

NATIONAL JUNIOR COLLEGE, SINGAPORE
Senior High 2
Preliminary Examination
Higher 1

CANDIDATE
NAME

BIOLOGY
CLASS

2bi2____ / 2IPbi2__

REGISTRATION NUMBER

BIOLOGY

Paper 2

8875/02

26 August 2016

2 hours

Additional Materials: Answer Paper

READ THESE INSTRUCTIONS FIRST

Write your name and Biology class 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.

Section A

Answer **all** the 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 the brackets [] at the end of each question or part question.

For Examiner's Use	
Section A	(Total: 40)
1	/ 12
2	/ 12
3	/ 7
4	/ 9
Section B	(Total: 20)
5 or 6	/ 20
Total	/ 100

This document consists of **15** printed pages.

Section A

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

- 1 Fig. 1.1 shows the main steps involved in the synthesis of preproinsulin to insulin in the pancreatic β -cell. The preproinsulin is synthesised into the lumen of organelle **A** as proinsulin.

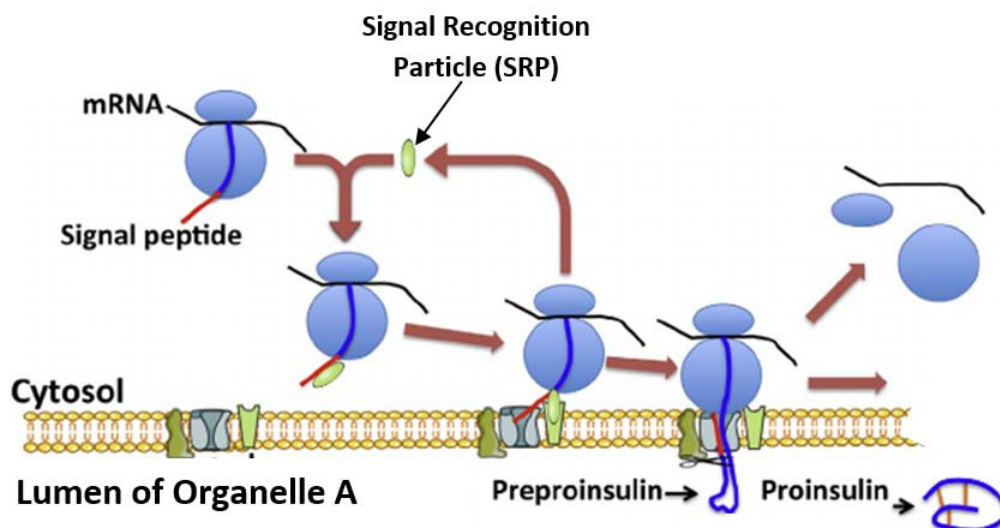


Fig. 1.1

The proinsulin is then be transported to organelle **B** where it is further processed to form insulin.

Fig. 1.2 shows the conversion of proinsulin to insulin in organelle **B**.

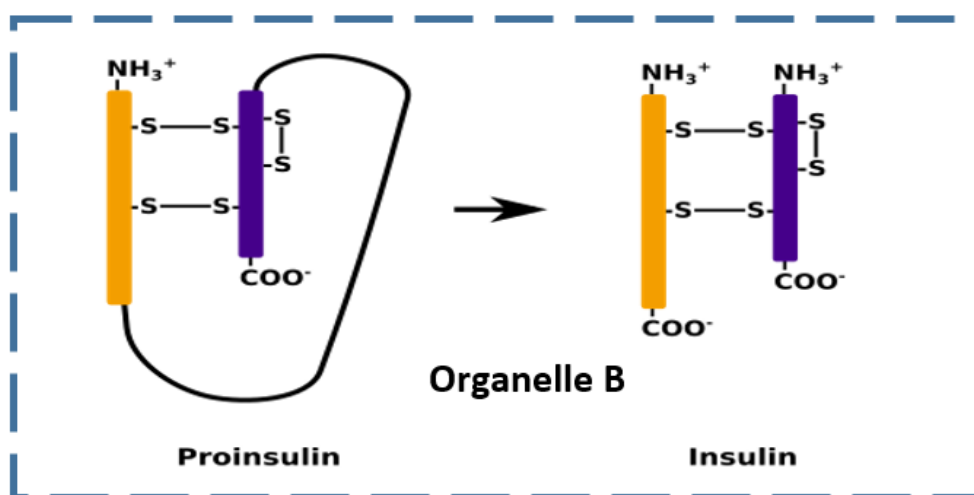


Fig. 1.2

(a) Name the organelles labelled **A** and **B**.

organelle **A**:

organelle **B**:

[1]

(b) State the role of rRNA in insulin protein synthesis

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[2]

(c) Insulin is released by pancreatic β -cell. Outline the route taken by proinsulin.

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[2]

Fig. 1.3 shows the structure of small sections of DNA and messenger RNA (mRNA) in the nucleus of pancreatic β -cell during transcription of the gene coding for insulin.

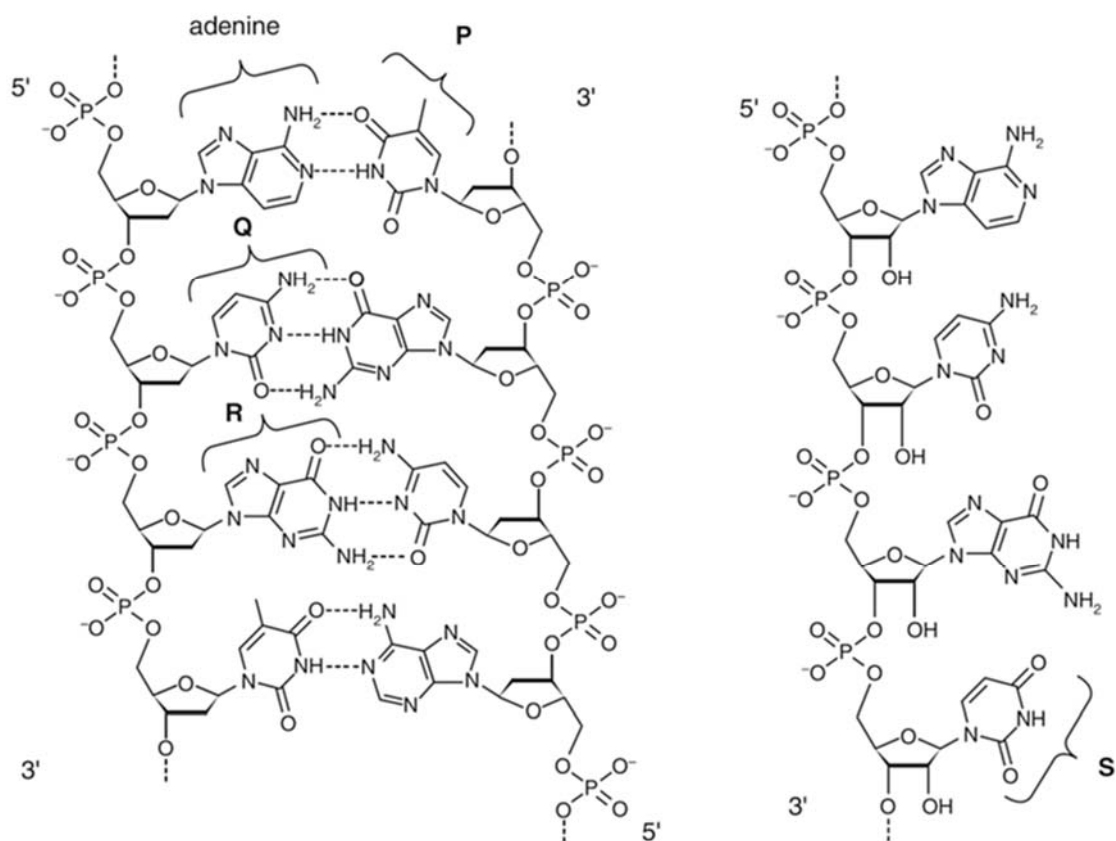


Fig. 1.3

(d) Name the bases **P** to **S**.

P:

Q:

R:

S:

[2]

(e) Describe how messenger RNA coding for insulin is synthesised in pancreatic β -cell.

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..... [3]

(f) Explain why gene mutations do not always produce mutated insulin protein whereas mutations of the splicing sites involved in RNA splicing will produce mutated insulin.

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..... [2]

[Total: 12]

- 2 Clover is an important crop plant grown as food for sheep and cattle. It is a leguminous plant and its root nodules contain nitrogen-fixing bacteria.

Some clover plants can produce hydrogen cyanide when their tissues are damaged. This is a poisonous compound which will prevent herbivores such as slugs from feeding on the plant. Cyanide is also poisonous to the plants that produce them. Those plants that can produce cyanide are called cyanogenic; those that cannot are called acyanogenic.

Fig. 2.1 shows how the production of cyanide in a species of European clover is genetically controlled.

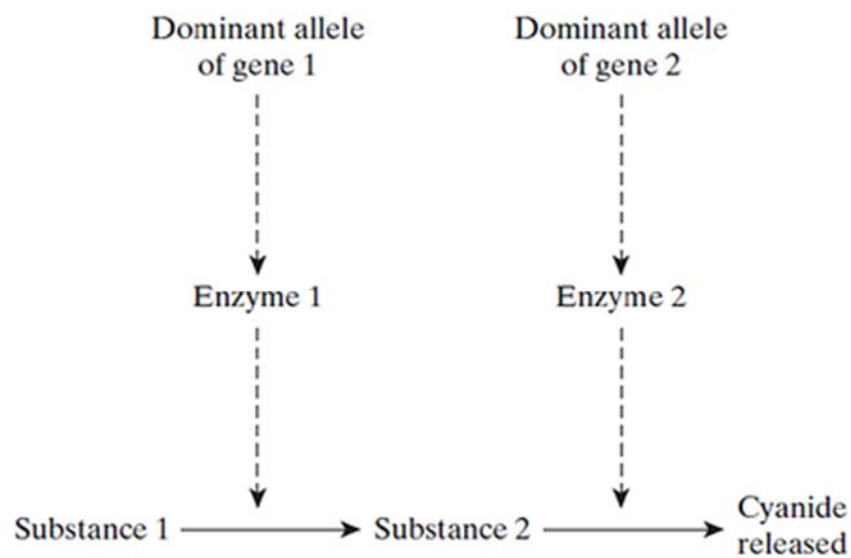


Fig. 2.1

- (a) Distinguish between gene and alleles.

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[2]

- (b) Using appropriate symbols, show by means of a genetic diagram, the different genotypes and phenotypes obtained when two plants that are heterozygous at both the gene loci are crossed.

When the leaves of cyanogenic plants are damaged by slugs, or exposed to low temperatures, membranes within the cells are broken. This causes the release of the enzymes that control the reactions that produce cyanide.

Fig. 2.2 shows the proportions of cyanogenic and acyanogenic plants in clover populations in different parts of Europe and the mean minimum winter temperatures. It also shows isotherms, which are lines joining places with the same mean January temperature. Slugs are not usually active at temperatures below 0°C.

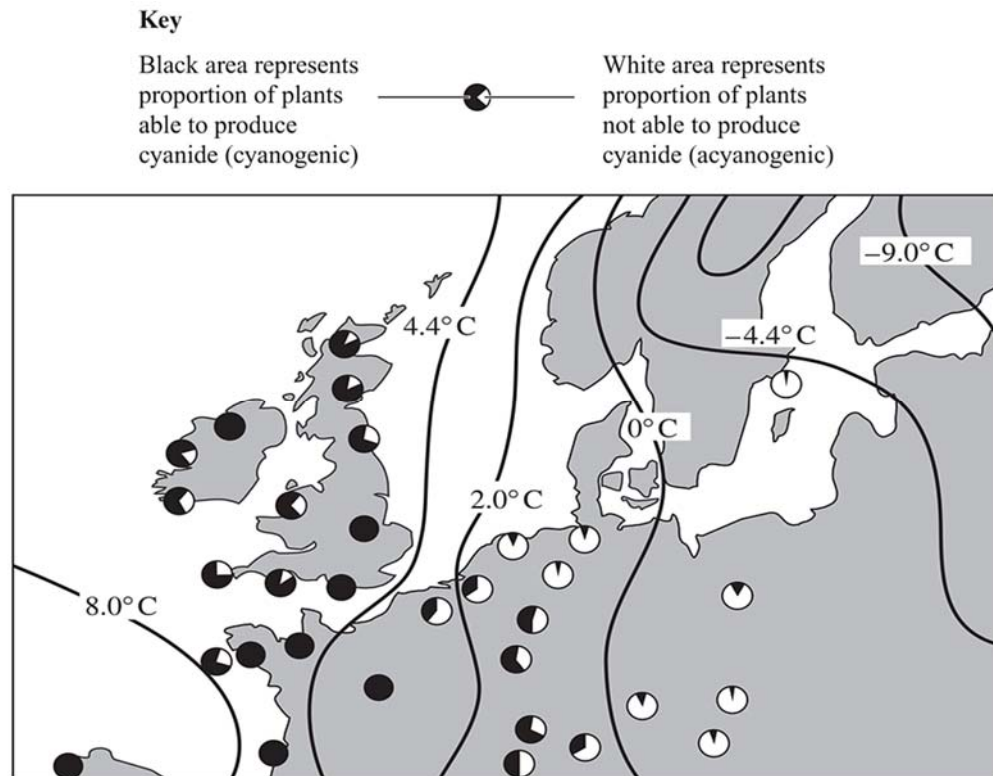


Fig. 2.2

- (c) Explain how different proportions of cyanogenic and acyanogenic plants may have evolved in populations in different parts of Europe.

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[4]

- (d) Explain using an example, how homology supports Darwin's theory of natural selection.

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..... [2]

[Total: 12]

- 3 (a) Human newborns and hibernating mammals contain large amounts of brown adipose tissue ('body fat').

Fig. 3.1 shows the electron micrograph of a brown adipocyte. Brown adipocytes are characterised by presence of numerous vacuoles and organelle X throughout the cell.

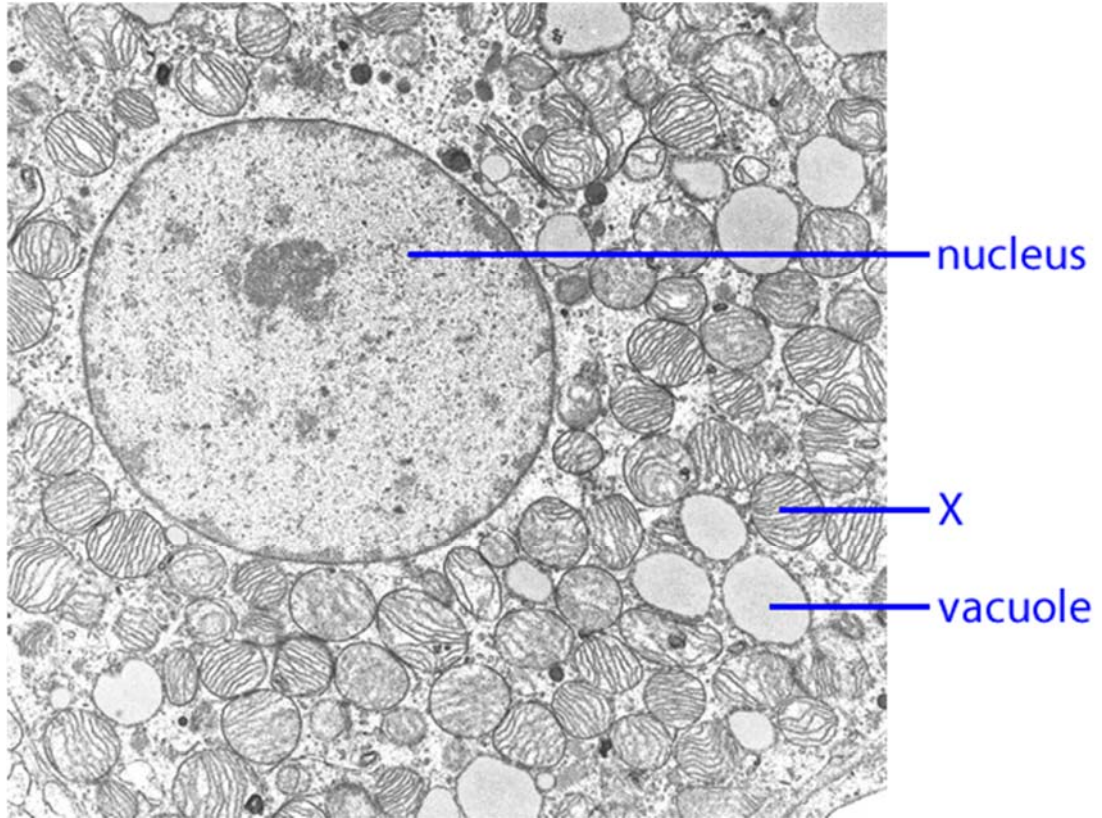


Fig. 3.1

- (i) Identify organelle X.

..... [1]

- (ii) Suggest the role of the numerous vacuoles found in brown adipocytes.

..... [1]

- (b) Fig. 3.2 shows the schematic representation of a series of protein complexes found on the inner membrane of organelle X.

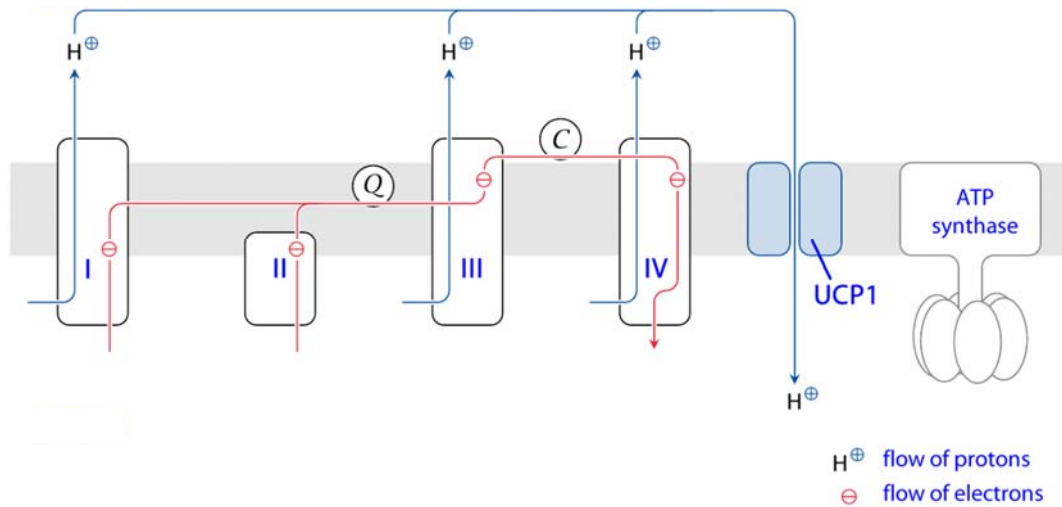


Fig. 3.2

- (i) Oxygen is required to sustain the process illustrated in Fig. 3.2.

With reference to the Fig. 3.2, describe the role played by oxygen.

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..... [1]

- (ii) Brown adipocytes contain a unique protein, UCP1, which is not found in organelle X in any other cell type.

Evaluate the impact of UCP1 on the normal functioning of the process illustrated in Fig. 3.2 and suggest the physiological significance of brown adipose tissue.

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..... [2]

- (c) In other cell types, NADH and FADH₂ are used to drive ATP synthesis by ATP synthase.

Using relevant information from Fig. 3.2, suggest and explain why more ATP is produced from NADH.

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..... [2]

[Total: 7]

4

Fig. 4.1 shows the life cycle of a water flea.

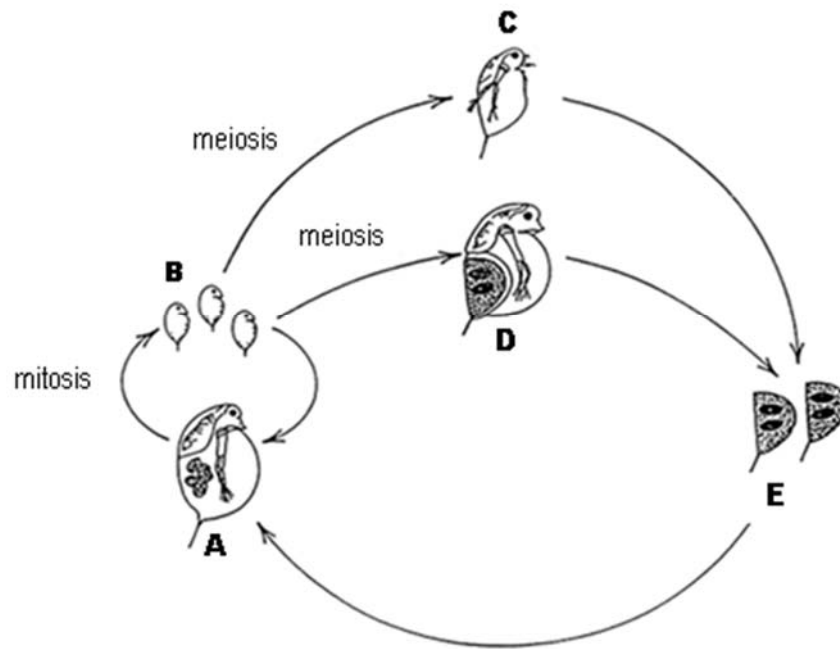


Fig. 4.1

In favourable conditions, all the animals in a population are females (**A**). These females produce eggs by mitosis, which develop into young females (**B**) without being fertilized. In unfavourable conditions, eggs produced by meiosis develop directly without fertilization into either males (**C**) or females (**D**). The eggs produced by the females (**D**) are fertilized by the sperms from the males (**C**), then released in protective egg cases (**E**) which enable them to survive unfavourable conditions. When favourable conditions return, these eggs develop back into females (**A**).

- (a)** The females at stage **A** of the life cycle have 18 chromosomes.

Complete the table to show the number of chromosomes at the other stages of the life cycle.

stage of life cycle	chromosome number
A	18
B	
C	
D	
E	

[1]

- (b)** Explain why the eggs from **D** and the sperms from **C** must be produced by mitosis.

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..... [2]

- (c)** Explain why females **A**, developed from fertilized eggs **E**, are genetically different from each other.

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..... [3]

- (d)** Give an example of a favourable condition in which females will develop from eggs formed via mitosis.

..... [1]

- (e)** The eggs of the water flea are produced by stem cells in the ovary.

Explain what makes a stem cell unique from a normal adult cell in the water flea.

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..... [2]

[Total: 9]

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)** Describe how the molecular structure of phospholipids is related to their function in the plasma membrane. [6]
- (b)** Explain the mode of action of enzymes in terms of specificity and activation energy. [8]
- (c)** Explain the effects of competitive and non-competitive inhibitors on the rate of enzymatic activity. [6]

[Total: 20]

Or

- 6 (a)** Describe the polymerase chain reaction and explain the advantages and limitations of this procedure. [8]
- (b)** Explain the significance of genetic engineering in improving the quality and yield of crop plants and animals and also in solving the demand for food in the world (e.g. Bt corn, golden rice and GM salmon). [6]
- (c)** Describe the natural functions of restriction enzymes and explain how they can be used in the process of gene cloning. [6]

[Total: 20]

- End of paper -