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NANYANG JUNIOR COLLEGE
JC 2 PRELIMINARY EXAMINATION
Higher 1

CANDIDATE NAME

CLASS

BIOLOGY

8875/02

Paper 2 Core Paper

19 September 2016

Additional Materials: Answer Paper

2 hours

READ THESE INSTRUCTIONS FIRST

Write your Centre number, index number and name on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Section A

Answer **all** questions.

Section B

Answer **one** question.

The use of an approved scientific calculator is expected, where appropriate. ,
You may lose marks if you do not show your working or if you do not use appropriate units.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

For Examiner's Use	
Section A	
1	
2	
3	
4	
5 or 6	
Total	

This document consists of **16** printed pages and **2** blank pages.

[Turn over]

Section A

Answer **all** the questions in this section.

1 Many microorganisms can digest cellulose by using a group of enzymes collectively known as cellulases. Cellobiose is the disaccharide produced during cellulose digestion.

The cellulase known as β-glucosidase completes the digestion of cellulose by hydrolysing the cellobiose molecule to produce two β-glucose molecules.

(a) Draw the ring structure of one β-glucose molecule in the space provided.

[1]

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(b) β-glucosidase was extracted from two different bacteria, *Agrobacterium tumefaciens* and *Thermotoga maritima*.

Fig. 1.1 shows the results of an investigation into the effect of temperature between 0 °C and 100 °C, on the activity of each enzyme.

- **L** represents the lowest temperature at which activity of each enzyme was detected.
- **H** represents the highest temperature at which activity of each enzyme was detected.

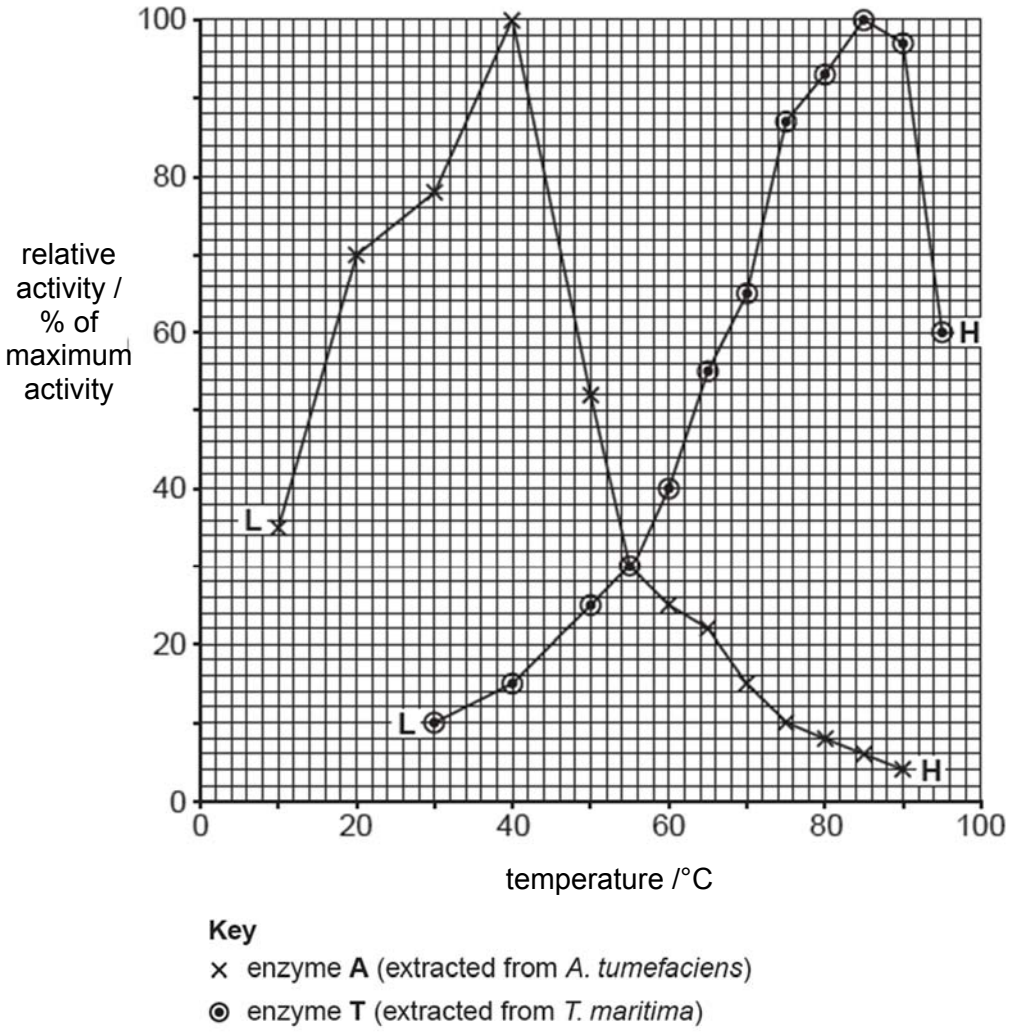

Fig. 1.1

(i) With reference to Fig. 1.1, describe the **differences** in the results for the two enzymes, **A** and **T**.

[3]

(ii) Both enzyme A and enzyme T act on cellobiose. They have a similar, but not identical, primary structure.

Suggest how similarities **and** differences in the primary structure of the two enzymes could help to explain the results obtained in the investigation.

[3]

[Total: 7]

2 The micrographs below show nuclei of cells at different phases during meiosis in an animal.

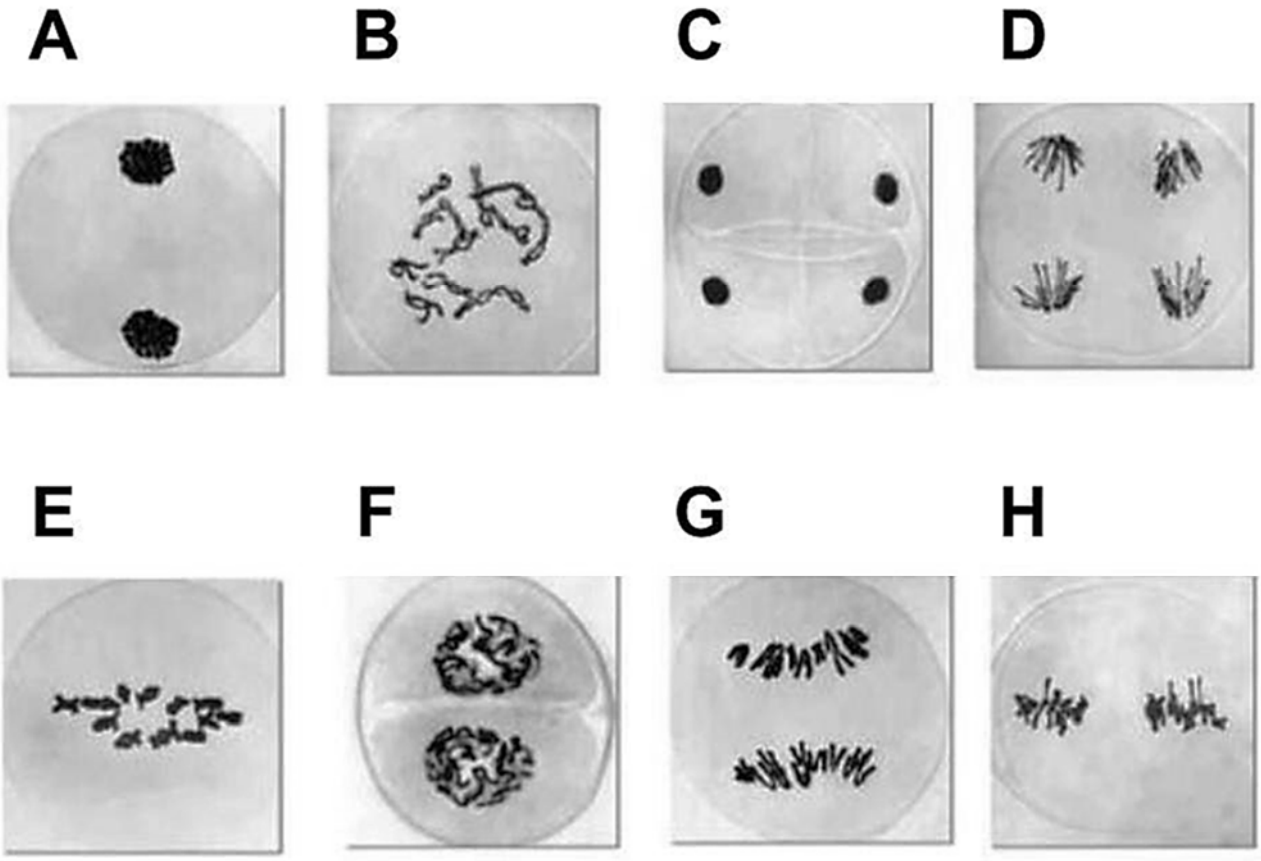

Fig. 2.1

(a) Micrograph B shows Prophase I. Arrange the letters shown on the micrographs to indicate the correct chronological sequence.

.....

[1]

(b) There are 50 units of DNA in the cell shown in micrograph B and the diploid number is 20.

(i) State the units of DNA in this cell during G1 phase prior to mitosis.

.....

[1]

(ii) State the number of chromosomes in the mature sperm of this animal.

.....

[1]

(c) Contrast the behaviour of chromosomes in mitosis and meiosis.

[3]

A genetically modified tomato, known as Flavr Savr, is the first genetically modified food to be commercially sold for human consumption. This tomato is made more rot-resistant by adding an antisense gene (oligonucleotide - a short RNA or DNA molecule complementary to mRNA produced by a gene) to interfere with the production of the enzyme polygalacturonase (PG). The enzyme causes the softening of the fruit by degrading pectin and this result in the fruit being more susceptible to being damaged by fungal infection.

PG production during fruit ripening was measured in plants with one and with two antisense genes, and in normal plants. The results are shown in Fig. 2.2.

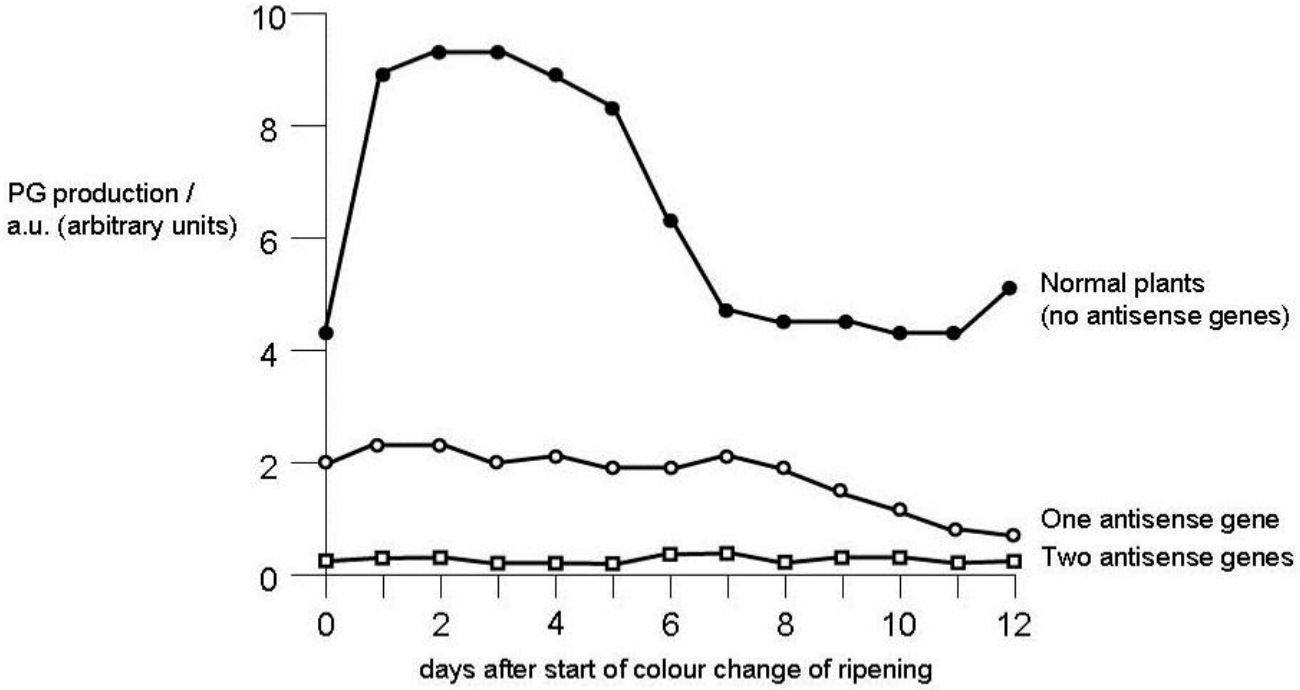

Fig. 2.2

(d) With reference to Fig. 2.2, describe and explain the difference in PG production between

(i) normal tomato plants and transformed plants with one antisense gene.

[3]

(ii) transformed plants with one antisense gene and those with two antisense genes.

[2]

[Total: 11]

3 A suspension of mitochondria was isolated from liver tissue and mixed with sucrose solution. A respiratory substrate was added. After that various substances were added to the suspension, at different time intervals and the amount of oxygen remaining in the preparation was monitored over some time. Fig. 3.1 shows the results as well as the times at which different substances were added.

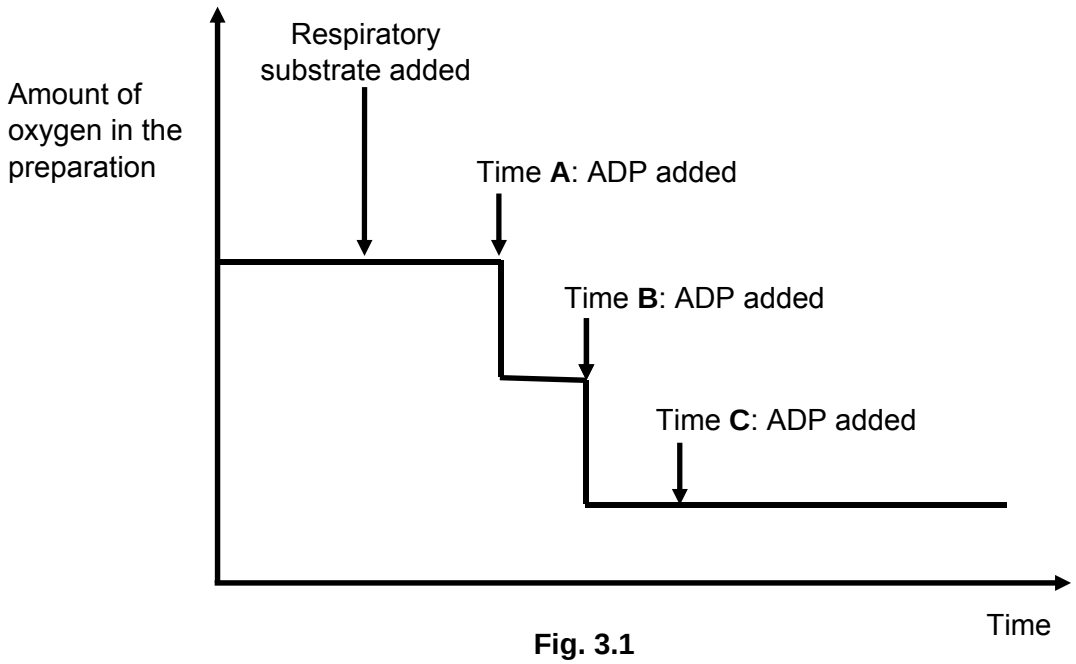

Fig. 3.1

(a) Explain why is there a need to add sucrose?

[2]

(b) Explain why glucose cannot be the respiratory substrate that was added.

[2]

(c) Explain the change in the amount of oxygen between Time A and Time B.

[2]

(d) Account for the shape of the graph after Time C.

[1]

In aerobic respiration of the organelle, acetylcoenzyme A is broken down as shown in **Fig. 3.2**.

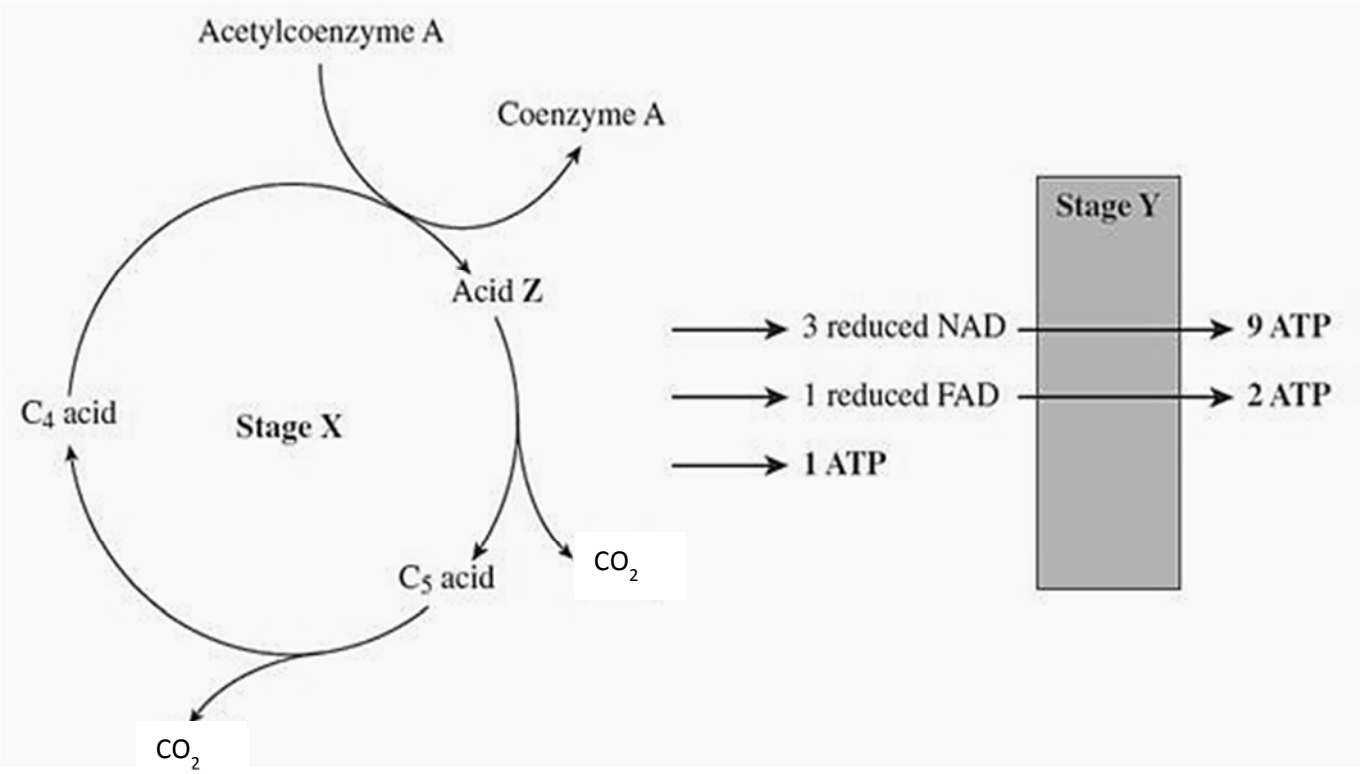

Fig. 3.2

Different fatty acids contain different numbers of carbon atoms. The first stages in the aerobic respiration of palmitic acid of stearic acid are given in equations 2 and 3

Equation 2

$C_{15}H_{31}COOH$ + 8 Coenzyme A + 7 NAD + 7 FAD + 2 ATP → 8 Acetylcoenzyme A + 7 reduced NAD + 7 reduced FAD + 2 ADP + 2Pi

Palmitic acid

Equation 3

$C_{17}H_{35}COOH$ + 9 Coenzyme A + 8 NAD + 8 FAD + 2 ATP → 9 Acetylcoenzyme A + 8 reduced NAD + 8 reduced FAD + 2 ADP + 2Pi

Stearic acid

(e) The greater the number of carbon atoms in a fatty acid, the greater the yield of ATP when the fatty acid molecule is respired aerobically. Use Fig. 3.2 and equations 2 and 3 to explain why.

[2]

[Total: 9]

4 Factor VII is an essential blood clotting protein encoded by the gene *F8.* A deficiency of this protein in humans results in the failure of blood coagulation and hence, one suffers from the bleeding disorder haemophilia. Currently, *F8* can be artificially synthesized and inserted into the plasmid pGB119 to produce Factor VIII in bacteria. Factor VIII is then transfused into the blood of patients suffering from haemophilia. Fig. 4.1 is a plasmid map of pGB119.

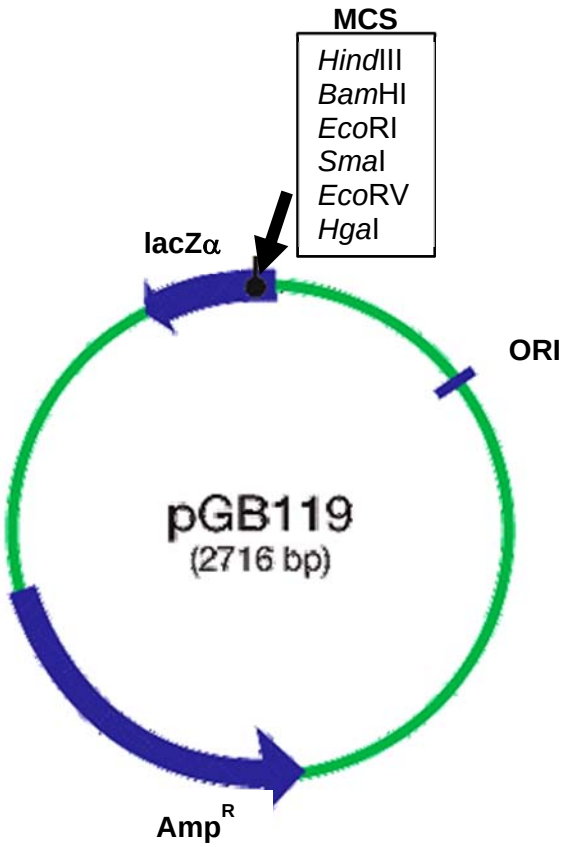

Fig. 4.1

The multiple cloning site (MCS) allows a large number of restriction enzymes to cut pGB119, producing sticky ends or blunt ends. The restriction enzyme *Bam*HI is used in the production of the recombinant plasmid with *F8,* which is then used to transform bacteria.

(a) Compare the way in which sticky ends and blunt ends are produced.

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.....

.....

.....

[2]

(b) The protein Factor VIII produced by the recombinant bacteria is identical to Factor VIII synthesized in humans. However, the engineered gene inserted into the plasmid may possess a nucleotide sequence that is different from that of a human gene.

Give reasons why this is so.

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.....

.....

.....

[2]

The plasmid Pgb119 is engineered to contain the marker gene *Hok* that codes for a protein found to be toxic to host bacteria, as it damages the cell membrane. Fig. 4.2 shows pGB119 with the MCS in the *Hok* gene.

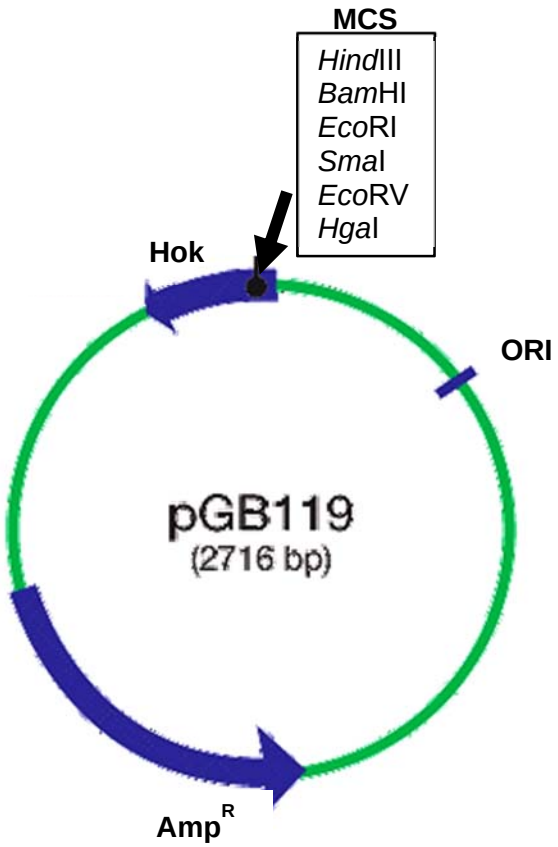

Fig. 4.2

(c) Bacteria transformed with either reannealed or recombinant pGB119 were plated onto a nutrient agar plate and left for a few days. Explain how the two types of bacteria can be distinguished from each other.

[4]

Dogs have been used as animal models of haemophilia. Two populations of a dog species affected with haemophilia living in the wild were studied. One population was found to occupy the lowlands while the other population was found to occupy the highlands. While the dogs in the two populations were very similar, some phenotypic differences were observed to be present.

(d) Explain the presence of phenotypic differences between the dogs in the two populations.

[3]

(e) To determine if a dog species and wolf species are related, an investigator studied DNA sequences which codes for an important protein that performs the same function in both species.

Sequence A (from dog species) and Sequence B (from wolf species) were identical except at two points.

Explain how Sequences A and B provide evidence to support the theory of evolution.

[2]

[Total: 13]

Section B

Answer EITHER 5 OR 6.

Write your answers on the separate answer paper provided.
Your answers should be illustrated by large, clearly labelled diagrams, where appropriate.
Your answers must be in continuous prose, where appropriate.
Your answers must be set out in sections (a), **(b)** etc., as indicated in the question.

Either

5 **(a)** Discuss the importance of genetic variation in natural selection and evolution. [6]

(b) Outline the large scale production of human insulin using genetic engineering. [8]

(c) Discuss the ethical and social implications of genetically modified crop plants. [6]

[Total: 20]

Or

(a) Describe and explain the advantages of molecular (nucleotide and amino acid sequences) methods in classifying organisms. [6]

(b) Describe how information on mature mRNA is used to synthesise polypeptides in eukaryotes. [8]

(c) With reference to solving the demand for food in the world, explain, with a named example, the significance of genetically engineered crop plants to improve their yield. [6]

[Total: 20]