

HONG KONG EXAMINATIONS AND ASSESSMENT AUTHORITY  
HONG KONG DIPLOMA OF SECONDARY EDUCATION EXAMINATION 2012

**BIOLOGY PAPER 2**

11.45 am – 12.45 pm (1 hour)  
This paper must be answered in English

**INSTRUCTIONS**

- (1) There are **FOUR** sections, A, B, C and D in this Paper. Attempt **ALL** questions in any **TWO** sections.
- (2) Write your answers in the Answer Book DSE (C) provided. Start each question (not part of a question) on a new page.
- (3) Present your answers in paragraphs wherever appropriate.
- (4) Illustrate your answers with diagrams wherever appropriate.
- (5) The diagrams in this paper are **NOT** necessarily drawn to scale.

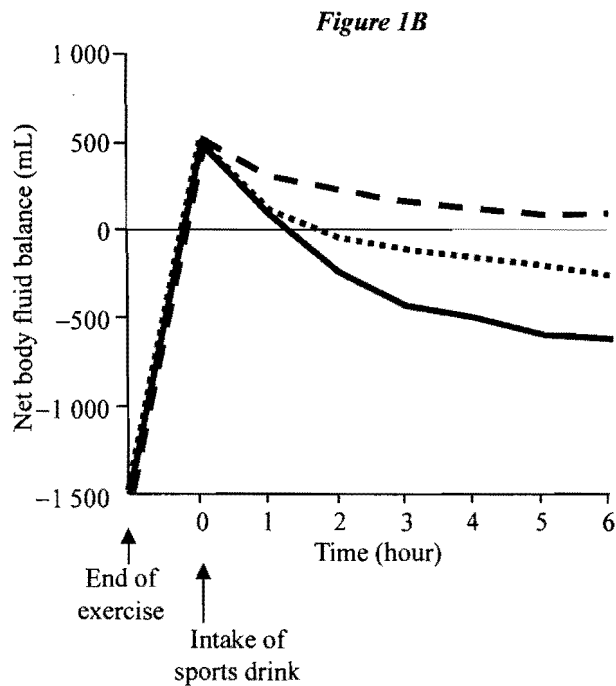
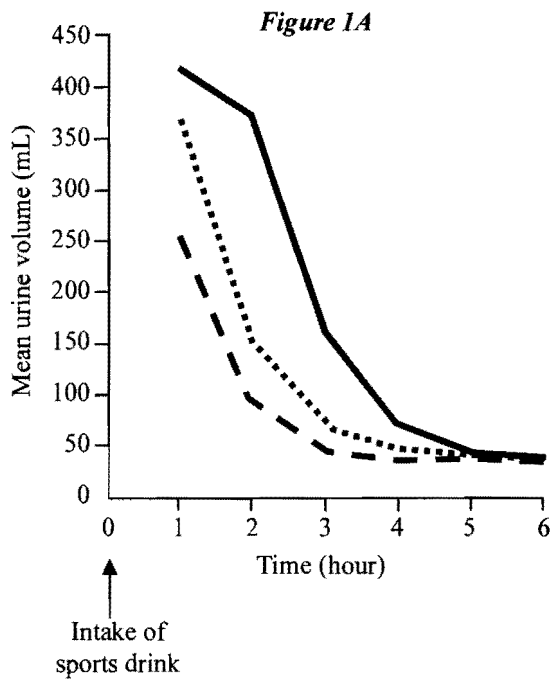
**SECTION A Human Physiology: Regulation and Control**

Answer **ALL** parts of the question.

1.(a) In a study about the replenishment of water after exercise, participants performed exercise until they lost 1 500 mL water. They were then divided into 3 groups and asked to consume a 2 000 mL sports drink containing 0, 50 and 100 mmol / L sodium respectively. Urine samples were collected at 1-hour intervals for 6 hours and the net body fluid balance throughout the course of the experiment was determined. The results are respectively shown in the Figures 1A and 1B below:

Key:

- 0 mmol / L sodium
- ..... 50 mmol / L sodium
- - - 100 mmol / L sodium



- (i) Describe the general patterns of the urine output after consuming drinks with different sodium concentrations. (4 marks)
- (ii) Account for the high urine output of the participants who consumed sports drink with 0 mmol / L sodium. (4 marks)
- (iii) In terms of the replenishment of water, which sports drink would you recommend for athletes to consume after exercise? Explain your answer. (3 marks)

1.(b) In the study described in (a), the participants performed exercise in a room maintained at 34°C and 60-70% relative humidity.

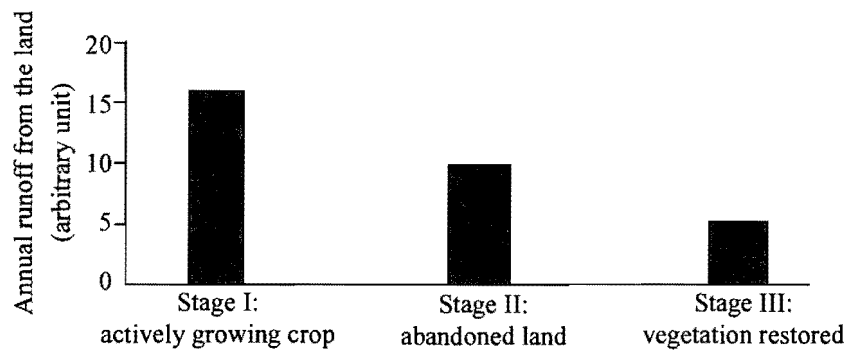
- (i) State *two* major ways in which participants lost water during exercise. (2 marks)
- (ii) If the temperature and relative humidity in the room had been set higher, it would have been dangerous to the participants. Explain why this is so. (4 marks)
- (iii) After the exercise, the breathing rate of the participants remained at a fairly high level. Explain the significance of this. (3 marks)

## SECTION B Applied Ecology

Answer ALL parts of the question.

- 2.(a) In shifting agriculture, plots of land on hill slopes are cleared of trees so as to grow crops. The trees are then burnt and the ash is dispersed throughout the field as fertilizer. After growing crops for several years until the soil loses its fertility, the land will be abandoned. After a period of time, the land will be recolonized by natural vegetation. Figure 2A below shows the annual runoff (water run off from soil) at 3 different stages of shifting agriculture:

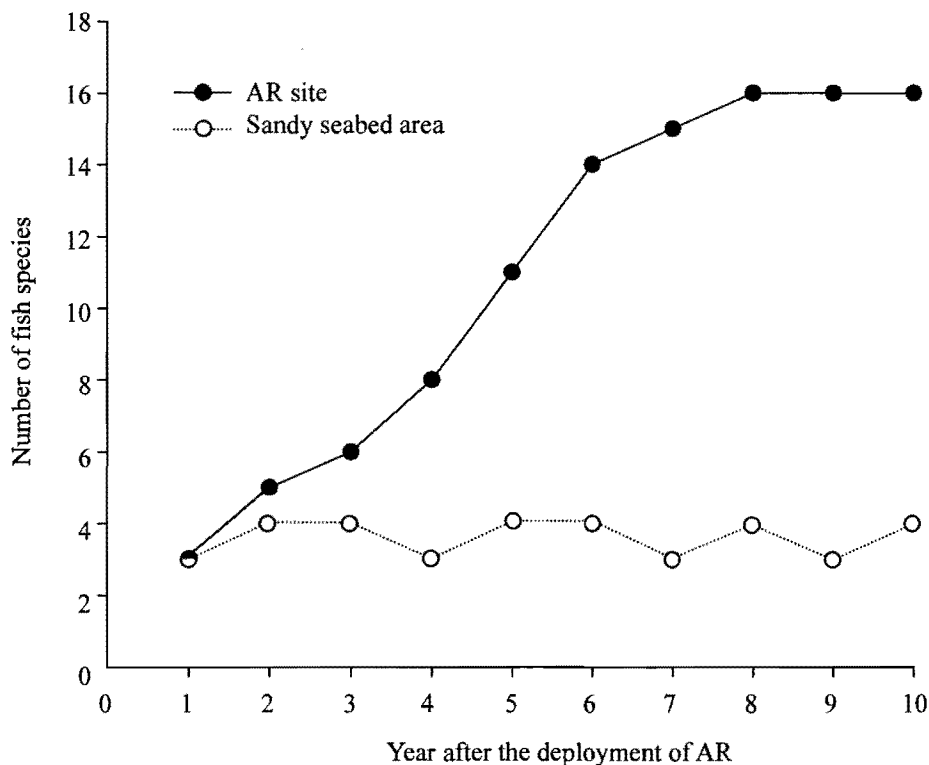
*Figure 2A*



- Briefly describe the process in Stage II that leads to the restoration of the natural vegetation in Stage III. (3 marks)
- Suggest *two* agricultural activities which could account for the difference in the annual runoff between Stage I and Stage III. (5 marks)
- As soil nutrients are depleted in Stage I, the leaves of the crops become yellow. Which soil nutrient is probably lacking? Explain your answer. (2 marks)
- State *two* ways in which soil nutrients are lost from land. (2 marks)

2.(b) An artificial reef (AR) is a man-made structure deployed on the seabed to enhance biodiversity. A ten-year study was carried out on a sandy seabed to investigate the effect of an AR on the number of fish species. The number of fish species at the AR site (around and within AR) was compared with another similar sandy seabed area nearby. The results are shown in Figure 2B below:

**Figure 2B**

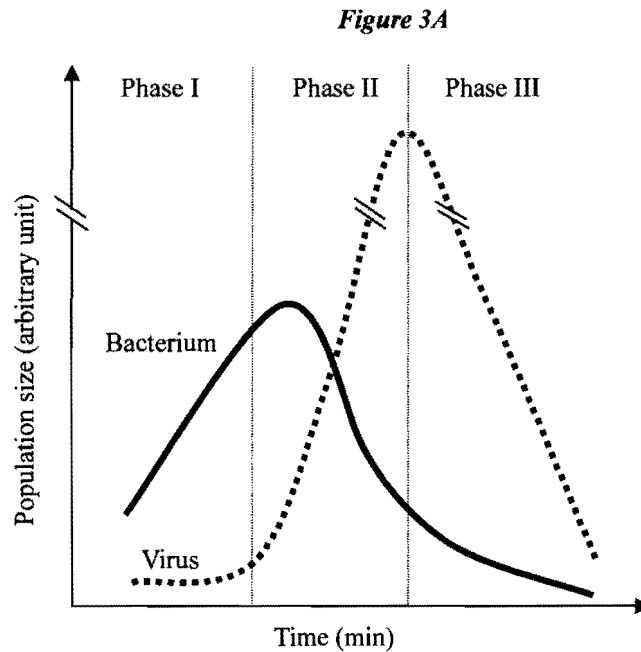


- (i) Compare the results obtained in terms of the number of fish species at the AR site and the sandy seabed area. (3 marks)
- (ii) Explain why AR has an effect on the number of fish species at the AR site. (3 marks)
- (iii) Give *two* criteria for the selection of suitable materials for AR construction and explain the importance of these criteria. (2 marks)

**SECTION C Microorganisms and Humans**

Answer **ALL** parts of the question.

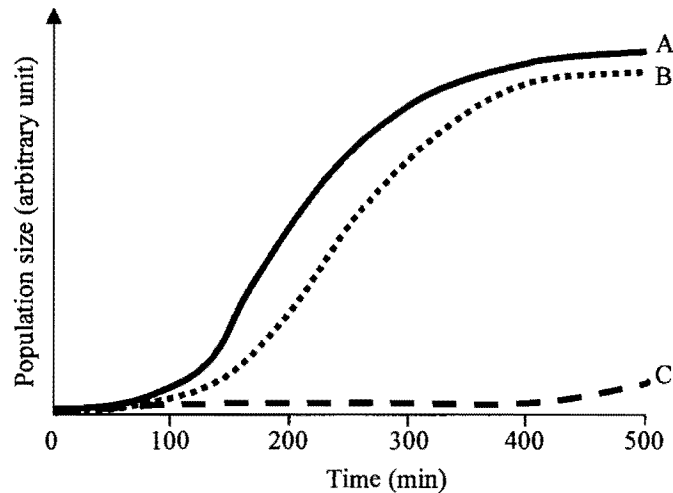
- 3.(a) Viruses that infect bacteria may be used to eliminate pathogenic bacteria in food production lines. Figure 3A below indicates variations in the population size of a virus and its bacterial host:



- (i) What is the importance of the bacterial host to the virus? (1 mark)
- (ii) With reference to the life cycle of viruses, explain the difference in the virus population in Phase I and Phase II. (4 marks)
- (iii) Explain the drop in the population size of the virus in Phase III. (1 mark)
- (iv) The results of scientific research have suggested that adopting such technology in food production would be safe for humans. Why would it be safe? (2 marks)
- (v) Compared to conventional disinfection techniques, such as UV irradiation and steam sterilization, viral disinfection has limitations. Suggest *two* limitations. (2 marks)

- 3.(b) The wild type and mutant of a bacterial species were examined for growth under different culture conditions. The mutants were unable to produce cell walls. Figure 3B below indicates the change in the cell number of the wild type grown in an isotonic liquid medium (A), the mutant in an isotonic liquid medium (B), and the mutant in a hypotonic liquid medium (C):

**Figure 3B**



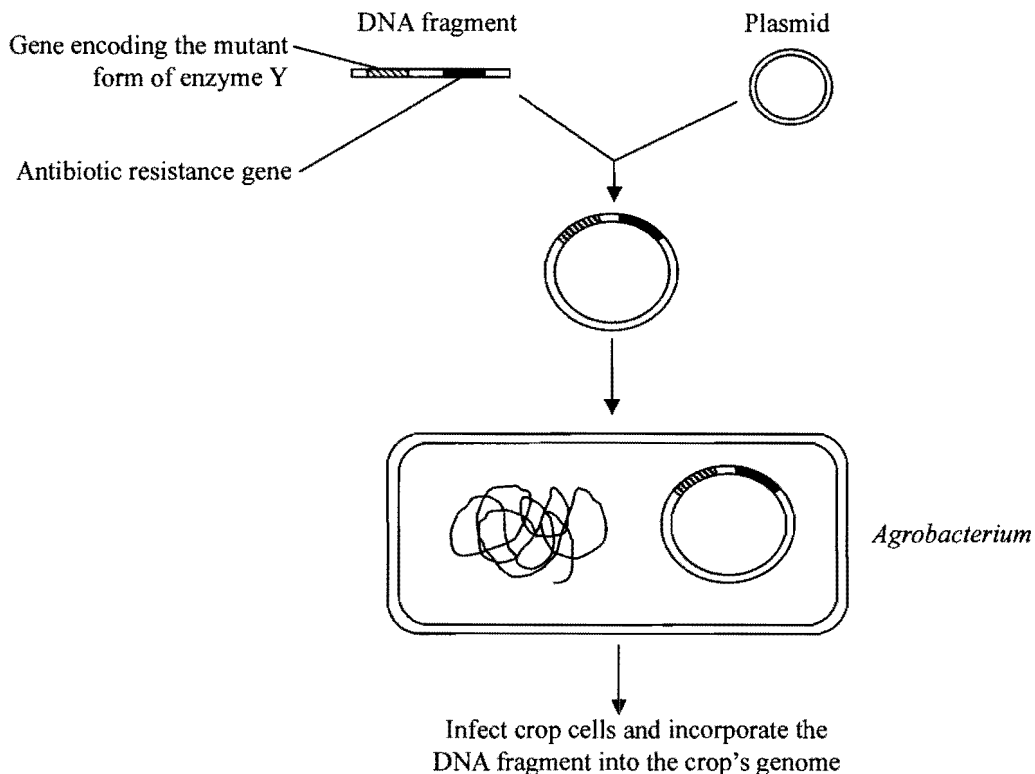
- (i) Suggest *two* methods of determining the population size of bacteria in a liquid culture. (2 marks)
- (ii) With reference to the function of cell walls, explain the different growth rates observed for the two mutant cultures, B and C. (4 marks)
- (iii) What would happen to the population size of the wild type (A) if the culture at the 400<sup>th</sup> minute was mixed with an equal volume of the fresh culture medium? Explain your answer. (4 marks)

**SECTION D                      Biotechnology**

Answer **ALL** parts of the question.

4.(a) Chemical X inhibits enzyme Y in photosynthesis and kills all plants. A scientist identified a mutant form of enzyme Y that works properly in photosynthesis and is not inhibited by chemical X. He cloned the gene encoding the mutant form of enzyme Y and put it into a plasmid so that the gene can be transferred into some cells of a crop species. Figure 4A below is a diagrammatic representation of the process:

**Figure 4A**



- (i) Describe **two** steps taken to put the DNA fragment into the plasmid. (2 marks)
- (ii) The scientist then transferred the plasmid into the cells of a crop plant using *Agrobacterium*. After the treatment, only some crop cells have incorporated with the DNA fragment.
  - (1) Explain why only some of the treated crop cells have incorporated with the DNA fragment. (2 marks)
  - (2) How can the scientist identify those crop cells that carried the DNA fragment? (3 marks)
- (iii) The scientist suggests that growing this genetically modified crop together with chemical X applied to the field can greatly increase the crop yield. Explain the reasoning for this suggestion. (4 marks)



- 4.(b) A 25-year-old athlete, Keith, had nerve damage and became paralyzed. In view of the difficulties associated with tissue transplants, he proposed cloning himself, using the method used for Dolly the sheep, so as to get a nerve for transplantation. He discussed his idea with a scientist.
- (i) Give *two* problems associated with conventional tissue transplants. (2 marks)
  - (ii) Keith's idea could not be put into practice. State *one* ethical reason to explain why not. (1 mark)
  - (iii) The scientist suggested that stem cell therapy may be a way of obtaining some nerve cells.
    - (1) State *one* place in Keith's body where stem cells can be obtained. (1 mark)
    - (2) Describe how stem cells may be used to cure Keith. (3 marks)
    - (3) Describe *two* limitations of using stem cell therapy in this case. (2 marks)

**END OF PAPER**

Sources of materials used in this paper will be acknowledged in the *Examination Report and Question Papers* published by the Hong Kong Examinations and Assessment Authority at a later stage.