

JURONG JUNIOR COLLEGE
JC 2 PRELIMINARY EXAMINATIONS
Higher 1

CANDIDATE
NAME

CLASS

BIOLOGY

8875/02

Paper 2 Structured Questions

25 August 2017

Additional Materials: Answer Paper

2 hours

READ THESE INSTRUCTIONS FIRST

Write your name and class in the spaces at the top of this page.

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.

Circle the question number of the question attempted.

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	
Section B	
5 / 6	
Total	

This document consists of **15** printed pages and **3** blank pages.

[Turn over

Section A

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

- 1 White blood cells such as dendritic cells synthesise intracellular enzymes.

Fig. 1.1 is a summary diagram of events that occur in a dendritic cell.

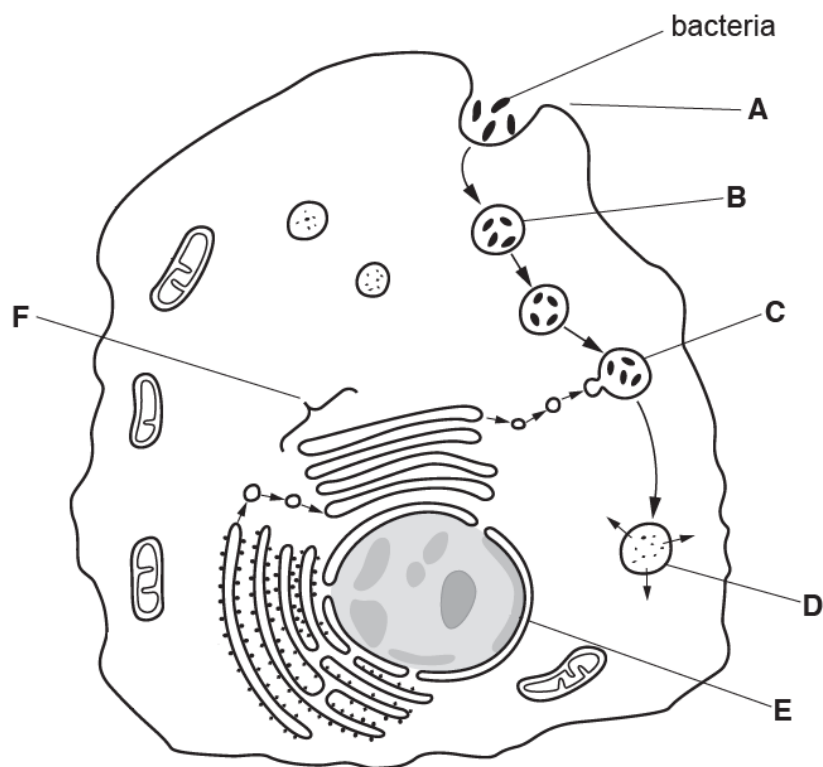


Fig. 1.1

- (a) (i) Name the process at A. [1]

- (ii) Name structures B, E and F. [3]

B

E

F

(b) Describe what happens to the bacteria between C and D. [2]

(c) The gene coding for transcription factor in dendritic cells is known as *Batf3*. The transcription factor is essential for the development of dendritic cells.

(i) Explain what is meant by a *gene*. [1]

(ii) There are a number of known mutations for *Batf3*.

Outline how a mutation in *Batf3* can lead to the formation of an altered polypeptide where one amino acid is replaced by a different amino acid. [3]

[Total: 10]

2 Fig. 2.1 shows some stages in mammalian respiration.

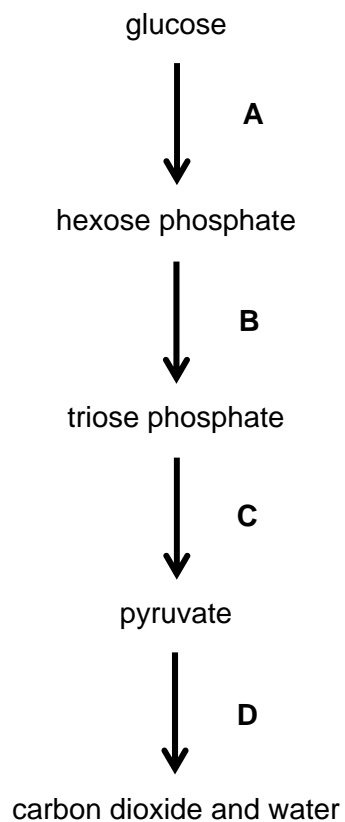


Fig. 2.1

(a) Name the processes taking place during Stage D and state precisely where they occur. [3]

- (b)** Intermediates produced at the end of Stages B and C are important in the conversion of carbohydrates to lipids such as triglycerides. Some of the triose phosphate can be converted into glycerol-3-phosphate, while pyruvate can undergo further reactions to form intermediates required for the synthesis of fatty acids.

Describe the formation of triglycerides. [3]

- (c) The first reaction in Stage A is catalysed by the enzyme hexokinase. It has been observed that hexokinase is bound to the outer mitochondrial membrane in muscle cells which undergo high rates of glycolysis.

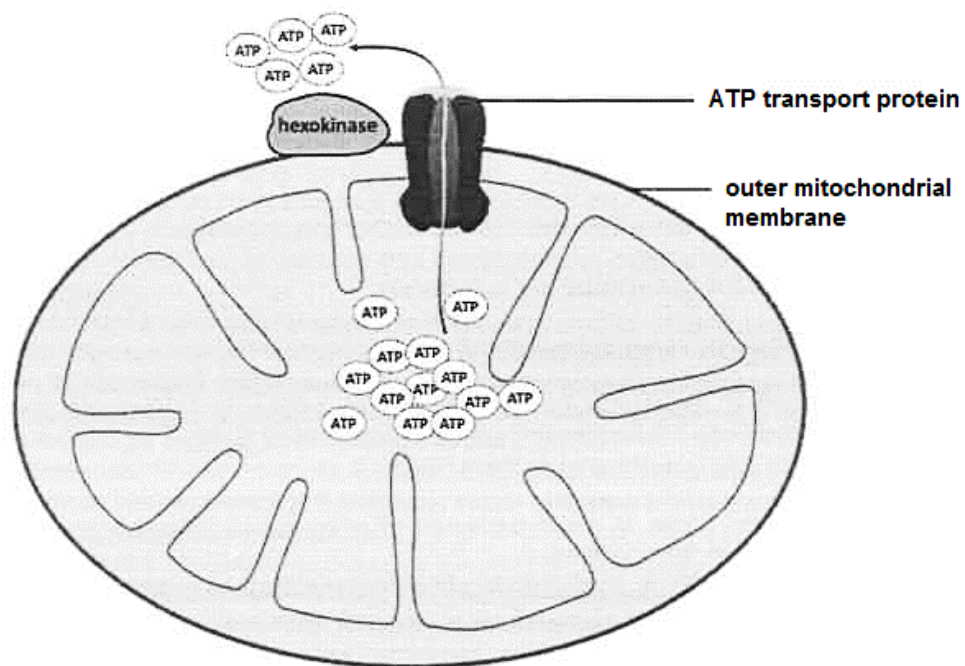


Fig. 2.2

With reference to the role of mitochondria and Fig. 2.2, suggest how the association of hexokinase with mitochondria can lead to high rates of glycolysis. [2]

(d) Fig. 2.3 shows an electron micrograph of a mitochondrion.

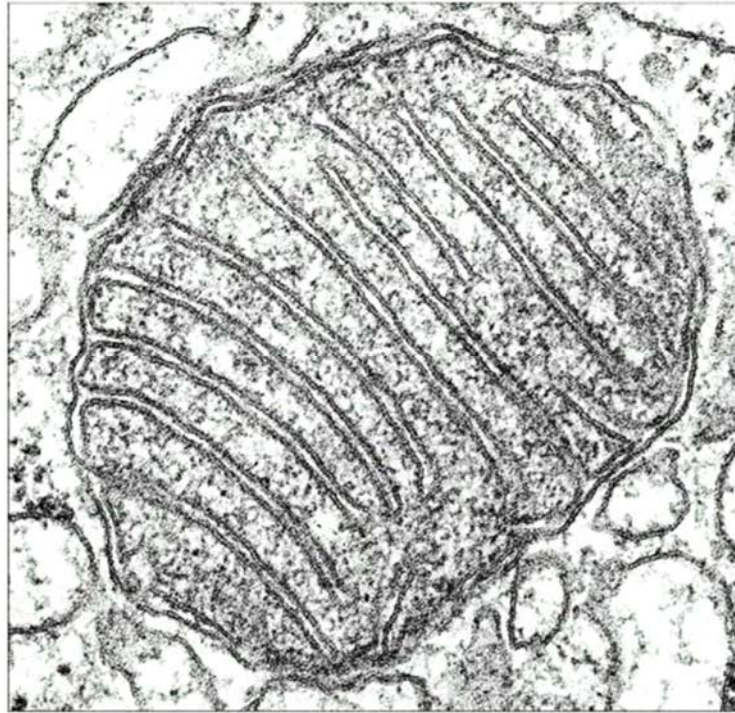


Fig. 2.3

With reference to features visible in Fig. 2.3, outline how the structure of the mitochondrion is adapted for its function. [1]

- (e) Phosphatidylcholine (a phospholipid) is present in membranes such as those of the mitochondrion. The molecular structures of tristearin (a triglyceride) and phosphatidylcholine are shown in Fig. 2.4.

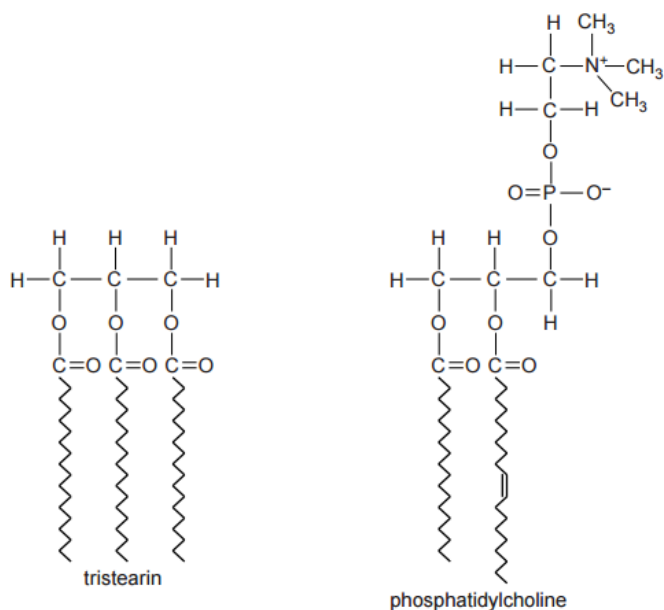


Fig. 2.4

State two structural differences between tristearin and phosphatidylcholine, other than in numbers of the different types of atoms. [2]

[Total: 11]

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- 3 A type of pheasant occurs in a range of colours, especially when bred in captivity. It may, for example, have green or purple plumage as seen in Fig. 3.1.



Fig. 3.1

Sometimes when a green male is crossed with a green female all the offspring, male and female, are green. However, sometimes a green male crossed with a green female results in offspring in which the majority of the offspring are green, but in which some of the females are purple, as shown in Table 3.1.

Table 3.1

phenotype	number of offspring
green male	7
green female	3
purple female	4

Plumage colour in pheasants is sex-linked.

In birds, the sex chromosomes are referred to as W and Z, rather than Y and X as in mammals. The W chromosome has no genes that affect plumage colour. The heterogametic sex is the female, **not** the male. Thus the male has two Z chromosomes (ZZ) and the female has one W and one Z chromosome (WZ).

(a) Use a genetic diagram to explain the results in Table 3.1. [3]

(b) Using the same symbols as in **(a)**, indicate the genotypes of the parents which could give rise to purple male offspring. [1]

(c) Using the information provided, state which allele for plumage colour is dominant and explain your answer. [2]

(d) Describe how you would determine the unknown genotype of a green male. [2]

[Total: 8]

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- 4 Human growth hormone (hGH) is a peptide hormone that is important for human development. Recombinant hGH can be synthesised via genetic engineering with the use of plasmids.

(a) (i) State the type of organism that contains plasmids. [1]

(ii) Describe one feature of plasmids that make them suitable to be used for genetic engineering. [2]

The polymerase chain reaction (PCR) can be used to amplify the gene coding for hGH before genetic engineering is carried out.

(b) Describe what occurs during the first two stages in PCR.

(i) Stage 1 [2]

(ii) Stage 2 [2]

- (c) Outline how a recombinant plasmid can be produced for genetic engineering after the gene coding for hGH was isolated from human cells and amplified using PCR. [3]

- (d) With the advancement in technology, plasmid-free bacteria cells have been constructed for the production of hGH with the gene coding for hGH inserted directly into the host chromosome instead of using plasmid.

Suggest how this new method is an improvement over the previous method. [1]

[Total: 11]

Section B

Answer **one** question.

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.

- 4** Early ancestors of today's horses were browsers. Their teeth were adapted for eating woody shrubs and trees. In the early Miocene (23 million years ago), the first groups adapted for grazing emerged. Modern horses are grazers, with teeth adapted for grinding tougher, grassy materials.

The foot structure evolved from four separate toes to three, then to only one that touched the ground with two smaller side toes higher than the ground. In more modern horses, the two side bones are fused together. Modern horses are of much greater size than their ancestors.

- (a)** Describe the causes of variation in horses. [6]
- (b)** Explain how natural selection could lead to evolution of modern horses with distinct phenotypic differences. [6]
- (c)** Explain, with examples, what is meant by anatomical and molecular homologies in horses. [8]

[Total: 20]

- 5** Invertase, a major enzyme present in plant tissues such as the developing roots of carrots, catalyses the hydrolysis of sucrose (a non-reducing sugar) to fructose and glucose (reducing sugars).

A scientist carried out an investigation into the effect of pH on the activity of invertase in carrots, by recording the time taken for the reducing sugars to change the colour of pink potassium manganate (VII) solution to a colourless end point. From the results obtained, the scientist concluded that the optimum pH of invertase was pH 5.0.

After additional analyses, the scientist also found that the invertase is:

- made up of several subunits
- synthesised with a signal peptide required for entry into the rough endoplasmic reticulum and thus into the secretory pathway
- glycosylated and bound to the cell wall

(a) Describe how invertase can be synthesised from mRNA. [8]

(b) Outline structural features and roles of the rough endoplasmic reticulum. [4]

(c) Describe the investigation carried out by the scientist to examine the effect of pH on the activity of invertase in carrots. [8]

[Total: 20]

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