

**RAFFLES INSTITUTION**

**2016 Year 6 Preliminary Examination**

Higher 1

CANDIDATE  
NAME

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CIVICS  
GROUP

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INDEX  
NUMBER

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## **BIOLOGY**

**8875/02**

Paper 2 Core Paper

**15<sup>th</sup> September 2016**

Additional materials: Answer Paper

**2 hours**

### **READ THESE INSTRUCTIONS FIRST**

Write your index number, CT group & name 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.

#### **Section A**

Answer **all** questions.

#### **Section B**

Answer **one** question.

At the end of the examination, **hand in your essay SEPARATELY**.  
The number of marks is given in brackets [ ] at the end of each question or part question.

For Examiner's Use	
Section A	
1	/5
2	/13
3	/6
4	/7
5	/9
Section B	
6 or 7	/20
Total	/60

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

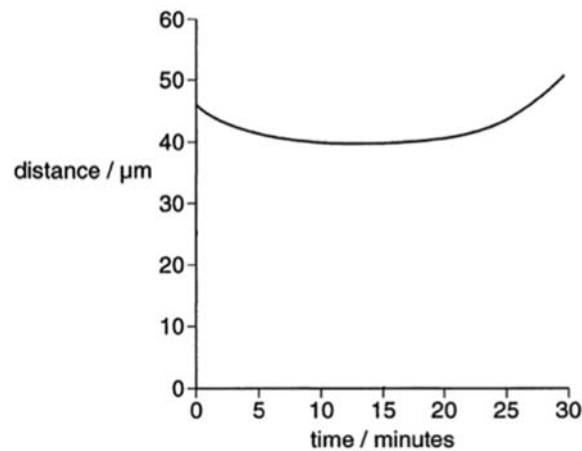


Raffles Institution  
Internal Examination

**Section A**

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

1. Further studies of the spindle fibers in the spore-forming fungus were carried out during its mitotic division. Fig. 1.5 is a graph showing the distance between poles of the spindle during mitosis.



**Fig. 1.5**

- (a) It was observed that anaphase started at minute 15. On Fig. 1.5, sketch and label
- (i) graph Y, that shows the distance between centromere and poles of the spindle, and
  - (ii) graph Z, that shows the distance between centromeres of sister chromatids.

[2]

- (b) Outline the role of centromeres.

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[Total : 5]

- 2 Fig. 2.1 shows an electron micrograph of normal liver tissues of mice.

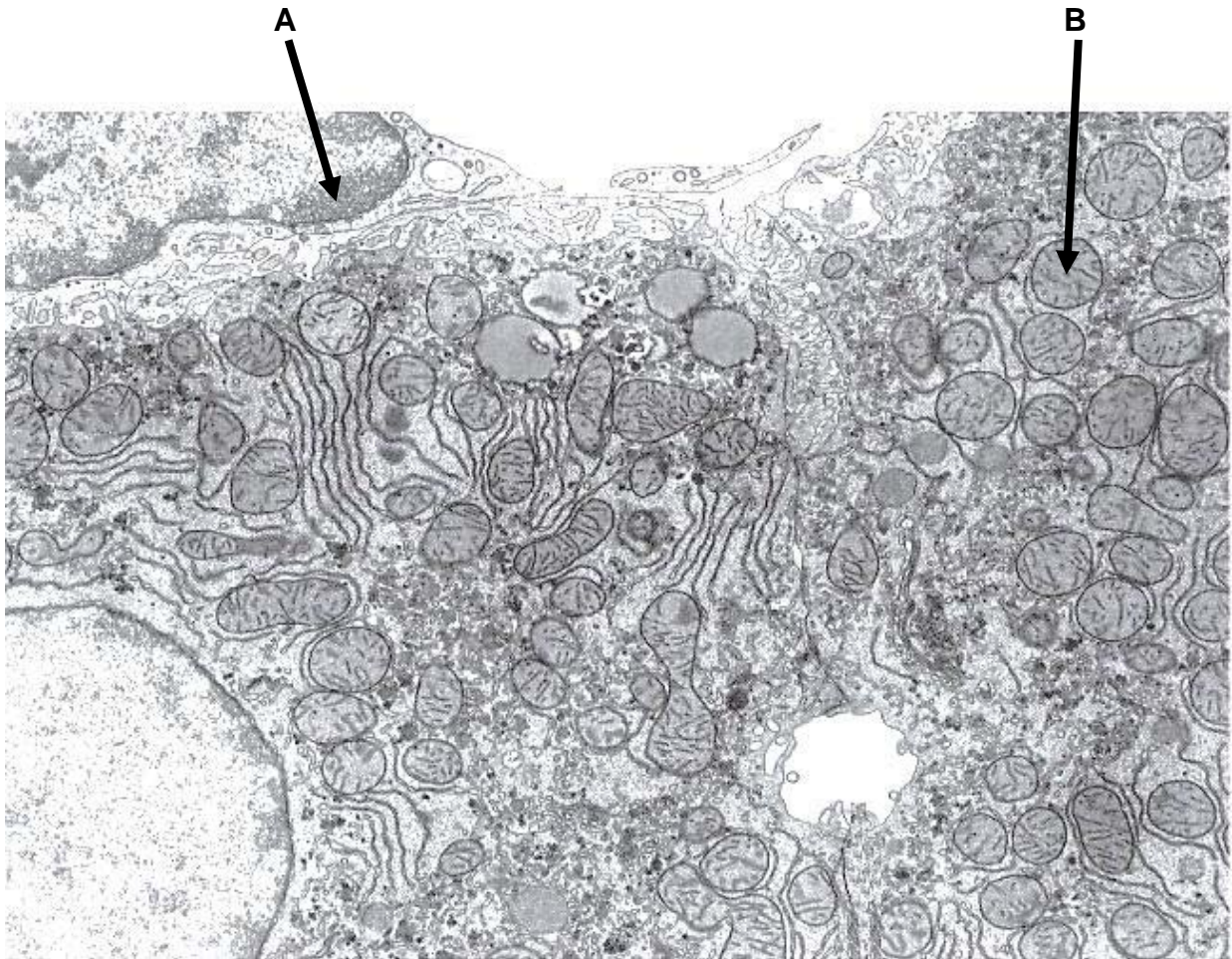


Fig. 2.1

- (a) Identify organelles **A** and **B**.

[1]

organelle <b>A</b>	
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organelle <b>B</b>	
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The liver tissue was homogenized and cell fractionation was performed. A sample of organelle B was obtained by differential centrifugation resuspended in a buffer. The concentration of  $H^+$  in the various compartments within organelle B was measured at regular intervals. 10 minutes after the start of the experiment, a 10nM pyruvate solution was added to the buffer containing organelle B.

The results of the experiment are shown in Fig 4.2.

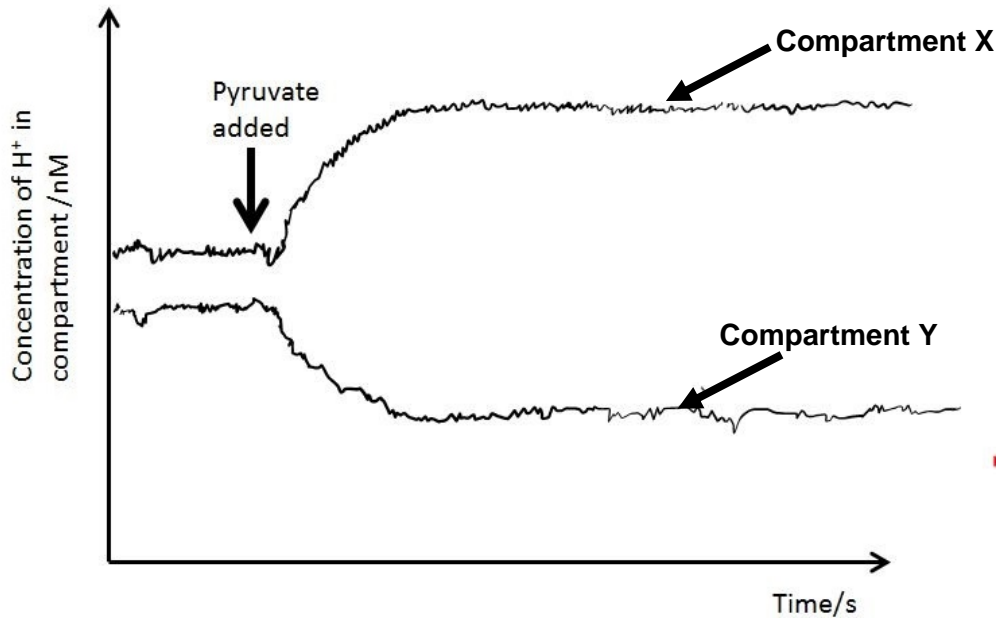


Fig. 2.2

- (b) (i) Identify compartments X and Y. [1]

compartment X		compartment Y	
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- (ii) Explain the changes in the concentration of  $H^+$  in compartment X following the addition of pyruvate into the buffer.

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- (c) A metabolic poison, 2,4-dinitrochlorobenzene (2DNP), acts as a proton ionophore, an agent that can transport protons across biological membranes down a concentration gradient.
- (i) The experiment was repeated in the presence of high concentration of 2DNP. Sketch on Fig 2.2, a graph that shows the concentration of  $H^+$  in compartment Y in the presence of 2DNP. [1]

- (ii) Explain the effect of 2DNP on ATP synthesis.

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- (d) Compare the production of ATP in photophosphorylation and oxidative phosphorylation.

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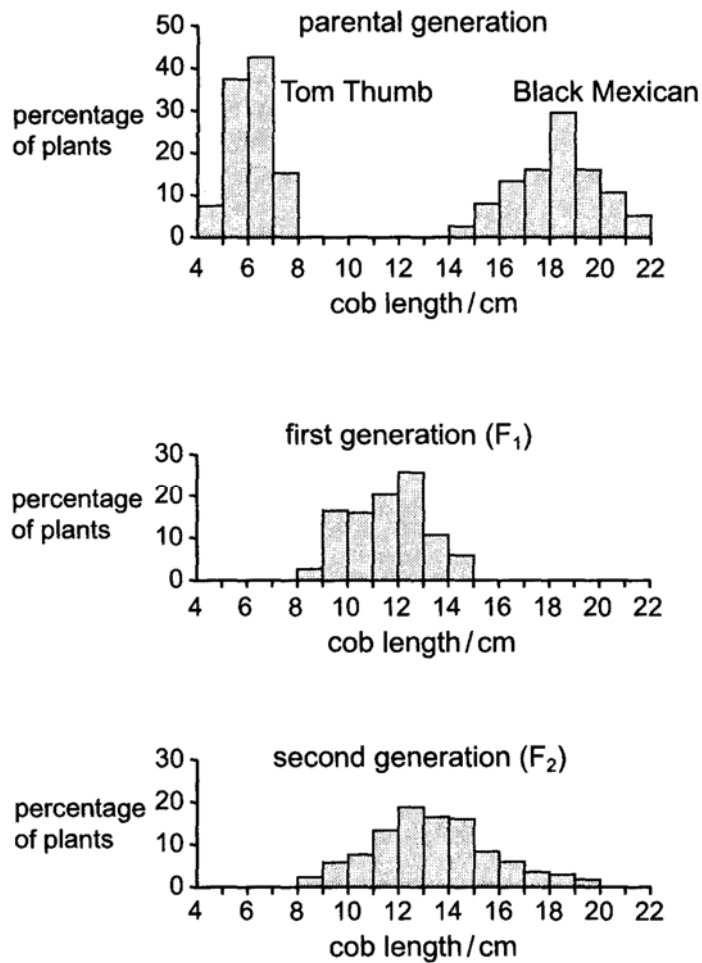
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..... [3]

[Total : 13]

- 3 To study the inheritance of the cob length of maize, scientists crossed a variety of maize with long cobs with another variety of maize with short cobs. Cob length of the two varieties, Tom Thumb and Black Mexican and their hybrids are shown in Fig. 3.1.



**Fig. 3.1**

- (a) (i) State the term used to describe the range of phenotypes in the first generation ( $F_1$ ) of offspring.

..... [1]

- (ii) Explain why there is a range of phenotypes for cob length in the  $F_1$  generation.

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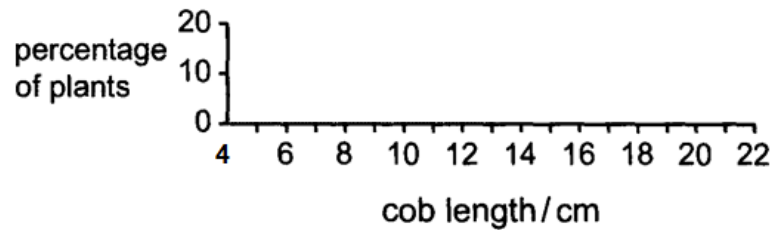
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- (b) Sketch in the space below, the graph showing the expected cross between  $F_1$  and the parental variety Tom Thumb. [2]



[Total : 6]

- 4 The rock wallabies, *Petrogale lateralis pearsonii*, (Fig. 4.1) on Pearson Island off the coast of South Australia have had no genetic contact with rock wallabies in the Australian mainland since they were isolated by rising sea levels at the end of the last glacial period, around 10 000 years ago.



Fig. 4.1

Scientists have taken blood samples from the wallabies and compared the distribution of unique DNA sequences called microsatellites, which are scattered across the wallabies' chromosomes. These microsatellites give a measure of the population's genetic diversity, or lack of it. In this case, the microsatellite data showed that the Pearson Island population has low genetic diversity. The scientists concluded that the Pearson Island population of rock wallabies has been through a genetic bottleneck event.

- (a) (i) Explain how a genetic bottleneck event may lead to a decrease in genetic diversity.

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..... [2]

- (ii) The population of rock wallabies on Pearson Island is most closely related to small populations of rock wallabies in southern Western Australia. Some scientists argue that some individuals from the southern Western Australian populations should be released onto Pearson Island.

Explain the rationale for such a suggestion.

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..... [2]

- (b) The *Dolichotis patagonum* shown in Fig. 4.2, which is also known as a dillaby, is a mammal that looks similar to the marsupial rock wallaby (Fig. 4.1).



**Fig. 4.2**

The marsupial wallaby and placental dillaby are morphologically similar.

Explain why morphological data alone, may not accurately represent the degree of relatedness of 2 different species.

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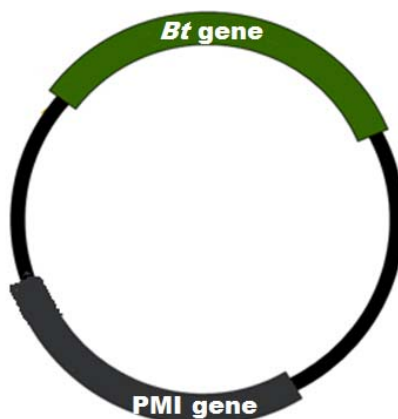
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..... [3]

[Total : 7]



- 5 Transgenic BT maize which produces the *Bacillus thuringiensis* toxin was created. In the production of this BT maize, the recombinant plasmid shown in **Fig. 5.1** was constructed. The BT gene was inserted together with the gene that codes for the enzyme phosphomannose isomerase (PMI), which allows plant cells to utilize mannose as a carbon source.



**Fig 5.1**

- (a) (i) Restriction endonucleases are used in the formation of recombinant plasmids.

Explain the mechanism of action of restriction enzymes.

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..... [3]

The recombinant plasmid shown in Fig 5.1 was used to transform maize cells. The maize cells were grown in a medium containing only mannose as the carbon source, and grown into BT maize.

- (ii) Antibiotic or herbicide resistance genes are commonly included in the plasmid used for creating transgenic plants.

Explain why such genes were not needed in this case.

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- (iii) Describe one other feature of plasmids and explain why that feature is significant in its role as a vector in genetic engineering.

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- (c) The caterpillars of corn borers are the main target pest of BT corn.

Predict, with reasons, one short term and one long term effect of continued cultivation of BT maize on the population of corn borers.

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..... [2]

[Total : 9]

### Section B

#### Answer EITHER 6 OR 7.

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 sections (a), (b) etc., as indicated in the question.

- 6 (a) Compare the structure of cellulose with that of collagen. [6]
- (b) Using a named example, explain the significance of genetically modified animals. [6]
- (c) Describe the role of messenger RNA in protein synthesis. [8]

[Total: 20]

- 7 (a) Explain how enzymes speed up reactions. [6]
- (b) Compare DNA replication and polymerase chain reaction [6]
- (c) With reference to the structure of ribosome, describe the role of the ribosome in translation. [8]

[Total: 20]

**End of Paper**

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