

JURONG JUNIOR COLLEGE  
JC 2 PRELIMINARY EXAMINATIONS  
Higher 1

CANDIDATE  
NAME

CLASS

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**BIOLOGY**

**8875/02**

Paper 2 Core Paper

**2 September 2015**

Additional Materials: Answer Paper

**2 hours**

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**READ THESE INSTRUCTIONS FIRST**

Write your name and class on all the work you hand in.  
Write in dark blue or black pen on both sides of the paper.  
You may use soft pencil for any diagrams, graphs or rough working.  
Do not use staples, paper clips, highlighters, glue or correction fluid.

**Section A**

Answer **all** questions.

**Section B**

Answer any **one** question.

Circle the question number of the question attempted.

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	
<b>Section A</b>	
<b>1</b>	
<b>2</b>	
<b>3</b>	
<b>4</b>	
<b>Section B</b>	
<b>5 / 6</b>	
<b>Total</b>	

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This document consists of **13** printed pages and **1** blank page.

**[Turn over**

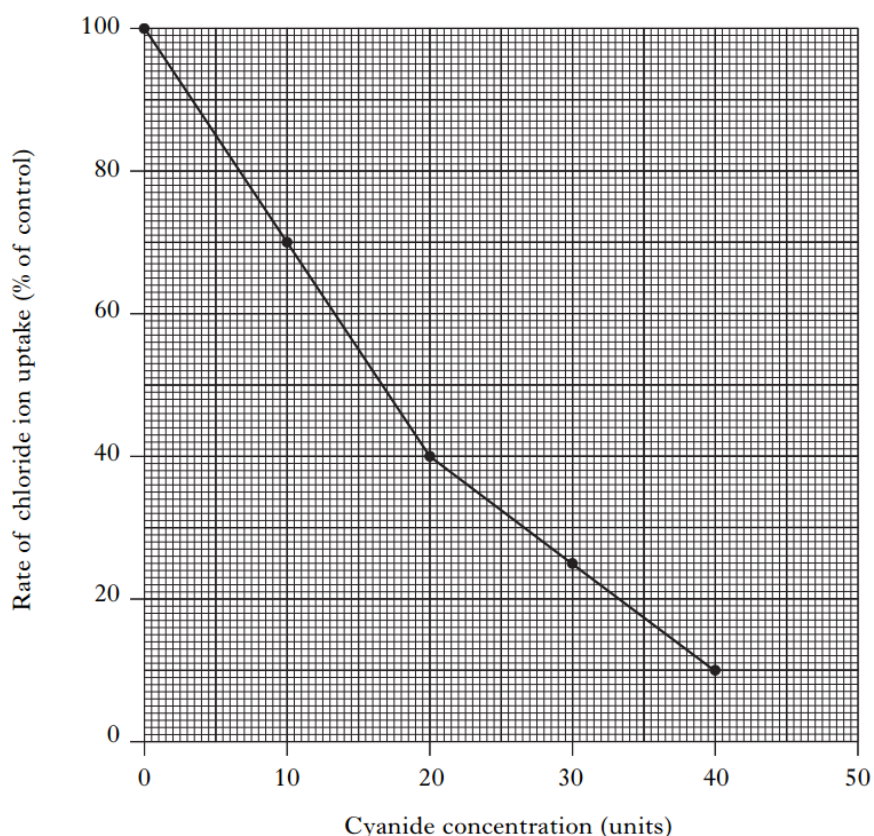
## Section A

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

- 1 The plasma membrane of beetroot cells contains protein and phospholipids and has a porous nature. As a result, the membrane is selectively permeable.

Cyanide is a poison that inhibits cytochrome c oxidase involved in aerobic respiration.

Fig. 1.1 shows how cyanide concentration affects the uptake of chloride ions by beetroot cells. The rates of chloride ion uptake are given as percentages of those obtained in a control experiment with no cyanide.



**Fig. 1.1**

- (a) It is known that the uptake of chloride ions requires the presence of transmembrane protein.

Describe how the membrane holds onto the transmembrane protein. [2]

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**(b)** With reference to Fig. 1.1,

**(i)** identify how chloride ions would be moved across the membrane, [1]

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**(ii)** account for your answer in (b)(i). [3]

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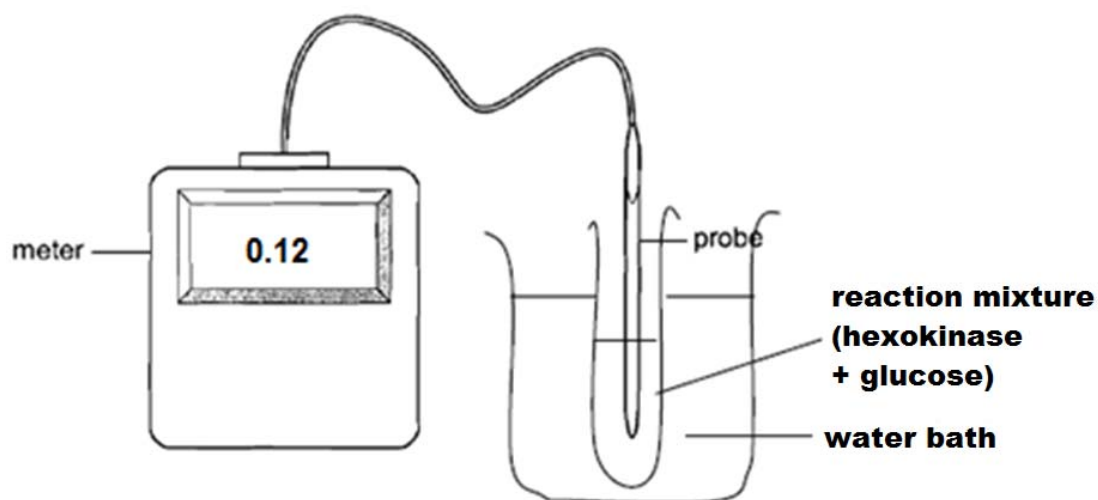
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Fig 1.2 shows the apparatus used in an investigation into the effects of varying substrate concentration on hexokinase, another enzyme of the aerobic respiration pathway, in the absence or presence of inhibitors.



**Fig. 1.2**

Table 1.1 shows the results of the investigation; the greater the absorbance, the more active the enzyme.

**Table 1.1**

substrate concentration / %	absorbance / arbitrary units		
	absence of inhibitor	inhibitor X	inhibitor Y
0.1	0.12	0.03	0.06
0.25	0.17	0.06	0.06
0.5	0.21	0.14	0.06
1.0	0.36	0.30	0.06

**(c)** State a variable that must be kept constant for the investigation. [1]

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**(d)** With reference to Table 1.1,

**(i)** describe the effect of substrate concentration on the activity of hexokinase, [1]

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**(ii)** explain this effect. [2]

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**(e) (i)** State the type of inhibition shown by inhibitor X. [1]

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**(ii)** Explain the results collected in the presence of inhibitor X. [3]

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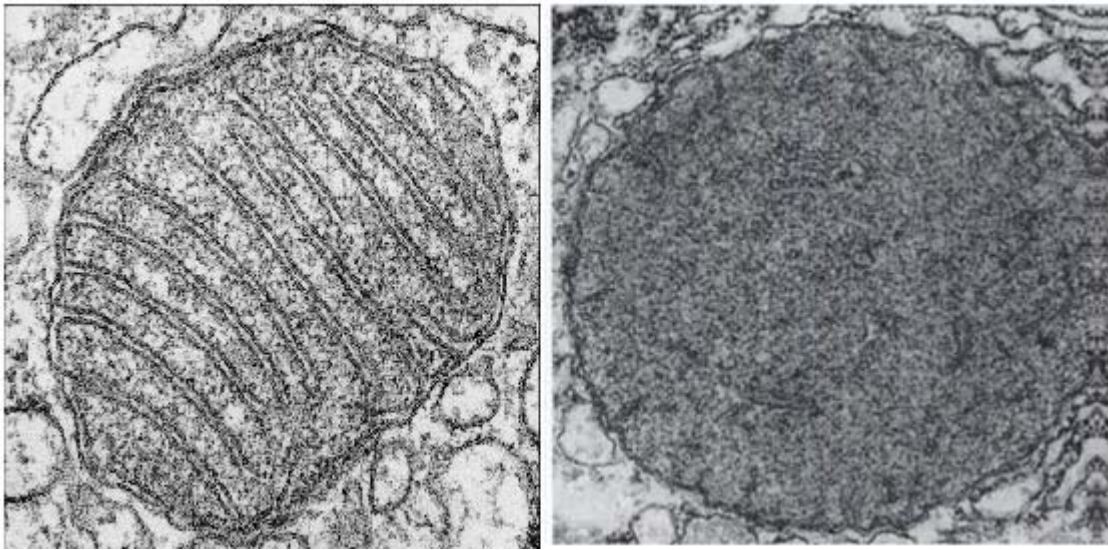
**(iii)** Explain why the absorbance value remains at 0.06 au in the presence of inhibitor Y at all substrate concentrations. [1]

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[Total: 15]

- 2 Fig. 2.1 shows a normal mitochondrion and a mitochondrion with a structural defect due to lethal cell injury.



**Fig. 2.1**

- (a)** State the mitochondrial structural defect shown in Fig. 2.1. [1]

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- (b)** Explain the implications of this structural defect on

- (i)** glycolysis, [2]

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- (ii)** oxidative phosphorylation. [2]

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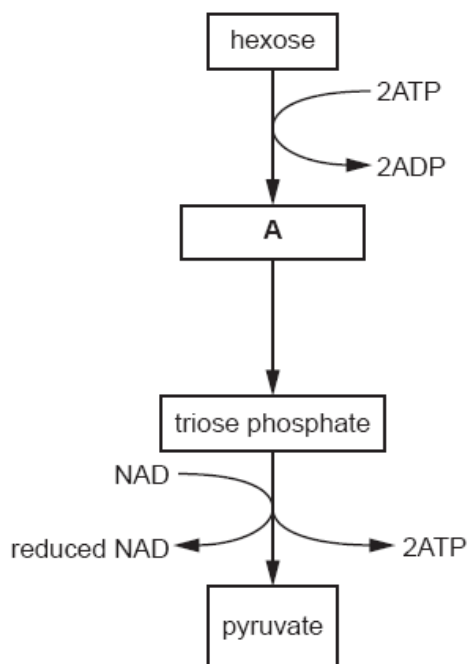
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- (c) The metabolic pathway in which a hexose sugar, such as glucose, is broken down in respiration by cells starts with glycolysis. Fig. 2.2 outlines the key stages of glycolysis.

The enzymes responsible for catalyzing the first and last key steps, phosphofructokinase (PFK) and pyruvate kinase are the primary steps for allosteric enzyme regulation. PFK is allosterically inhibited by ATP, so glycolysis is slowed when cellular ATP concentrations are high.



**Fig. 2.2**

- (i) Name substance A and suggest why hexose is converted to substance A. [2]

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- (ii) Explain the role of NAD in aerobic respiration. [2]

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[Total: 9]

- 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.

Sometimes when a green male is crossed with a green female, all the male and female offspring are green. However, sometimes a green male crossed with a green female results in offspring in which the majority are green, but 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

- (a) In birds, the sex chromosomes are referred to as W and Z. The W chromosome has no genes that affect plumage colour. The heterogametic sex is the female, **not** the male.

- (i) State which allele for colour of plumage is dominant. [1]

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



In pheasant, another gene on the Z chromosome controls the rate of feather production. The allele for slow feather production, F, is dominant to the allele for rapid feather production, f.

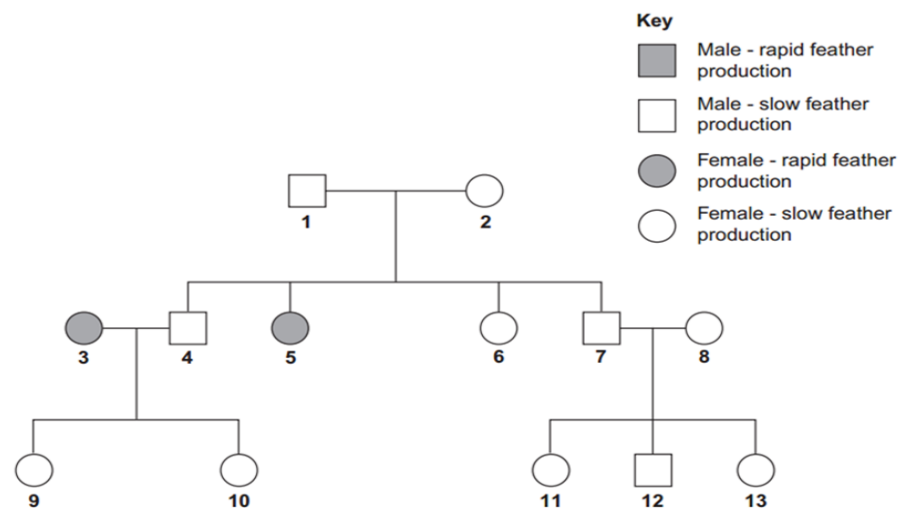
- (b) Explain why recessive, sex-linked characteristics are more common in female pheasant than in male pheasant. [1]

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Fig. 3.1 shows the results produced from crosses carried out by a farmer.



**Fig. 3.1**

- (c) Explain one piece of evidence from Fig. 3.1 which shows that the allele for rapid feather production is recessive. [1]

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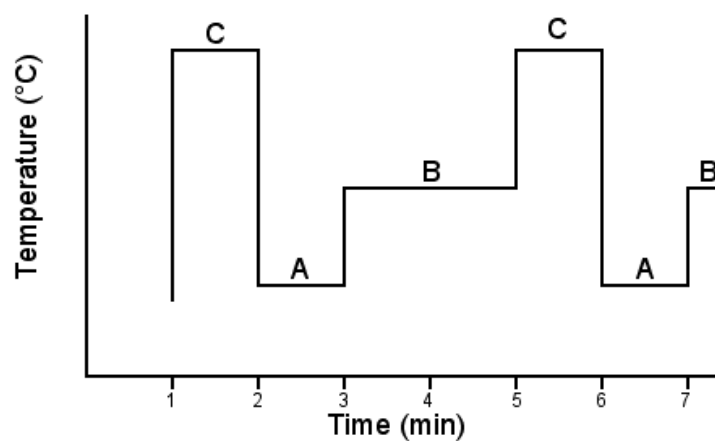


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[Total: 6]

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- 4 Fig. 4.1 shows the temperatures used at the different stages during part of the polymerase chain reaction (PCR), which is an automated process.



**Fig. 4.1**

**(a)** Describe what is happening at B and C. [4]

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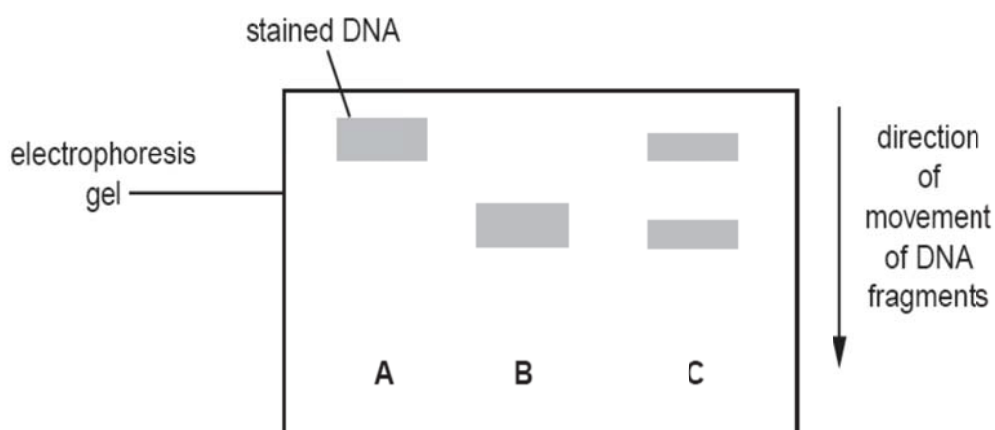
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In Europe, the commonest mutation of the cystic fibrosis transmembrane conductance regulator (CFTR) gene is  $\Delta F508$ . Deletion of three base pairs results in the loss of one amino acid, phenylalanine, in the CFTR protein.

In genetic screening for this mutation, a fragment of DNA including the site of the deletion is cut out of the gene.

The fragment is 100 base pairs (bp) long when cut out of the normal allele and 97 bp long when cut from the mutant allele. The different fragments are separated by gel electrophoresis.

The results of genetic screening for  $\Delta F508$  of three individuals, **A**, **B** and **C**, are shown in Fig. 4.2.



**Fig. 4.2**

**(b)** Describe how DNA fragments are separated in gel electrophoresis. [3]

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**(c)** Identify the position of a 100 bp fragment on Fig. 4.2 by means of a labelled arrow. [1]

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**(d)** Explain the result obtained from individual **C**. [2]

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[Total: 10]

## 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.

- 5** (a) Outline how the structure of cellulose is related to its specific function. [6]
- (b) Explain how *E. coli* can be genetically engineered to produce insulin avoiding the problems associated with introns. [10]
- (c) Explain how Bt corn produced through genetic engineering improve the yield of crops. [4]
- [20]
- 6** (a) Name each stage of mitosis. For each of the stage, describe the behaviour of chromosomes. [8]
- (b) Explain how meiosis and random fertilisation may result in genetic variation in offspring. [7]
- (c) Explain why genetic variation is important in natural selection. [5]
- [20]

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