HWA CHONG INSTITUTION
JC2 Preliminary Examination
Higher 1

CANDIDATE NAME		**CT GROUP**	**14S ___**
CENTRE NUMBER		**INDEX NUMBER**	

BIOLOGY

8875 / 02

Paper 2 Core Paper

27 August 2015

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	**/ 9**
3	**/ 10**
4	**/ 12**
5 / 6	**/ 20**
Total	**/ 60**

SECTION A: STRUCTURED QUESTIONS

QUESTION 1

Fig. 1.1 shows a molecule of haemoglobin. The haem group plays an important role in the function of haemoglobin.

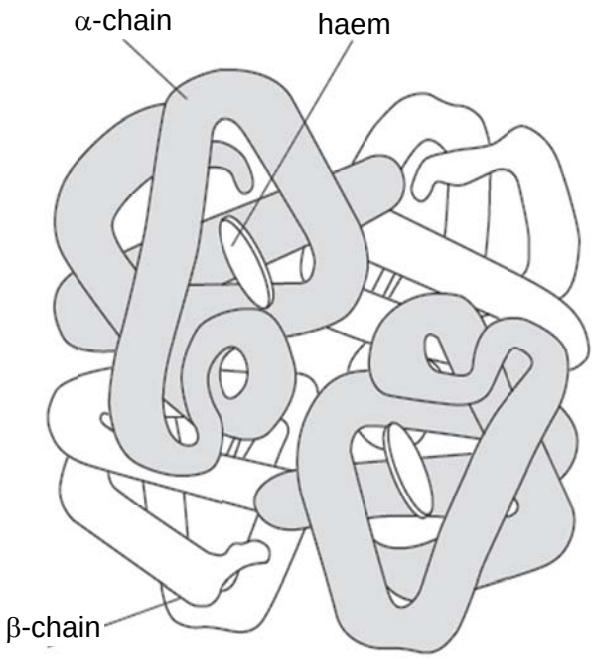


Fig. 1.1

(a) Describe the role of the *haem* group in haemoglobin. [2]

(b) Discuss the advantages of having four subunits in haemoglobin. [3]

The Greylag goose and the Andean goose have different haemoglobin structures. Possession of a haemoglobin with high oxygen affinity helps the Andean goose to adapt to high altitudes. Greylag goose lives in the Indian plains, whereas the Andean goose lives in the High Andes. The haemoglobin of the Andean goose differs from that of the Greylag goose by nine replacements in the α-chain and seven in the β-chain.

(c) Explain how the differences in haemoglobin structure of the Greylag and Andean geese contribute to their different oxygen affinities. [4]

[Total: 9]

QUESTION 2

Studies were carried out on soil-dwelling aerobic and anaerobic bacteria. Samples were taken from different depths at intervals of one month and six months after the soil was put into a large heap for storage.

Table 2.1 shows the numbers of aerobic and anaerobic bacteria at different depths in the stored soil.

Table 2.1

depth in soil store / m	mean number of bacteria per gram of stored soil $\times 10^7$			
	aerobic bacteria		anaerobic bacteria	
	after one month	after six months	after one month	after six months
0.0	12.4	12.5	0.4	0.6
0.5	10.1	8.3	0.6	1.0
1.0	9.8	5.9	0.8	3.8
1.5	9.7	3.1	0.8	7.6
2.0	10.5	0.8	0.7	8.1
2.5	10.8	0.7	0.8	8.5
3.0	10.2	0.9	0.6	8.8

(a) **(i)** Account for the trends shown by the distribution of the two types of bacteria after six months. [3]

(ii) Describe how aerobic bacteria are structurally adapted for cellular respiration. [2]

In a further study, soil samples were taken at two depths, **A** and **B**, in the soil store. The samples were taken at intervals over six years. Soil samples of equal mass were used to determine the activity of dehydrogenases in the Krebs cycle of the aerobic bacteria.

Fig. 2.1 shows the mean dehydrogenase activity of the bacteria in these samples.

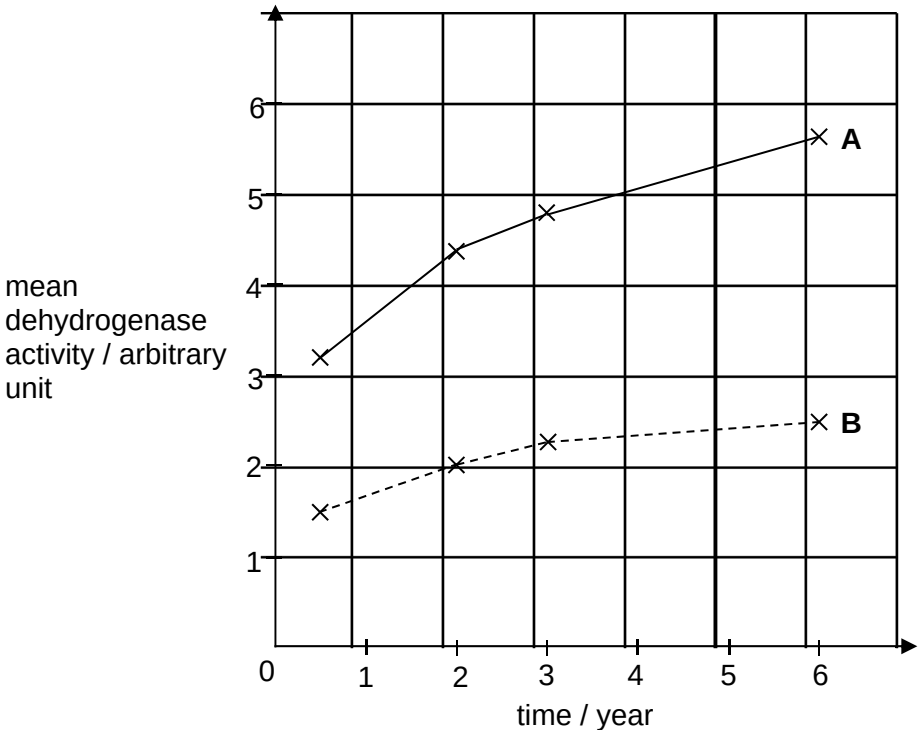


Fig. 2.1

(b) **(i)** State with evidence from Fig. 2.1 which depth, **A** or **B**, were samples taken from a greater depth. [2]

(ii) Explain the roles of dehydrogenases in the Krebs cycle of aerobic bacteria. [2]

[Total: 9]

QUESTION 3

(a) State the structural features of DNA that make it a stable molecule. [2]

DNA polymerase is an enzyme involved in the replication of DNA.

One of the substrates required by DNA polymerase is ATP.

ara-ATP is a chemical that affects DNA polymerase activity.

In an investigation, the effect of different concentrations of ATP on the rate of DNA synthesis was determined:

- with no ara-ATP
- with a low concentration of ara-ATP
- with a high concentration of ara-ATP.

The results of the investigation are shown in Fig. 3.1.

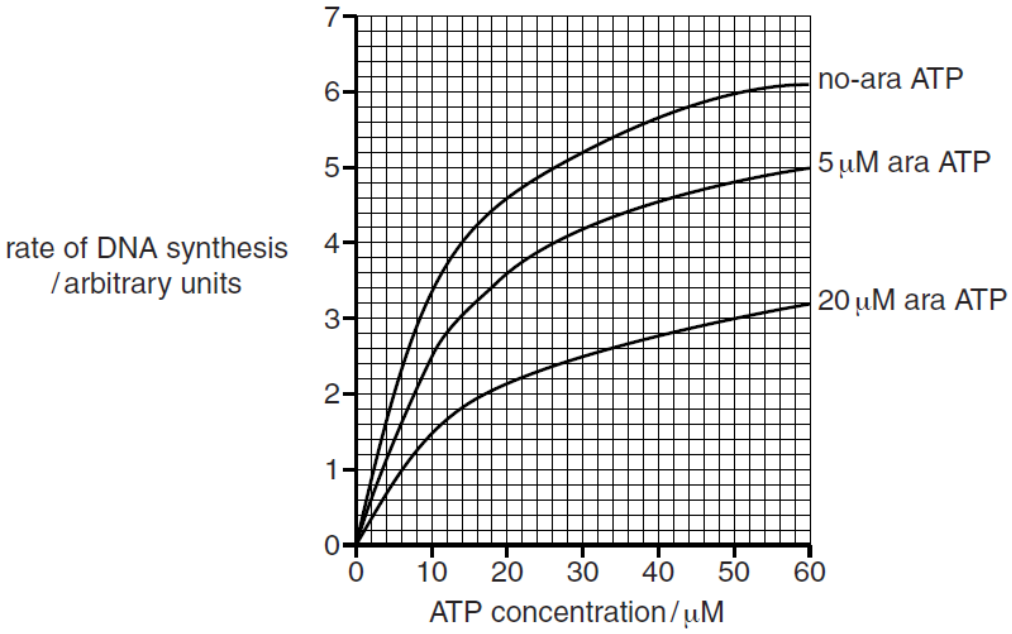


Fig. 3.1

(b) Explain, in terms of mode of action of enzymes, the results of the investigation shown in Fig. 3.1. [3]

Colour blindness is a genetic condition characterised by the inability of the brain to perceive certain colours accurately.

- The most common form is termed red-green colour blindness (RGC).
- RGC results from a recessive allele.
- 0.6% of females worldwide have RGC.
- 8.0% of males worldwide have RGC.

The results of the investigation are shown in Fig. 3.2.

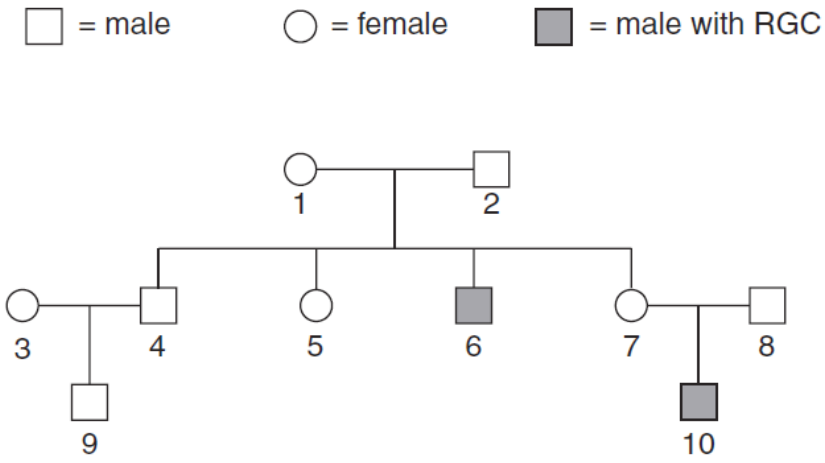


Fig. 3.2

(c) Define the term *recessive*. [1]

(d) Explain why females are less likely than males to have RGC. [2]

(e) With reference to Fig. 3.2, and using the symbols **R** for the dominant allele and **r** for the recessive allele, state the genotypes of the individuals **1** and **6**. [2]

1 _____

6 _____

[Total: 10]

QUESTION 4

Genes can be transferred from one species to another using plasmids, which are circular pieces of DNA found in some bacteria.

Fig. 4.1 shows how a plasmid is cut and a piece of foreign DNA inserted. The foreign piece of DNA usually contains more than one gene.

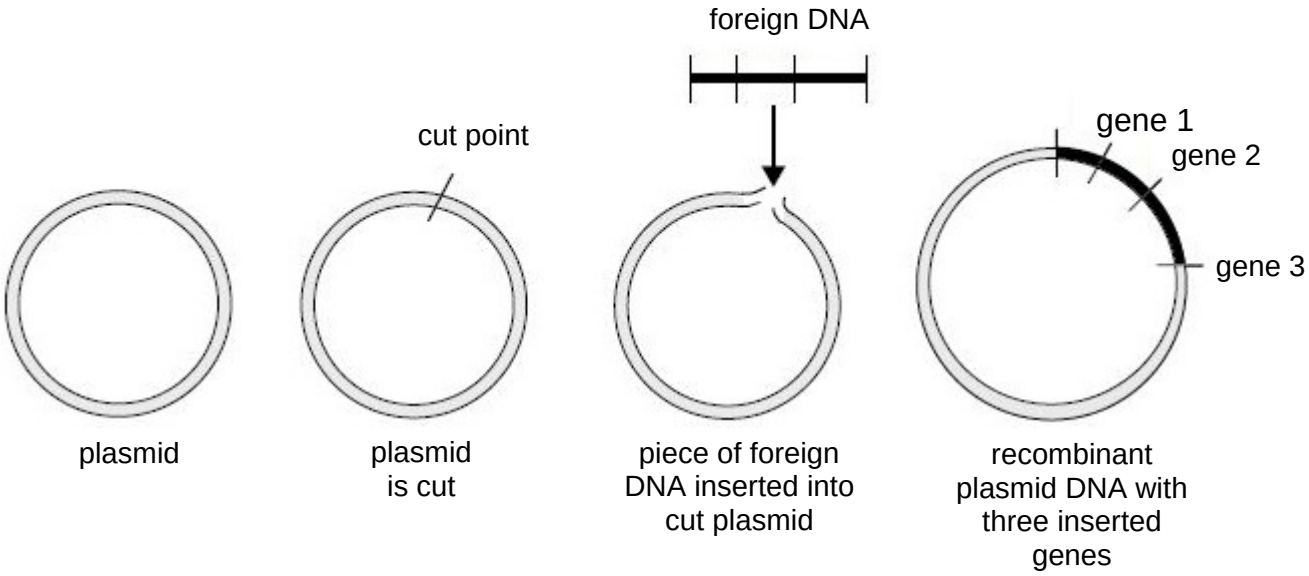


Fig. 4.1

Many copies of the new recombinant plasmid DNA are then incubated with bacteria.

(a) Explain what is meant by recombinant plasmid DNA. [2]

(b) Outline the roles of the enzymes used in the formation of the recombinant plasmid DNA. [2]

(c) One of the foreign genes inserted into the plasmid, codes for resistance to a particular antibiotic.

Explain why it is important to include a gene for antibiotic resistance in the plasmid produced. [2]

Recombinant plasmid DNA is a very useful cloning vector in recombinant DNA technology. It can be used in a variety of settings with plants and animals.

For example, some plants are resistant to attack by insects. The plants produce a protein that poisons the larval stage of some insects that feed on them. The production of the protein is under genetic control.

A particular species of crop plant was genetically engineered to contain this gene. Such plants are referred to as genetically modified (GM) plants.

(d) Explain why a farmer might choose to grow a crop that was genetically engineered to be resistant to insects, rather than spray the crop with insecticide. [2]

Some plants are resistant to particular herbicides, chemicals that are used to kill plants. This trait is also under genetic control.

The gene that confers herbicide resistance has also been incorporated into some GM crop plants. This enables a farmer to spray his GM crop with a herbicide that will not harm the GM crop but does kill weed plants growing within the crop.

Two farmers have properties next door to each other. They grow the same cereal crop.

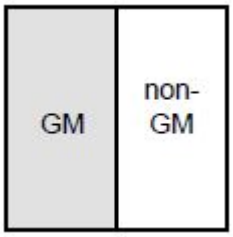
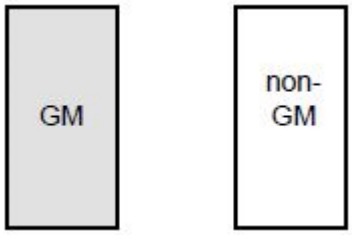
- Farmer **X** wishes to grow GM crops that are resistant to herbicide.
- Farmer **Y** wishes to continue to grow non-GM crops.

Farmer **Y** was concerned, and suggested to farmer **X** that pollen from the GM crop could fertilise the non-GM plants.

(e) Suggest why farmer **Y** might be concerned about the possibility of his crop being fertilised by pollen from farmer **X**'s crop. [1]

The farmers agreed to carry out field trials to establish whether leaving a gap between crops reduced the likelihood of cross-pollination. A number of trials were planted so that the results of one trial did not interfere in any way with the results of another. The percentage of seeds produced at various positions as a result of cross-pollination was measured for each trial. The outline of these trials and the results gathered are shown in Table 4.1.

Table 4.1

	Percentage of cross-pollination	
	at edge of non-GM crop	10 m into non-GM crop
Trial 1  no gap between plots	10	2
Trial 2  5 m between plots	1	0.5
Trial 3  7 m between plots	1	0.3

(f) Deduce the conclusions that can be drawn about cross-pollination and the gap between crops. [3]

[Total: 12]

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.

You 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 and explain the fluid mosaic model of membrane structure. [5]

(b) Outline the roles and functions of membranes within cells and at the surface of cells. [8]

(c) Explain how meiosis and random fertilisation can lead to variation. [7]

[Total: 20]

QUESTION 6

(a) Outline the role of organelles in protein synthesis. [5]

(b) Describe how the information on DNA is used to synthesise mRNA. [7]

(c) Explain with named examples, how embryological and molecular homologies support Darwin's theory of evolution. [8]

[Total: 20]

--- End of Section B ---

--- End of Paper ---