



MERIDIAN JUNIOR COLLEGE
JC2 Preliminary Examinations 2017
Higher 1

CANDIDATE
NAME

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CIVICS
GROUP

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INDEX
NUMBER

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H1 BIOLOGY

8875/02

Paper 2

15 September 2017

2 hours

READ THESE INSTRUCTIONS FIRST

Do not open this booklet until you are told to do so.

Write your name, civics group and index number on all the work you hand in.

Write in dark blue or black pen on both sides of the paper.

You may use a soft pencil for any diagrams, graphs or rough working.

Do not use staples, paper clips, highlighters, glue or correction fluid/tape.

Section A

Answer **all** questions.

Section B

Answer **one** question.

The number of marks is given in brackets [] at the end of each question or part question.

For examiner's Use	
Section A	
1	/ 14
2	/ 7
3	/ 9
4	/ 10
Section B	
5 or 6	/ 20
Total	/ 60

This paper consists of **16** printed pages.

[Turn over]

Section A

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

QUESTION 1

Pepsin is an enzyme that digests protein. It is synthesized in the cells of the stomach as a longer, inactive proenzyme called pepsinogen. Secretion of pepsinogen into the acidic environment of the stomach then activates it.

Fig. 1.1 shows the structures of pepsinogen and pepsin. The active site of pepsin is indicated.

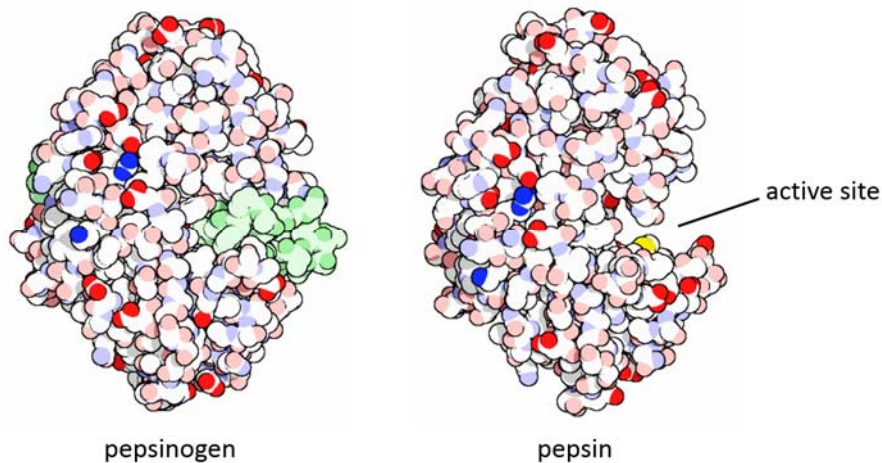


Fig. 1.1

- a) With reference to Fig. 1.1, explain how the structure of pepsinogen allows it to be inactive. [2]

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- b) Explain how a point mutation on DNA can change the primary structure of pepsin but not its globular structure. [4]

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- c) Pepsinogen is secreted by the gastric chief cells of the stomach. These cells also synthesize and secrete gastric lipases that hydrolyze lipids.

Explain how gastric chief cells are structurally adapted for its role. [3]

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- d) Another enzyme, DNA polymerase, carries out DNA replication with tight coordination of leading and lagging strand synthesis.

Describe **two** structural differences between DNA polymerase and its substrate. [2]

1.
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2.
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e) Fig. 1.2 shows the transport of substances in and out of the nucleus via the nuclear pore.

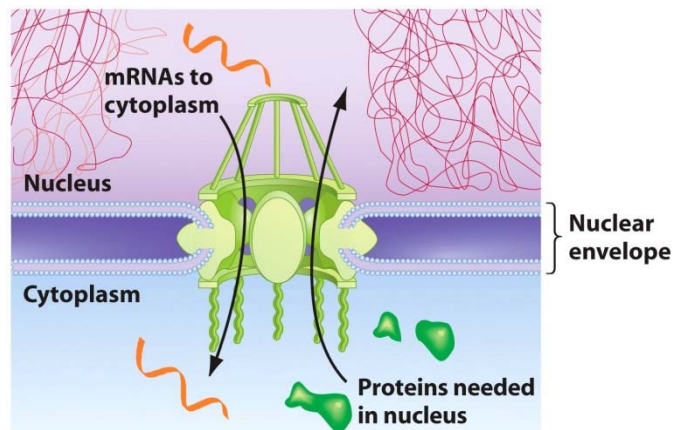


Fig. 1.2

i) Apart from enzymes and proteins that are directly involved in DNA replication and transcription, suggest **two** other substances that are transported from the cytosol into the nucleus. [2]

1.
2.

ii) Apart from messenger RNAs that exit the nucleus into the cytosol, suggest **one** other substances that are transported out of the nucleus. [1]

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[Total: 14]

QUESTION 2

In 1865, Gregor Mendel performed dihybrid crosses on pea plants for a variety of characteristics including flower colour, flower position and height (length of stem). From his observations he developed a fundamental law of genetics that some genetic characteristics are inherited independently.

For example, pure-breeding pea plants with red flowers on the sides of stems (axial) can be crossed with pure-breeding pea plants with white flowers on the ends of stems (terminal).

All the resultant plants (F_1 generation) have red flowers that are axial.

One set of results for the offspring from self-pollinating these F_1 plants is shown below.

261	red, axial flowers
86	red, terminal flowers
76	white, axial flowers
28	white, terminal flowers

a) Draw a genetic diagram to explain both crosses.

Use the following symbols to represent the different alleles involved:

R/r – Flower colour

A/a – Flower position

[5]

b) Explain how different characteristics are inherited independently in dihybrid inheritance. [2]

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[Total: 7]

QUESTION 3

A recent study of populations of the house mouse, *Mus musculus*, on the island of Madeira resulted in the following observations:

- There are six distinct populations.
- The mice are associated with human settlements.
- The populations are located in different valleys separated by steep mountains.
- Each population has a different diploid number of chromosomes

As a result of these observations, it has been suggested that evolution is taking place, leading to the formation of six different species.

Fig. 3.1 is a schematic representation of Madeira showing the distribution of the six populations.

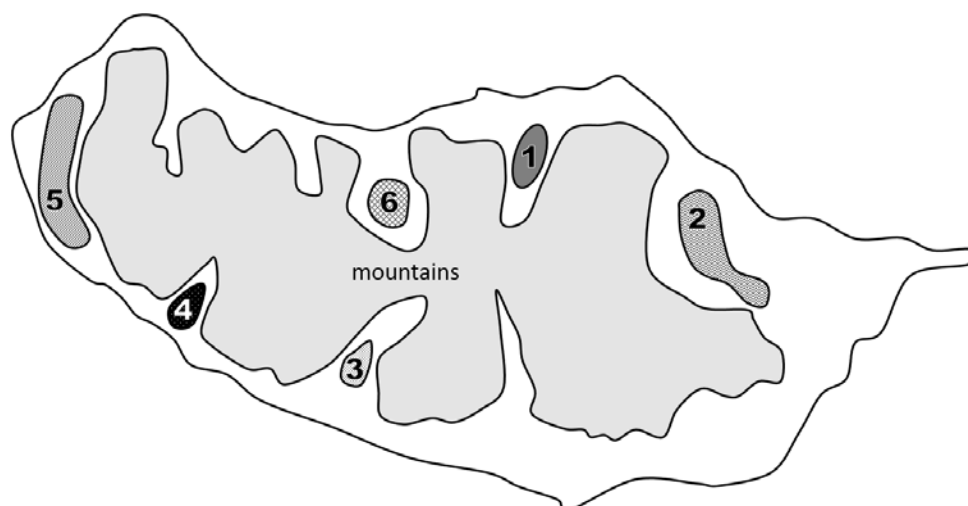


Fig. 3.1

- a) *'It has been suggested that evolution is taking place, leading to the formation of six different species.'*

Explain how this process is occurring in the house mouse populations of Madeira. [4]

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- b)** Explain the likely outcome of individuals from two separate populations being mated in captivity. [2]

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- c)** Cytochrome c is a protein that is found in all living organisms. Analysis of the amino acid sequences of proteins, such as cytochrome c, provides data that taxonomists use to produce more accurate classifications.

Explain why analyzing the amino acid sequences of proteins could provide useful data for taxonomists. [3]

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[Total: 9]

QUESTION 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-resistant gene and a tetracycline-resistant 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. 4.1 shows pBR322 and the recombinant plasmid.

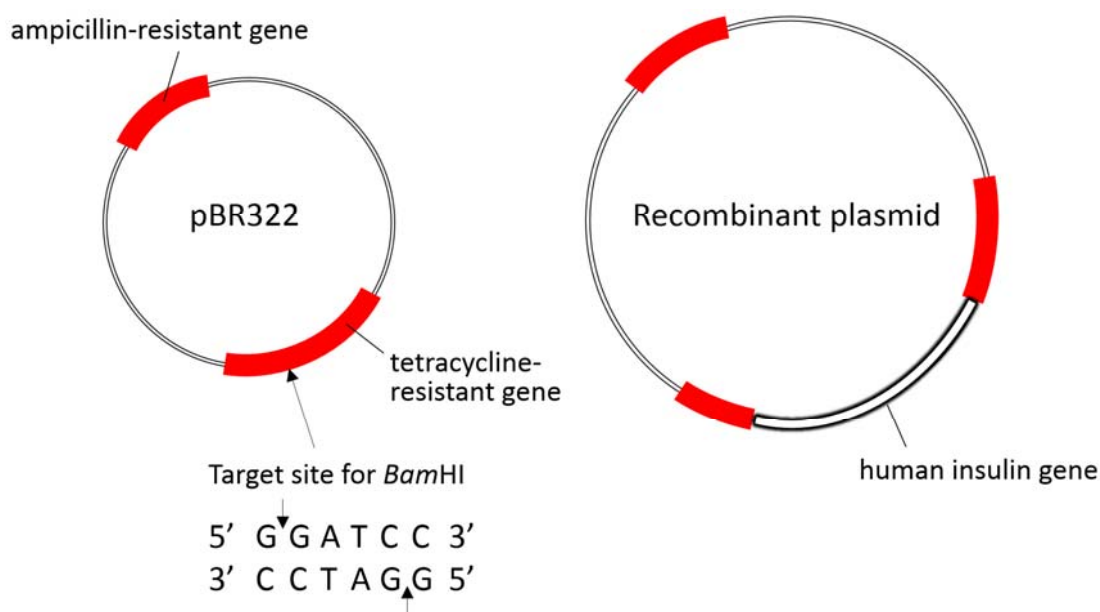


Fig. 4.1

- a) The cDNA of human insulin gene obtained by reverse transcription does not contain sticky ends.

With reference to Fig. 4.1, describe how a cDNA of human insulin gene can be inserted into pBR322 that has been cut by *Bam*HI. [3]

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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 (replica plating) containing nutrient agar and tetracycline, as shown in Fig. 4.2.

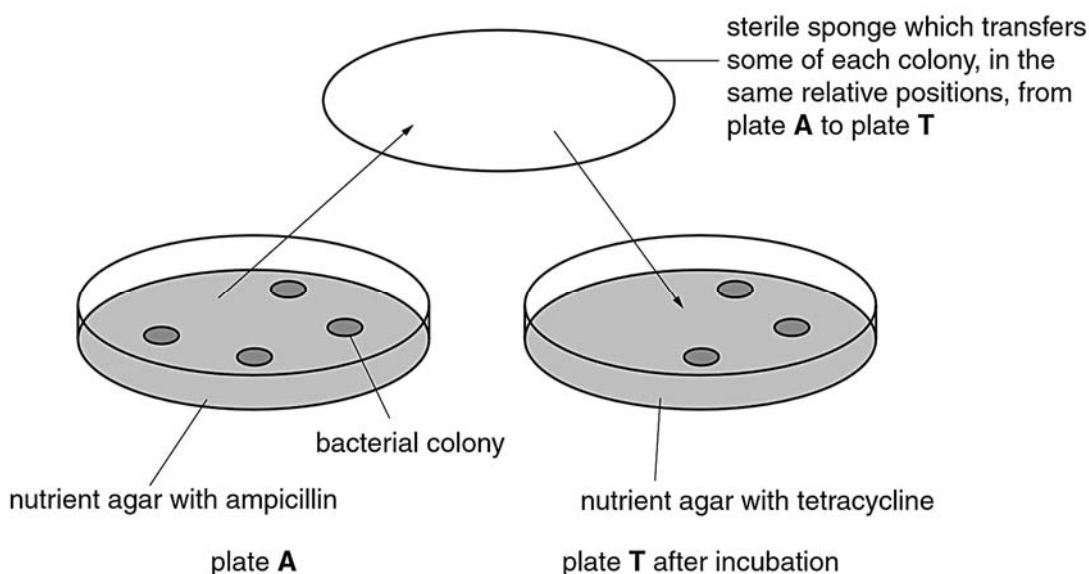


Fig. 4.2

- i) Explain why the bacteria were first spread onto plates containing ampicillin. [2]

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- ii) Explain why it is important that on the pBR322 plasmid, the target site for *Bam*HI is in the middle of the tetracycline resistance gene. [3]

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- iii) Use a label line and the letter **C** to identify, on Fig. 4.2, a colony of bacteria that contains the recombinant plasmid. [1]

- c) Plasmid vectors carrying antibiotic-resistant genes are now rarely used in gene technology because of the risk of transferring these genes to other bacteria that are previously susceptible to that antibiotic, hence conferring antibiotic-resistance to these bacteria.

State one type of gene that has replaced antibiotic-resistant genes in plasmid vectors **and** indicate how bacteria carrying this gene can be detected. [1]

Gene

Detection

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[Total: 10]

Section B
Answer **ONE** questions

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

QUESTION 5

- a)** DNA molecules replicate with a high degree of accuracy, yet not always perfectly.

Describe how this occurs and discuss why the survival of a species depends on DNA molecules being stable, yet not *absolutely* stable. [10]

- b)** Explain the underlying principles of the polymerase chain reaction (PCR) **and** explain how the specificity of PCR is achieved. [5]

- c)** Describe the process of endocytosis. [5]

[Total: 20]

QUESTION 6

- a)** Discuss the importance of hydrogen bonding in ensuring the continuity of life. [10]

- b)** Outline the functions of membranes **within** cells. [5]

- c)** With reference to specific examples, discuss the roles of coenzymes in yeast. [5]

[Total: 20]

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[illegible]

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[illegible]

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