Antibiotics

Question Paper 4

Level	International A Level
Subject	Biology
Exam Board	CIE
Topic	Infectious disease
Sub Topic	Antibiotics
Booklet	Theory
Paper Type	Question Paper 4

Time Allowed : **68 minutes**

Score : **/ 56**

Percentage : **/100**

Grade Boundaries:

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

1 **(a)** Outline the symptoms of cystic fibrosis (CF).

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(b) CF is caused by a recessive mutation, **b**, on an autosome.

Draw a genetic diagram to show, for parents with genotypes **BbXX** and **BbXY**, the **probability** of having a daughter who suffers from CF.

In your genetic diagram, show the genotypes of the gametes and the genotypes and phenotypes of the offspring.

genetic diagram

parental genotypes **BbXX** x **BbXY**

genotypes of gametes

genotypes and phenotypes of offspring

(c) One of the many mutations for CF results in the amino acid arginine being replaced by histidine in the polypeptide encoded by the CF gene.

Explain how a mutation may cause such a change in the amino acid sequence of a polypeptide.

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(d) A genetic test was performed on two individuals, **D** and **E**, to find the base sequences of a small part of the CF gene. The different base sequences are shown diagramatically in Fig. 3.1. Individual **E** has CF.

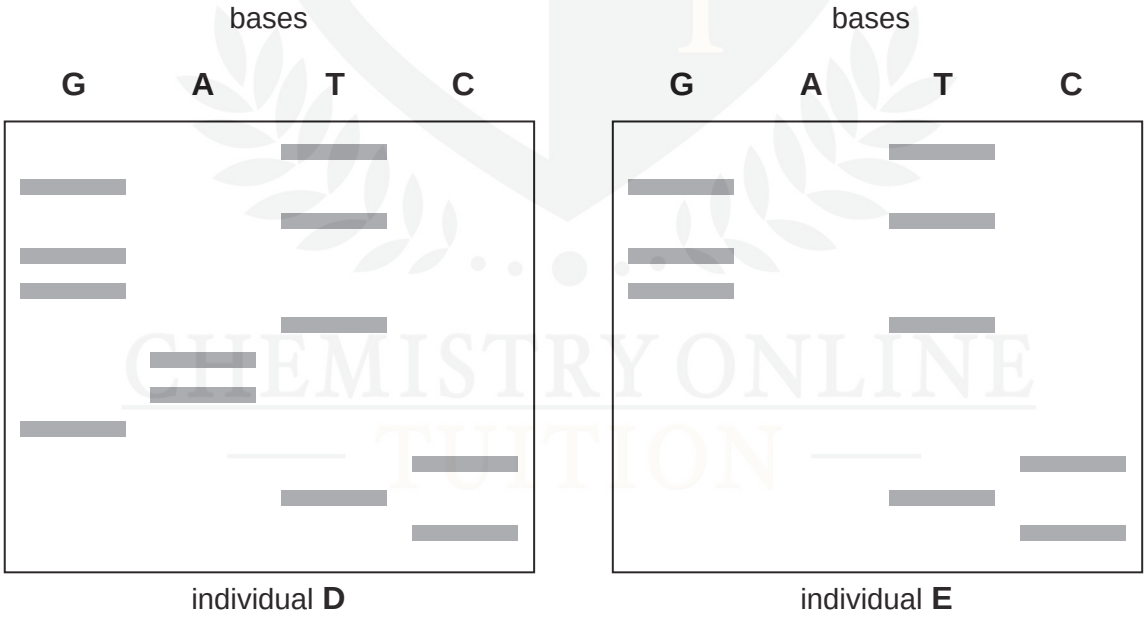

Fig. 3.1

With reference to Fig. 3.1, state,

(i) how the base sequence of **E** differs from that of **D**

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(ii) the effect of this difference in the polypeptide produced by the two individuals.

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[Total: 15]

2 (a) Describe the **advantages** of using batch culture for penicillin production and continuous culture for mycoprotein production. [8]

(b) Outline the hybridoma method for the production of a monoclonal antibody. [7]

[Total: 15]

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3 Fig. 4.1 shows the two base pairs in a DNA molecule.

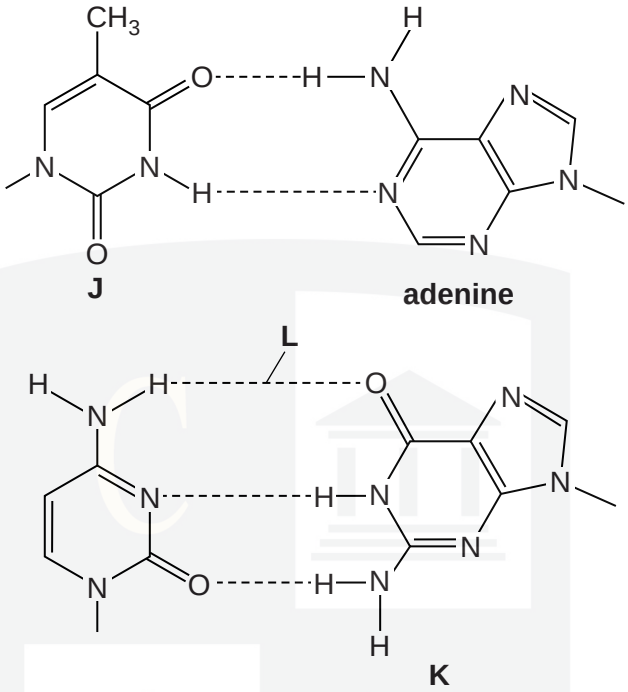

Fig. 4.1

(a) Name the bases labelled **J** and **K** and the bond labelled **L**.

J .....

K .....

L ..... [3]

HIV enters T-lymphocytes by a form of endocytosis. Two of the enzymes in HIV are:

- reverse transcriptase, which uses viral RNA as a template to make DNA to incorporate into the chromosomes of the host's cells
- protease, which is used to break a polypeptide into smaller molecules. These molecules are used to make the protein coat of new viral particles, which will infect other cells.

Various drugs have been developed to treat HIV infections. Table 4.1 gives information about some of these drugs.

Table 4.1

drug	**enzyme inhibited**	**mode of action**
zidovudine	reverse transcriptase	occupies active site
tenofovir	reverse transcriptase	occupies active site
efavirenz	reverse transcriptase	occupies sites other than the active site
atazanavir	protease	occupies active site

(b) Explain the difference between the mode of action of zidovudine and efavirenz.

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(c) People who receive drug treatment for HIV take a mixture of drugs that act in different ways.

Suggest the advantage of taking a mix of the drugs shown in Table 4.1.

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(d) Antibiotics are prescribed to people who have HIV/AIDS for the treatment of secondary infections, but not to treat the HIV infection.

Explain why this is so.

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[Total: 11]

4 The artificial plasmid, pBR322, was constructed to act as a vector. It has often been used to insert human genes, such as the human insulin gene, into the bacterium, *Escherichia coli*.

The plasmid was constructed to include two genes, each giving resistance to a different antibiotic: an ampicillin resistance gene and a tetracycline resistance gene. The plasmid also has a target site for the restriction enzyme, *Bam*HI, in the middle of the tetracycline resistance gene.

A pBR322 plasmid was cut using *Bam*HI and the cDNA gene for human insulin inserted into it.

Fig. 2.1 shows pBR322 and the recombinant plasmid.

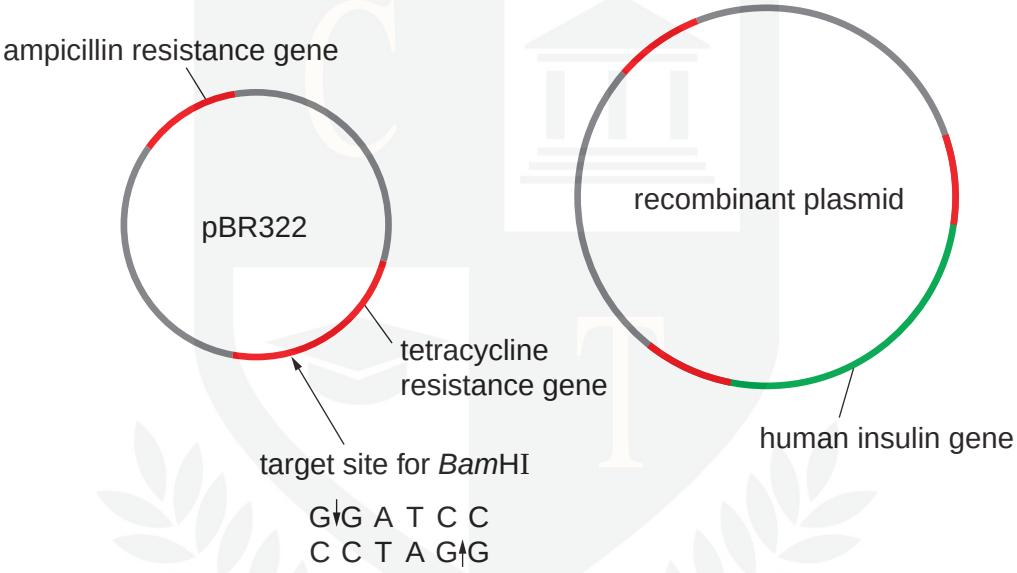

Fig. 2.1

(a) With reference to Fig. 2.1, describe how a cDNA human insulin gene can be inserted into pBR322 that has been cut by *Bam*HI.

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(b) Bacteria were then mixed with the recombinant plasmids. Those bacteria which had successfully taken up recombinant plasmids were identified using the following steps:

step 1 – the bacteria were spread onto culture plates containing nutrient agar and ampicillin and incubated to allow colonies to form

step 2 – some bacteria from each of the colonies growing on these plates were transferred to plates containing nutrient agar and tetracycline, as shown in Fig. 2.2.

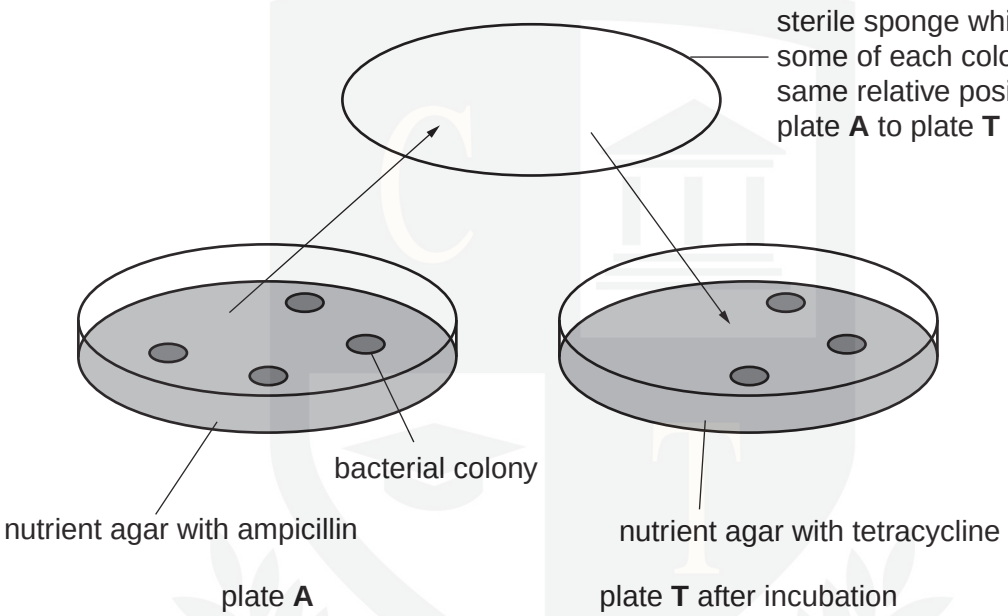

Fig. 2.2

(i) Explain why the bacteria were first spread onto plates containing ampicillin.

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(ii) Explain why it is important, for identifying bacteria that have successfully taken up the recombinant plasmid, that on pBR322 the target site for *Bam*HI is in the middle of the tetracycline resistance gene.

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(iii) Use a label line and the letter **C** to identify, on Fig. 2.2, a colony of bacteria that contain the recombinant plasmid.

Put your answer onto Fig. 2.2 on page 5. [1]

(c) Plasmid vectors carrying antibiotic resistance genes are now rarely used in gene technology.

(i) Explain why antibiotic resistance genes are now rarely used.

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(ii) State one type of gene that has replaced antibiotic resistance genes in plasmid vectors and indicate how its presence can be detected.

type of gene .....

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detection.....

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[Total: 15]