Genetic technology applied to medicine

Question Paper 2

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 2

Time Allowed : **47 minutes**

Score : **/ 39**

Percentage : **/100**

Grade Boundaries:

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

1 Factor VIII is a glycoprotein synthesised in liver cells. Many haemophiliacs, who are deficient in Factor VIII, are now treated by regular injections of genetically engineered Factor VIII. Fig. 1.1 shows the molecular structure of Factor VIII.

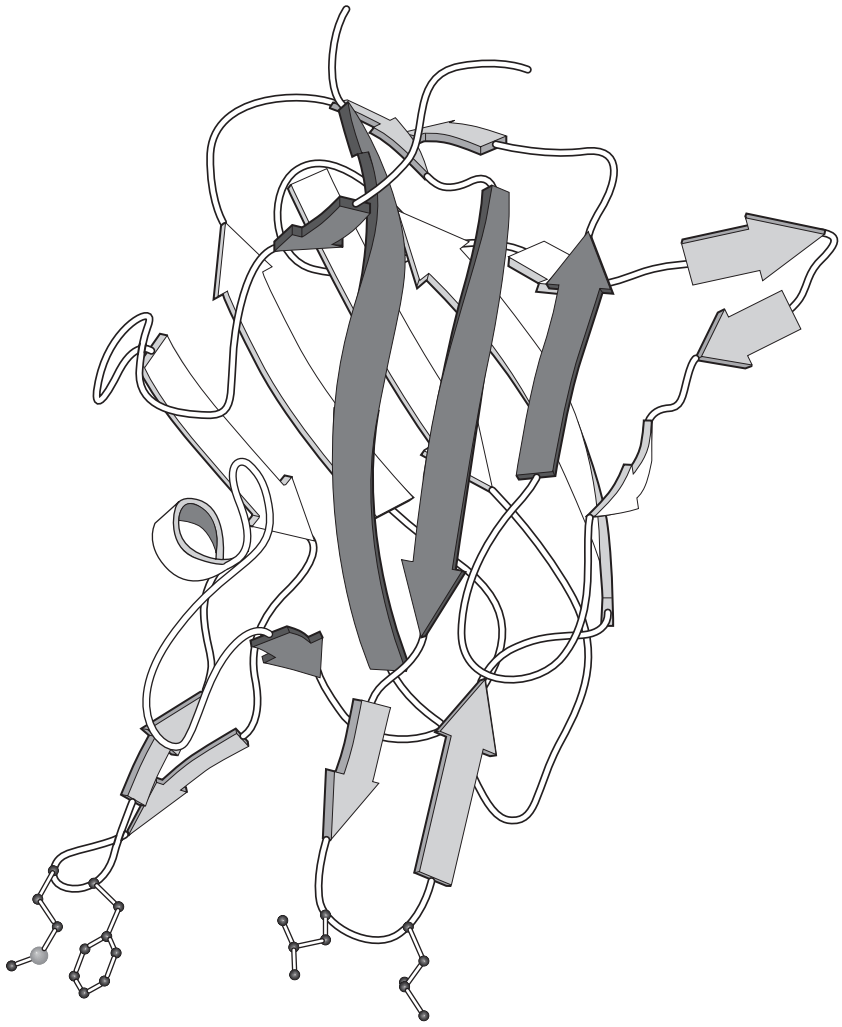

Fig. 1.1

(a) Explain how the shape of the Factor VIII protein molecule shown in Fig. 1.1 is maintained.

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(b) Outline how the isolated gene for human Factor VIII is obtained and inserted into a host cell.

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(c) State **one** advantage of using recombinant Factor VIII instead of blood derived Factor VIII.

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(d) Suggest why the host cell used to produce genetically engineered Factor VIII must be a mammalian cell and not a bacterial cell.

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[Total: 9]

2 Human insulin can be synthesised in a laboratory strain of *Escherichia coli* using recombinant DNA (rDNA) technology.

The starting point for the process is mRNA coding for insulin, isolated from human pancreas cells.

Four enzymes are needed:
- r verse transcriptase
- DNA polymerase
- rest iction enzyme
- DNA ligase.

(a) **(i)** State the role of each of these enzymes in producing rDNA carrying the gene for human insulin.

reverse transcriptase

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DNA polymerase

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restriction enzyme

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DNA ligase

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(ii) Outline the role of insulin in a healthy human.

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(iii) Describe and explain **one** advantage of treating diabetics with human insulin produced by rDNA technology.

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(b) It is possible to use rDNA technology to produce insulin with a slightly different structure from that of human insulin. The effect of the changed structure can then be investigated.

The activities of equal quantities of two insulins, both produced by *E. coli*, were compared in healthy, non-diabetic subjects:

- human insulin
- insulin **X**, in which the positions of two amino acids, lysine and proline, were exchanged. Lysine has a hydrophilic R group and proline has a hydrophobic R group.

The results of the investigation are shown in Fig. 3.1.

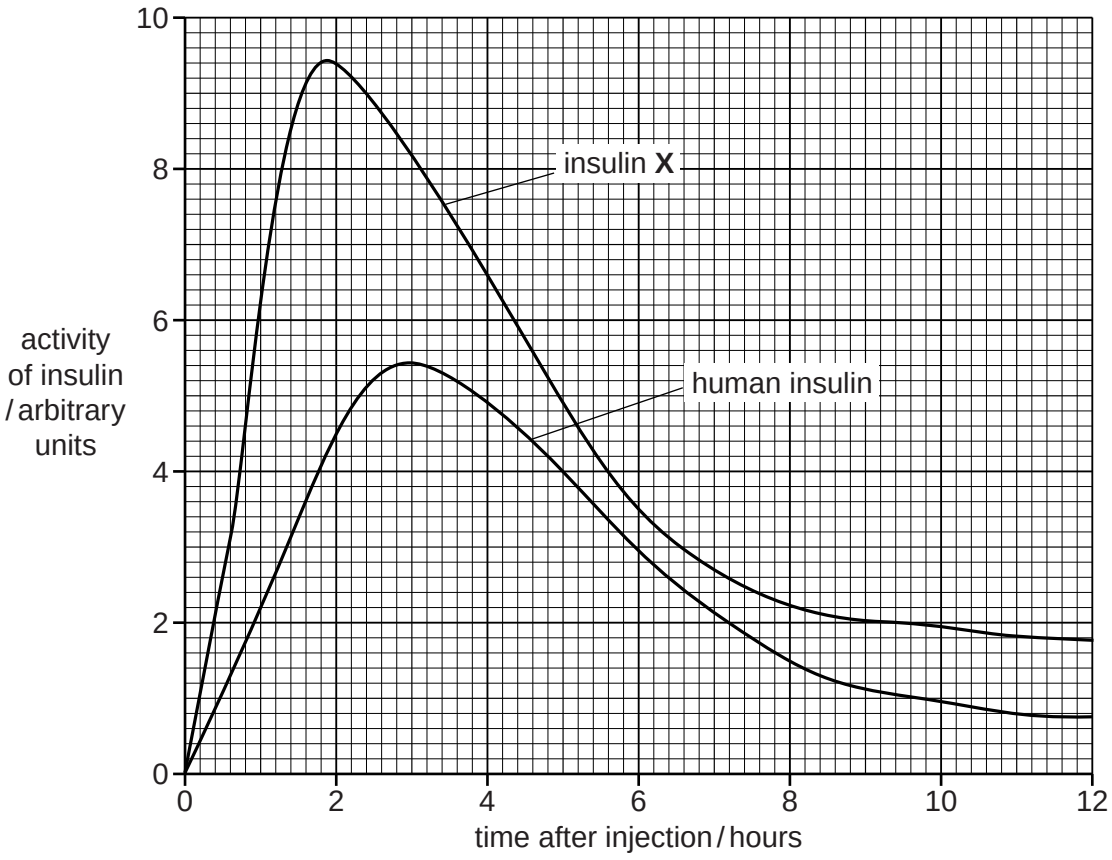

Fig. 3.1

(i) With reference to Fig. 3.1 describe the differences in activity between human insulin and insulin **X**.

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(ii) Suggest how exchanging the position of two amino acids in the insulin molecule can result in differences in activity.

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[Total: 15]

3 **(a)** Cystic fibrosis (CF) is a genetic disease caused by an autosomal recessive allele. Gene therapy has been attempted to treat CF since 1993. Outline the basic principles of gene therapy for the treatment of CF. [8]

(b) Describe the role of a genetic counsellor in dealing with genetic diseases in humans and discuss the circumstances in which a couple might be referred to a genetic counsellor. [7]

[Total: 15]

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