



**MERIDIAN JUNIOR COLLEGE**  
JC2 Preliminary Examinations 2015  
Higher 1

CANDIDATE  
NAME

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CIVICS  
GROUP

<b>1</b>	<b>4</b>				
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INDEX  
NUMBER

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## H1 BIOLOGY

**8875/02**

Paper 2

**17 September 2015**

**2 hours**

Additional Materials: Answer papers

### 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 on the answer paper provided.

At the end of the examination,

1. Fasten your answer papers to section B securely together.
2. Hand in the following separately:
  - Section A
  - Section B

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

For examiner's Use	
Section A	
1	/ 8
2	/ 10
3	/ 8
4	/ 14
Section B	
5 / 6	/ 20
<b>Total</b>	<b>/ 60</b>

This paper consists of **10** printed pages.

**[Turn over]**



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

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**QUESTION 1**

Fig. 1.1 shows a structure involved in one of the steps in gene expression in a eukaryotic cell.



**Fig. 1.1**

- a) Describe the importance of the structure shown in Fig. 1.1 in gene expression. [2]

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- b) Transfer RNA (tRNA) is also involved in gene expression.

Describe how its structure facilitates its function in gene expression. [2]

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- c) Glucose transporters (GLUTs) are transmembrane proteins found in the cell surface membrane of many cells, such as liver and muscle cells. These cells increase the number of GLUTs when there is a need for the body to lower its blood glucose concentration.

Outline how GLUTs on the cell surface membrane are formed after its polypeptide is synthesized in the rough endoplasmic reticulum. [4]

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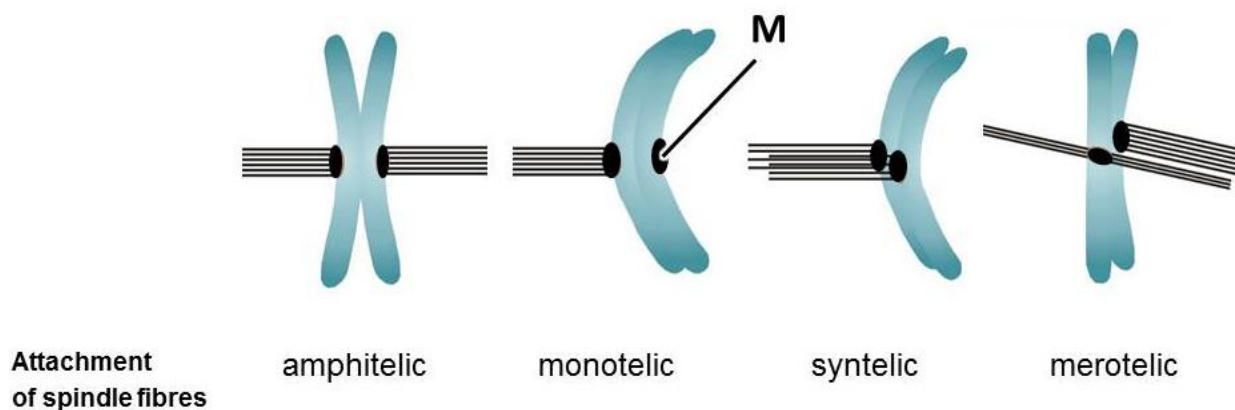
**[Total: 8]**



## QUESTION 2

Fig. 2.1 shows four ways by which spindle fibres may attach to chromosomes.

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**Fig. 2.1**

- a) Explain why there are two sister chromatids per chromosome in mitosis. [2]

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- b) With reference to Fig. 2.1,

- i) identify structure **M** and explain its role. [2]

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- ii) state and explain how spindle fibres should be attached to sister chromatids during mitosis. [2]

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- c) Explain how a mutation in a gene that usually slows mitosis might increase the chances of a cancerous growth forming. [3]

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- d) Suggest an outcome of the syntelic attachment of spindle fibres to the sister chromatids during meiosis II. [1]

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**[Total: 10]**



### QUESTION 3

Coat colour in cats is determined by a gene with two alleles coding for black and orange, which exhibit co-dominance.

When black cats are mated with orange cats:

- the female offspring are always tortoiseshell (black and orange patches).
- the male offspring are always the same colour as the mother.

a) Explain what is meant by *gene* and *co-dominance* in the above context. [2]

*Gene* .....

.....

*Codominance* .....

.....

b) Using the symbols **B** for the allele for black coat and **O** for the allele for orange coat, construct a genetic diagram to show the cross between a tortoiseshell female and a black male. [4]

c) Explain why any tortoiseshell cat cannot be a male. [2]

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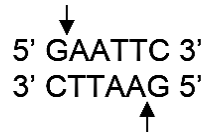
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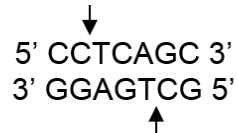
**QUESTION 4**

Restriction enzymes typically recognize palindromic sequence comprising 4 to 8 base pairs. For example, the recognition site for *EcoRI* is



The arrows indicate the site of cleavage. Such restriction enzymes typically consist of two identical subunits (homodimer), each comprising an active site.

Another class of restriction enzymes recognize non-palindromic sequence. For example, the recognition site for *BbvCI* is



- a) Using the above information, suggest how the structure of *BbvCI* restriction enzyme enables it to cleave non-palindromic sequence. [3]

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Restriction enzymes are indispensable tools used in genetic engineering. Golden Rice™ is a genetically modified form of rice that produces relatively large amounts of beta-carotene in the endosperm. Beta-carotene is metabolised in the human body to produce vitamin A.

- b) Explain why rice has been genetically modified to produce extra beta-carotene. [2]

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- c) The first type of Golden Rice™ produced only a very low mass of beta-carotene per gram of rice. Research continued to try to increase this.

Fig. 4.1 shows the metabolic pathway by which beta-carotene is synthesised in plants, and the enzymes that catalyse each step of the pathway.

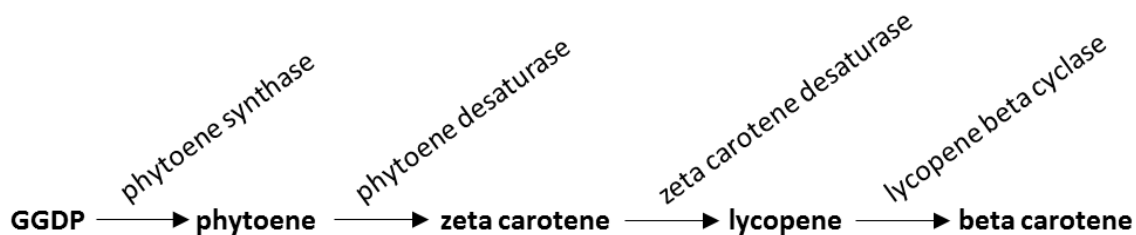


Fig. 4.1

The first type of Golden Rice™ contained a phytoene synthase gene, *psy*, from daffodils and a gene *crtl*, which produced the two desaturase enzymes, from the bacterium *Erwinia uredovora*.

Measurements of the quantities of intermediates in this metabolic pathway in rice endosperm showed that there was always a large amount of GGDP present, and that no phytoene accumulated in the tissues.

Explain how this suggests it was not the enzymes produced by the *crtl* gene that were limiting the production of beta-carotene. [2]

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- d) An agreement has been made between the commercial company that owns the production rights of golden rice and its developers. This allows the developers to give the rice to government-run breeding centres in rice-dependent countries. This agreement has addressed some concerns that initially arose from growing Golden Rice™.

State these concerns that initially arose from growing Golden Rice™. [2]

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The polymerase chain reaction (PCR) is a molecular technique which involves the use of DNA primers to amplify a section of DNA from a minute starting amount.

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- e) Explain why the nucleotide sequence of primers is critical to its function in PCR. [2]

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- f) Scientists have found a new method of copying DNA that is faster than PCR. The new method, called helicase-dependent amplification (HDA), uses the enzyme helicase to separate the two strands of DNA. This means that DNA can be copied at a constant temperature of 37°C. In all other mechanical aspects, HDA works in exactly the same way as PCR.

- i) Explain why HDA will not work with *Taq* DNA polymerase. [2]

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- ii) Explain why HDA is faster than PCR in amplifying DNA. [1]

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[Total: 14]



**Section B**  
Answer **one** question.

For  
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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) The optimum pH for the activity of rubisco is pH8 (alkaline). Describe how the illumination of chloroplasts leads to optimum pH conditions for rubisco. [7]
- b) Respiratory enzymes in yeasts oxidize glucose, releasing carbon dioxide as a by-product. Describe an investigation into the effect of varying temperatures on the rate of respiration in yeasts. [8]
- c) Explain the role of variation in evolution. [5]

**[Total: 20]**

**QUESTION 6**

- a) Compare tropocollagen and amylose. [6]
- b) The cell surface membrane consists of phospholipids and cholesterol. Describe how their structures and properties are related their functions. [6]
- c) Outline how agarose gel electrophoresis is carried out **and** explain its theoretical basis. [8]

**[Total: 20]**

**• END OF PAPER 2 •**