.

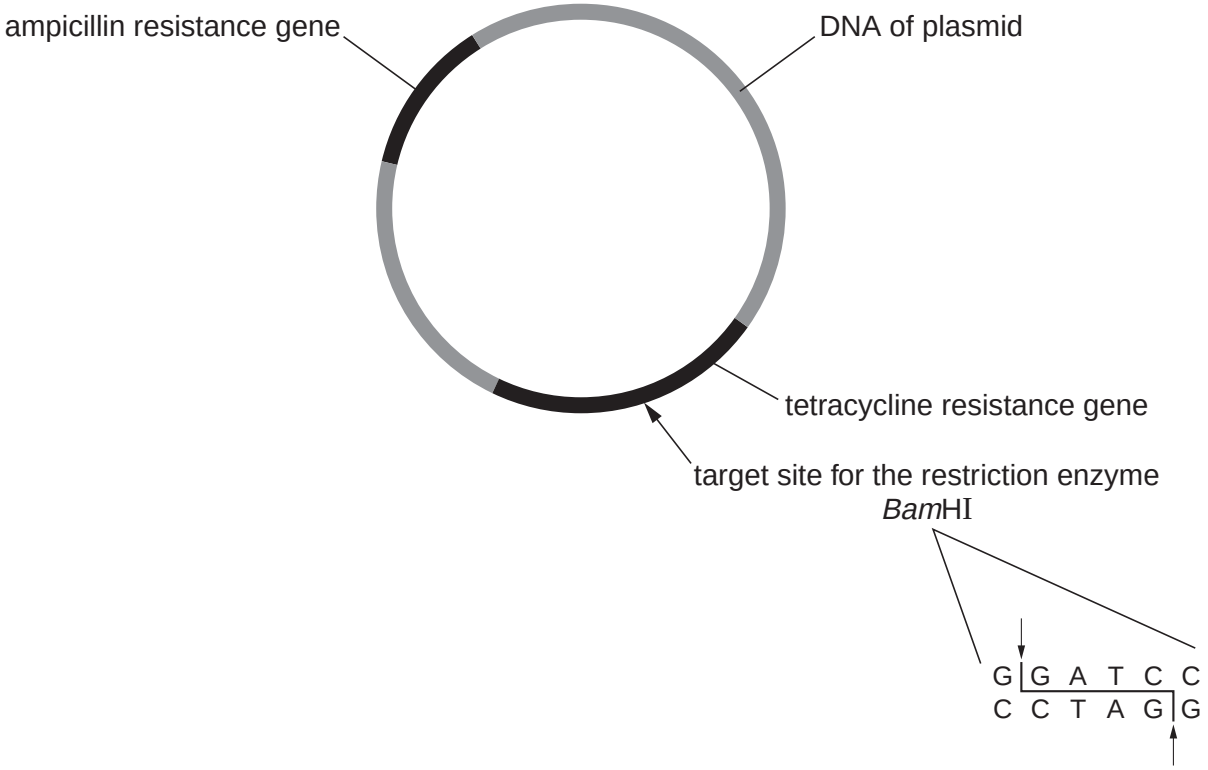

Fig. 6.1

(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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..... [2]

(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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..... [3]

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

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.....[4]

(b) Fig. 4.1 shows some of the steps involved in the production of bacteria capable of synthesising human insulin.

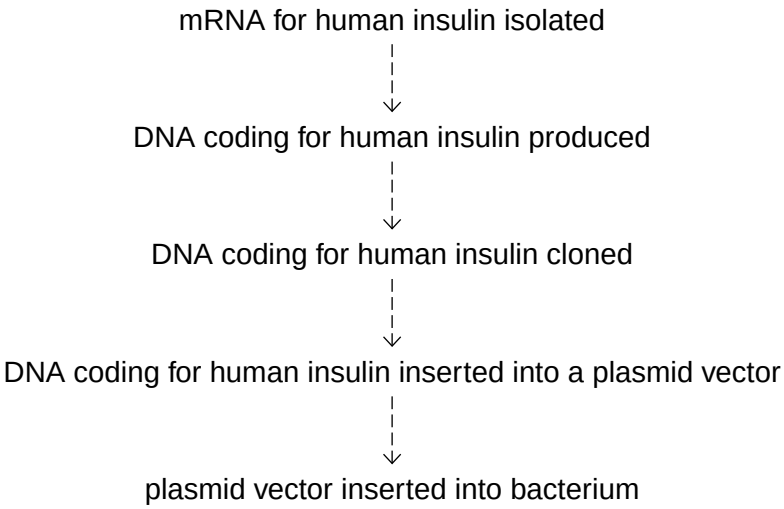

Fig. 4.1

State the role of each of the following enzymes in the production of bacteria capable of synthesising human insulin,

reverse transcriptase .....

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DNA polymerase .....

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restriction enzymes (restriction endonucleases) .....

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DNA ligase. .....

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.....[6]

[Total: 10]

3 **(a)** Penicillin belongs to a group of antibiotics known as β lactams, which all act in the same way on bacteria.

Describe how penicillin kills non-resistant bacteria.

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..... [4]

(b) One of the ways in which a bacterium may be resistant to an antibiotic, such as a β lactam, is by having protein pumps in its cell surface membrane which expel the antibiotic from the bacterium.

The gene coding for such an efflux pump is carried on a plasmid.

Outline how the bacterium produces an efflux pump from a gene on a plasmid.

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..... [3]

(c) A strain of the bacterium *Pseudomonas aeruginosa*, strain **R**, has a gene coding for an efflux pump and is resistant to a β lactam antibiotic.

The minimum inhibitory concentration (MIC) of the β lactam for strain **R** was determined. The MIC is the lowest concentration of antibiotic that prevents a colony of the bacterium from growing.

The MICs were also determined for two mutant strains derived from strain **R**, mutant strain **1** and mutant strain **2**. Each of these strains differs from strain **R** in the expression of the gene coding for the efflux pump.

The MICs for the three strains of *P. aeruginosa* are shown in Table 2.1.

Table 2.1

strain of *P. aeruginosa*	**MIC of β lactam / μg cm^{-3}**
resistant strain **R**	64
mutant strain **1**	0.5
mutant strain **2**	256

With reference to Table 2.1, suggest:

(i) why the MICs for mutant strains **1** and **2** differ from that for strain **R**

*mutant strain **1*** .....

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*mutant strain **2*** .....

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..... [4]

(ii) how a population of strain **R** of *P. aeruginosa* could be replaced by mutant strain **2**.

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[Total: 15]

4 **(a)** The pancreas acts both as an exocrine and an endocrine gland.

(i) Describe the parts of the pancreas involved in its **endocrine** function.

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.....[3]

(ii) State precisely the group of compounds to which the pancreatic hormone insulin belongs.

.....[1]

(b) People with insulin-dependent (type 1) diabetes require regular injections of insulin. In the past the insulin used came from animal sources such as pigs. Diabetics now use human insulin that has been manufactured using gene technology.

Describe the advantages of treating diabetics with insulin produced by gene technology.

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[Total: 7]

5 Enzymes are globular proteins that catalyse specific reactions.

(a) Explain how enzymes catalyse specific reactions.

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(b) Restriction enzymes cut DNA into fragments. They cut at specific sites determined by the sequence of bases. Fig. 4.1 shows the base sequences cut by three restriction enzymes and a section of DNA cut by one of these enzymes.

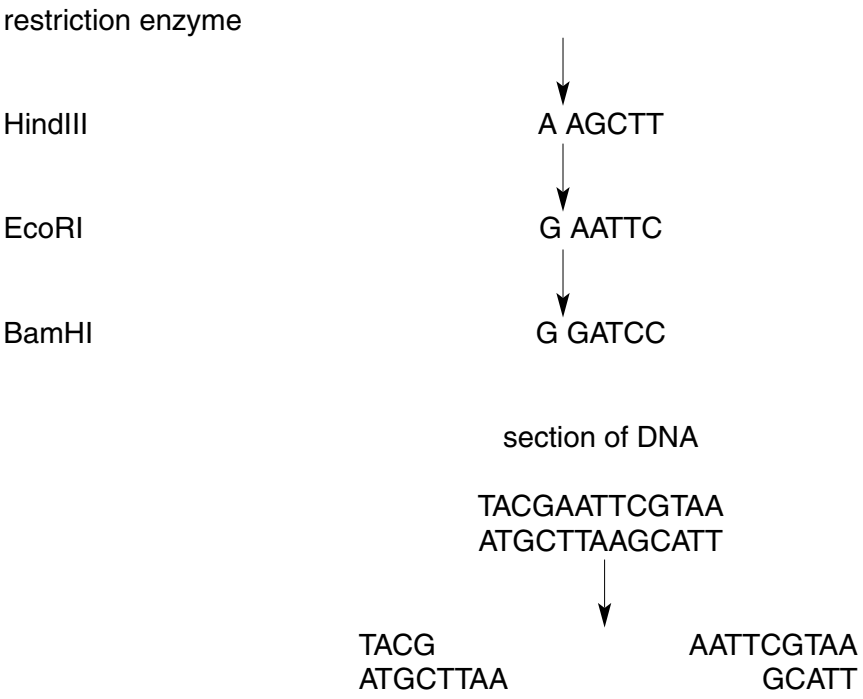

Fig. 4.1

(i) Identify the restriction enzyme that has cut the section of DNA shown in Fig. 4.1.

.....[1]

(ii) State the name given to the unpaired base sequences that remain after DNA has been cut by the three restriction enzymes shown in Fig. 4.1.

.....[1]

(c) Human genes may be cloned by inserting lengths of DNA into bacteria. This may be carried out by inserting the DNA into a plasmid.

Explain how lengths of DNA, cut by restriction enzymes, are inserted into plasmids.

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[Total : 8]