



HWA CHONG INSTITUTION
JC2 Preliminary Examination
Higher 1

CANDIDATE NAME

CT GROUP

CENTRE NUMBER

INDEX NUMBER

BIOLOGY

8875 / 02

Paper 2 Core Paper

13 September 2016

Additional Materials: Writing Paper

2 hours

INSTRUCTIONS TO CANDIDATES

Write your **name** and **CT group** in the spaces provided at the top of this cover page.

SECTION A

This section contains **four** questions. Answer **ALL** questions.

Write your answers on the lines / in the spaces provided.

SECTION B

This section contains **two** questions. Answer any **one** question.

Your answers must be in continuous prose, where appropriate.

Write your answers on the writing paper provided.

BEGIN EACH PART ON A FRESH SHEET OF WRITING PAPER.

A **NIL RETURN** is required for questions not answered.

INFORMATION FOR CANDIDATES

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

The use of an appropriate scientific calculator is expected, where appropriate. You may lose marks if you do not show working or if you do not use appropriate units.

You are reminded of the need for good English and clear presentation in your answers.

For Examiners' Use	
Question	Marks
1	/ 9
2	/ 8
3	/ 9
4	/ 14
5 / 6	/ 20
Total	/ 60

SECTION A: STRUCTURED QUESTIONS

QUESTION 1

- (a) Explain the role of helicase in DNA replication.

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..... [2]

Cytarabine is a drug used to treat certain cancers. It prevents DNA replication. Fig. 1.1 shows the structures of cytarabine and the DNA base cytosine.

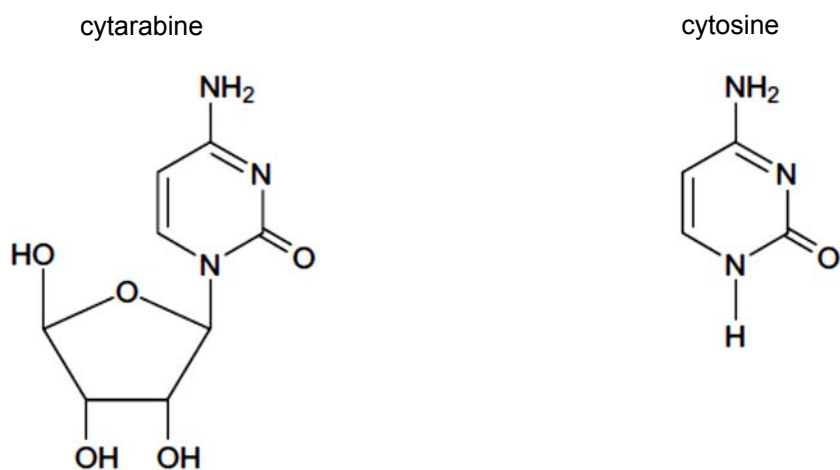


Fig. 1.1

- (b) Explain how cytarabine prevents DNA replication.

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..... [2]

Fig. 1.2 shows information about the movement of chromatids in a cell that has just started metaphase of mitosis.

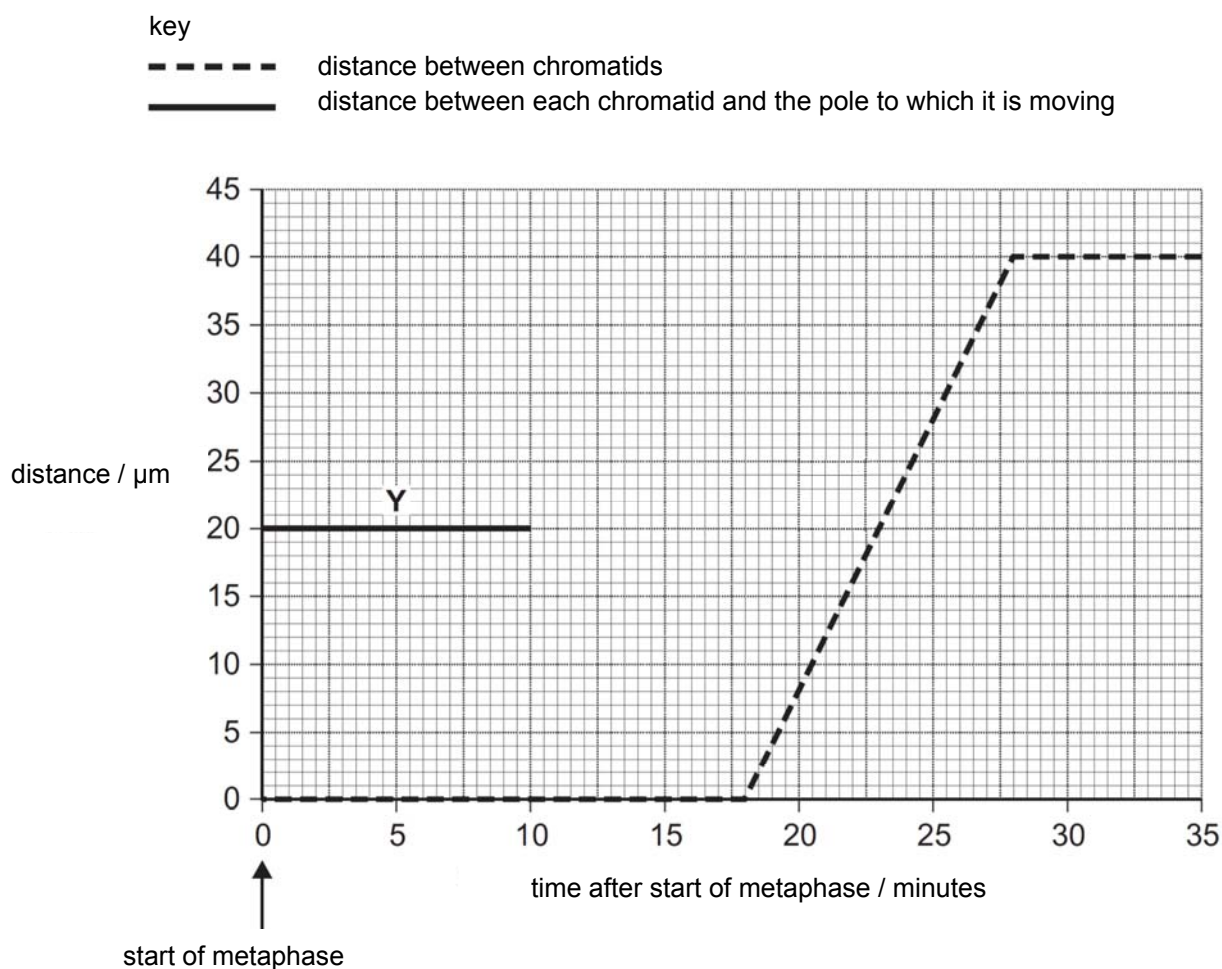


Fig. 1.2

With reference to Fig. 1.2,

(c) (i) state the duration of metaphase in the cell.

..... [1]

(ii) complete line Y on the graph.

[1]

(iii) account for your answer in (c)(ii).

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..... [3]

[Total: 9]

QUESTION 2

The unicellular green alga, *Chlorella*, a photosynthetic eukaryote is mass produced and harvested by commercial suppliers for use as a health food supplement.

Fig. 2.1 shows the effect of carbon dioxide concentration on the light-independent stage of photosynthesis in *Chlorella*. The following steps were carried out in a study:

- a cell suspension of *Chlorella* was illuminated using a bench lamp.
- the suspension was supplied with carbon dioxide at a concentration of 1% for 200 seconds.
- the concentration of carbon dioxide was then reduced to 0.03% for a further 200 seconds.
- the concentration of RuBP and glycerate-3-phosphate (GP) were measured at regular intervals.
- the temperature of the suspension was maintained at 25 °C throughout the investigation.

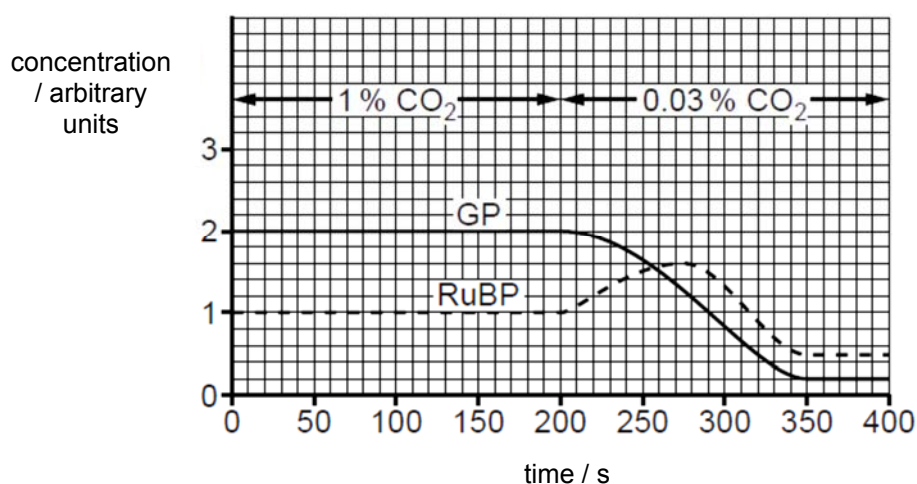


Fig. 2.1

- (a) (i) State precisely where RuBP and GP are located in the chloroplast.

..... [1]

- (ii) Explain why the concentration of RuBP changed between 200 and 275 seconds.

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 [2]

- (b) Suggest how the decrease in the concentration of GP leads to a decrease in harvest for commercial suppliers of *Chlorella*.

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- (c) In the light dependent stage, illumination of chloroplasts is important for maintaining the high pH in the stroma.

Explain how the illumination of chloroplasts maintains the high pH in the stroma.

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....., [3]

[Total: 8]

QUESTION 3

About three million years ago, the ancestors of mammoths migrated from Africa into Europe and Asia. There, about 1.7 million years ago, the steppe mammoth evolved and became adapted to the cooler conditions. Fig. 3.1 shows a steppe mammoth.

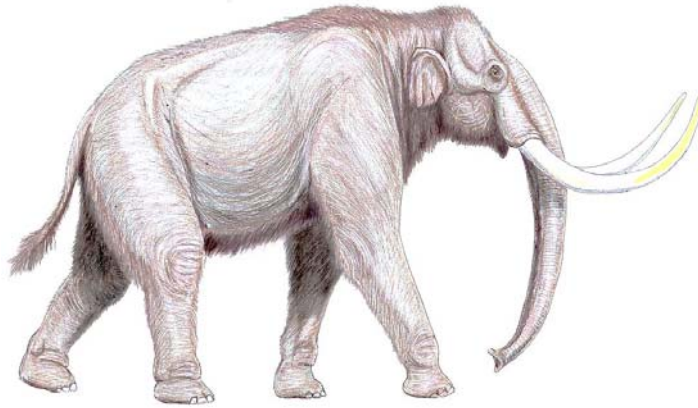


Fig.3.1

Then, about 700 000 years ago, as the climate changed and the Arctic became much colder, the woolly mammoth evolved. The woolly mammoth showed a number of obvious adaptations that help it to survive in the much colder Arctic.

- (a) (i)** Suggest and explain **one** such adaptation in the woolly mammoth.

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- (ii)** Explain how natural selection may have brought about the evolution of the woolly mammoth from the steppe mammoth.

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A frozen, 43 000 year old woolly mammoth was found in Siberia. Its DNA was extracted and sequenced. The sequences of the genes coding for the α and β chains of haemoglobin were compared with those of modern Asian elephants.

The results suggested that, when compared with Asian elephants:

- there was only one different amino acid in the woolly mammoth's α chains
- there were three different amino acids in the woolly mammoth's β chains.

(b) Explain the likely effect of these differences on a molecule of mammoth haemoglobin.

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..... [3]

[Total: 9]

QUESTION 4

An analysis of genes on separate loci in maize plants was carried out. In the experiment, pure-breeding maize plants with purple and smooth grains were crossed with pure-breeding maize plants with yellow and shrunken grains. All the plants in the F₁ generation have purple and smooth grains.

The F₁ plants were then cross-pollinated. The following results were produced in the F₂ generation:

purple and smooth	204
purple and shrunken	72
yellow and smooth	69
yellow and shrunken	21

- (a) Using the symbols **A** and **a** for colour of grain and **B** and **b** for texture of grain, draw a genetic diagram to explain these results. [4]

(b) Explain why yellow and shrunken grains breed true.

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....., [2]

Lack of vitamin A in the diet is a major problem in the rice-based societies of south-east Asia. Rice plants produce the precursor of vitamin A, β -carotene, in their green tissues, but not in the edible endosperms of their seeds.

Rice seeds lack the enzymes for two steps of the pathway for β -carotene production. The genes for these two enzymes have been inserted into rice embryos by genetic engineering, giving rise to Golden Rice™. This rice produces seeds containing β -carotene.

The added genes were:

- the *psy* gene from daffodil plants,
- the *crt 1* gene from the bacterium *Erwinia uredovora*.

(c) Explain why it is possible for rice plants to express genes from a bacterium.

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....., [1]

The following steps were taken to produce Golden Rice™:

- **step 1** – a length of DNA was made including a rice endosperm-specific promoter + *psy* + *crt 1*,
- **step 2** – copies of this length of DNA were inserted into plasmids from the *Agrobacterium tumefaciens*.

(d) (i) Describe the role of the rice endosperm-specific promoter that was added to *psy* and *crt 1* in **step 1**.

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- (ii) Explain how a length of DNA can be inserted into a plasmid in **step 2**.

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Field trials of genetically engineered crops, such as Golden Rice™, hope to identify any risks to the environment or to human health of growing and eating the crops.

- (e) (i) Suggest **one** possible risk to the environment of growing a genetically engineered crop.

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....., [1]

- (ii) Suggest **one** possible risk to human health of eating a genetically engineered crop.

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....., [1]

[Total: 14]

--- End of Section A ---

SECTION B: FREE RESPONSE QUESTION

Answer **one** question.

BEGIN EACH PART ON A FRESH SHEET OF WRITING PAPER.

Your answer should be illustrated by large, clearly labelled diagrams, where appropriate.

Your answer must be in continuous prose, where appropriate.

Your answer must be set out in parts **(a)**, **(b)** etc., as indicated in the question

A **NIL RETURN** is required for any parts not answered.

QUESTION 5

- (a) Describe how the molecular structure of cellulose is related to its function. [6]
- (b) Outline the basis of the selective permeability of the cell membrane with reference to phospholipids, cholesterol and proteins. [8]
- (c) Explain why animal cells mainly store lipids instead of carbohydrates. [6]

[Total: 20]

QUESTION 6

- (a) Describe and explain how the structure of the mitochondrion is adapted to ATP synthesis. [4]
- (b) Outline the main stages of the Krebs cycle and the role of its products in respiration. [8]
- (c) Explain the production of a small yield of ATP from anaerobic respiration in both yeast and mammals. [8]

[Total: 20]

--- End of Section B ---

--- End of Paper ---