HONG KONG EXAMINATIONS AND ASSESSMENT AUTHORITY
HONG KONG DIPLOMA OF SECONDARY EDUCATION EXAMINATION 2014

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.

Not to be taken away before the end of the examination session

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SECTION A Human Physiology: Regulation and Control

Answer **ALL** parts of the question.

1(a) The table below shows the amounts of different substances handled by the kidneys:

	Amount filtered into the kidney tubules	Amount reabsorbed into blood capillaries	Amount excreted along with urine
Glucose (g day^{-1})	180	180	0
Hydrogencarbonate (mEq day^{-1})	4 320	4 318	2
Sodium (mEq day^{-1})	25 560	25 410	150
Chloride (mEq day^{-1})	19 440	19 260	180
Potassium (mEq day^{-1})	756	644	92
Urea (g day^{-1})	47	23.5	23.5

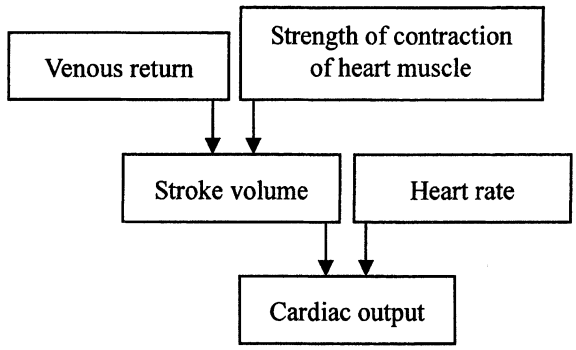
(i) With reference to the mechanisms involved in reabsorption, account for the differences in the amount of glucose and urea handled by the kidneys. (4 marks)

(ii) Of the total amount of water reabsorbed by the kidneys, only a small amount is regulated by a hormone.

(1) Using the information provided in the table, explain how most of the water is reabsorbed regardless of hormonal control. (3 marks)

(2) State the hormone which is responsible for regulating the reabsorption of water and state how it works. (2 marks)

1(b) Cardiac output refers to the blood volume supplying to the systemic circulation. The diagram below shows some factors that affect cardiac output:



(i) The contraction of which heart chamber determines the stroke volume? (1 mark)

(ii) Explain how the stroke volume is affected by the venous return and strength of the contraction of heart muscle. (2 marks)

(iii) Explain ***one*** way in which the venous return is increased when a person is doing exercise. (3 marks)

(iv) The average running speed in a marathon is usually much lower than that in a 100 m race. Explain why it is not possible for marathon runners to run at the same average speed as a 100 m runner throughout a marathon. (5 marks)

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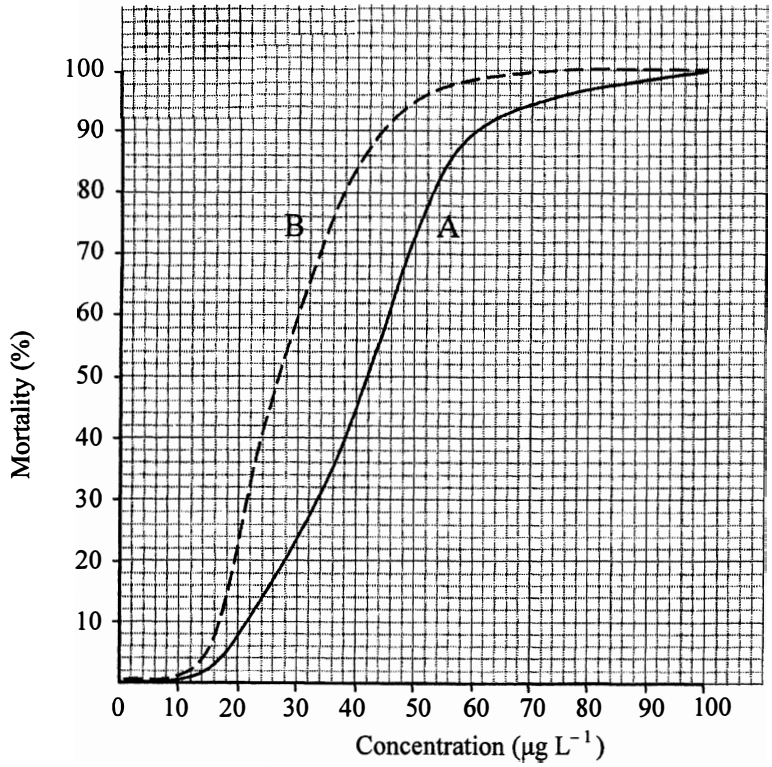
SECTION B Applied Ecology

Answer **ALL** parts of the question.

2(a) The graph below shows the mortality of a species of freshwater shrimp after it has been exposed to various concentrations of two **fat-soluble** pesticides, A and B, for 24 hours:



(i) (1) Determine the concentrations of pesticides A and B at which 50% of the shrimps were killed. (1 mark)

(2) Deduce which pesticide, A or B, was more toxic. (2 marks)

(ii) To further study the toxicity of pesticides A and B, the shrimps were exposed to either pesticide A or B at a concentration of 5 μg L^{-1} for 4 days. At the end of the study, the concentrations of pesticides in the body tissue of the shrimps were determined.

(1) 50 μg kg^{-1} of pesticide A and 80 μg kg^{-1} of pesticide B were found in the body tissue of the shrimps. Suggest ***three*** possible reasons why there was a higher concentration of pesticide B than pesticide A in the body tissue. (3 marks)

(2) Why was a concentration of 5 μg L^{-1} adopted for the pesticides used in the experiment? (1 mark)

(iii) A field survey was conducted to investigate the concentration of pesticide A in the body tissue of herbivorous fish and carnivorous fish. What difference in the concentrations of pesticide A would you expect to find between these two types of fish? Explain your answer. (3 marks)

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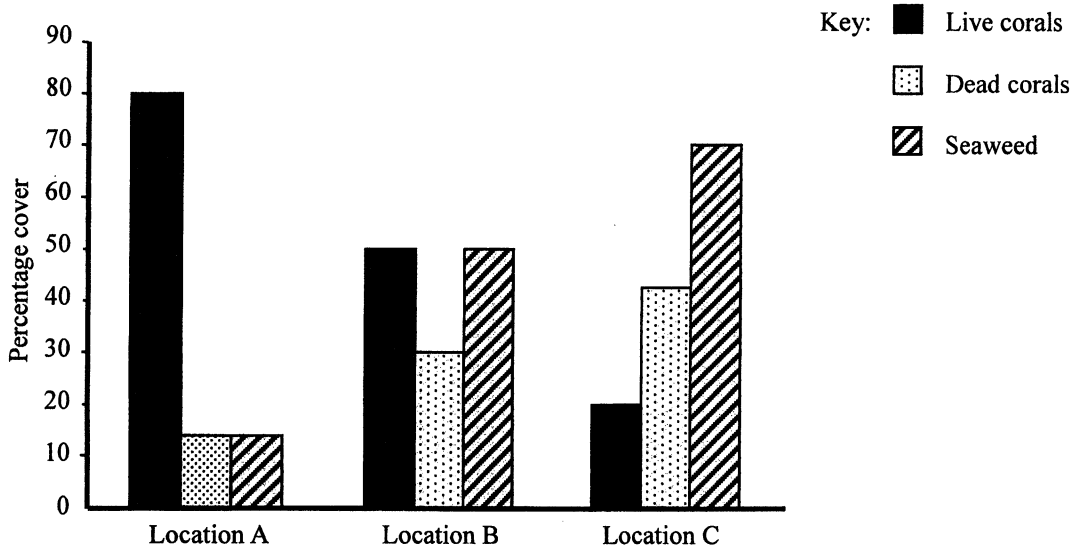
2(b) A field survey was conducted to determine the health status of the coral communities at three locations A, B and C on the sea bottom along a coastline. At each location, the percentage cover of live corals, dead corals and seaweed was determined. The results are shown in the graph below:



(i) At which location did the coral communities appear to be the healthiest? Support your answer with data. (2 marks)

(ii) (1) Suggest ***one*** human activity which may have led to the highest percentage cover of seaweed in location C. Explain your answer. (3 marks)

(2) Suggest ***one*** possible consequence of this human activity that may have resulted in the low percentage cover of live corals at location C. (1 mark)

(iii) (1) Hoi Ha Wan was chosen to be a marine park for the richness of its coral community. Explain the ecological importance of coral communities. (3 marks)

(2) Suggest ***one*** human activity that should be prohibited in a marine park. (1 mark)

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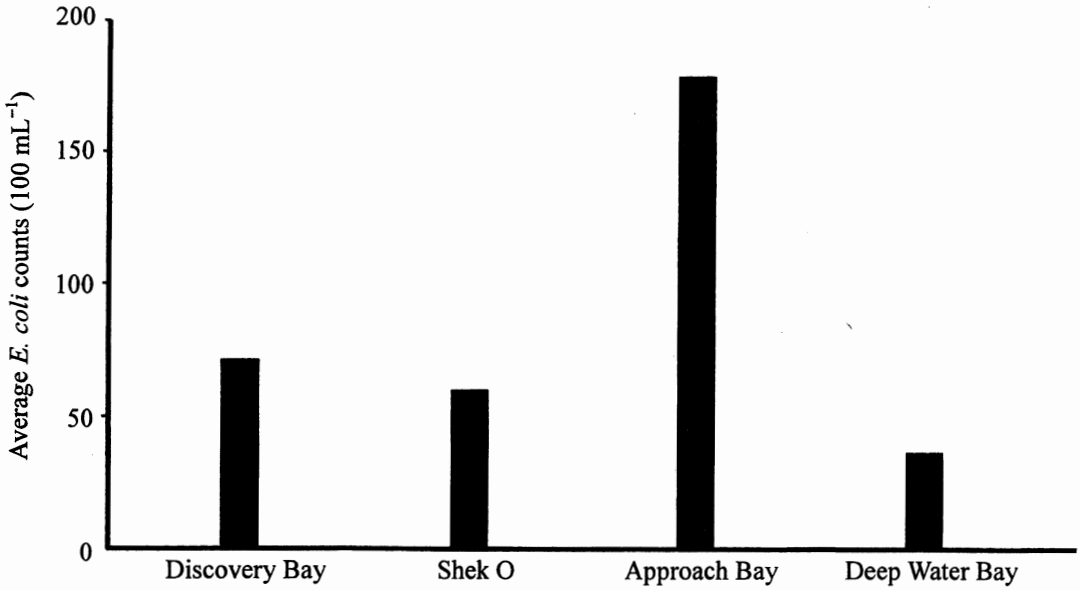
SECTION C Microorganisms and Humans

Answer **ALL** parts of the question.

3(a) In Hong Kong, *Escherichia coli* counts have been used to judge whether the water quality of beaches is suitable for swimming. The bar chart below shows the levels of *E. coli* in the water samples taken from four beaches in 2012:



(i) Why can *E. coli* counts be used to reflect the water quality? (3 marks)

(ii) Based on the above data, which beach would you prefer for swimming? Why? (3 marks)

(iii) State ***two*** limitations of using *E. coli* counts in estimating water quality. (2 marks)

(iv) To measure the number of *E. coli* in a water sample, a culturing step is needed and aseptic techniques must be used.

(1) What is the importance of using aseptic techniques in this process? (1 mark)

(2) Describe ***one*** commonly used aseptic technique for the preparation of the culture media and outline its principles. (3 marks)

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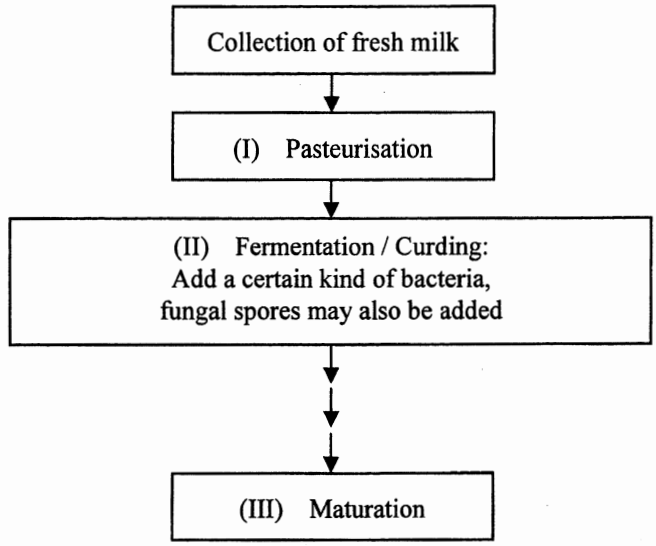
3(b) (i) In the past, cheese was made from milk by the action of environmental microorganisms. Its flavour was mainly due to the metabolites of microorganisms. Different batches of cheese produced during different seasons of a year might end up having different flavours. Explain this phenomenon. (3 marks)

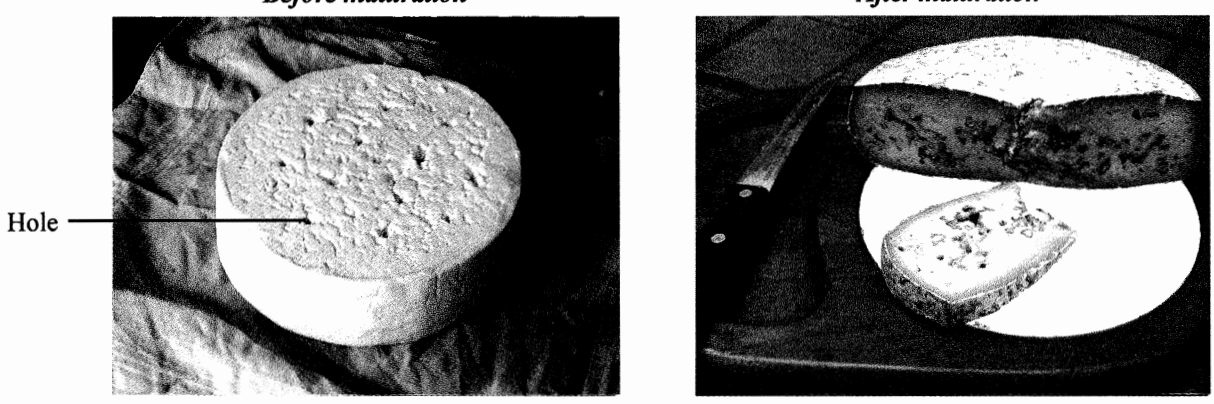
(ii) Nowadays, mass production of cheese is carried out in a controlled manner to ensure the quality and consistency of the cheese. The following flowchart shows some major steps involving microorganisms during the manufacture of cheese:



(1) In terms of quality and consistency, explain the importance of processes (I) and (II). (2 marks)

(2) In the production of blue cheese, a small number of the spores of a species of aerobic fungus is added into the cheese curds during process (II). In process (III), tiny holes are punched in the cheese using a needle. When a large number of spores appear in the cheese, the blue colour of the spores becomes visible. The photographs below show the appearance of the blue cheese before and after maturation:

Before maturation ***After maturation***



Suggest how the step of punching holes in the cheese leads to the appearance of the blue cheese after maturation. (3 marks)

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SECTION D Biotechnology

Answer **ALL** parts of the question.

4(a) In the past, animals with certain desirable traits were selected to breed for several generations and the offspring produced would be domesticated. This technique is known as selective breeding. Nowadays, animals with desirable traits can be produced by animal cloning or transgenic technology.

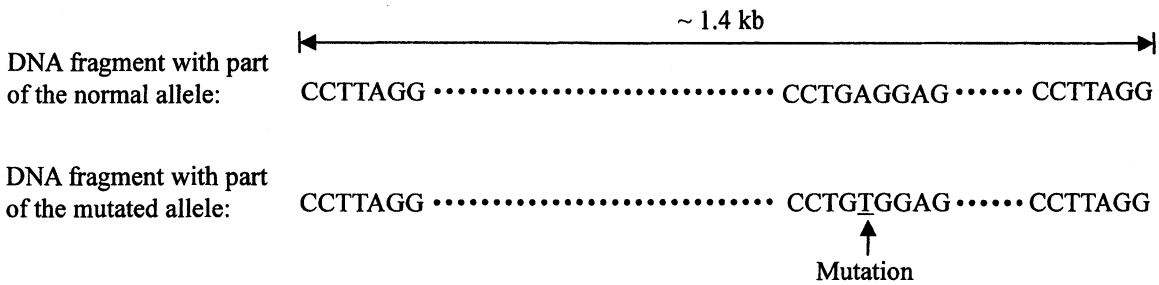
(i) With reference to the principles involved in selective breeding and animal cloning, explain why animal cloning is a better method of preserving the desirable traits of an animal than selective breeding. (5 marks)

(ii) Both selective breeding and transgenic technology affect the gene pool of a species. Transgenic technology is more controversial than selective breeding.

(1) How would selective breeding affect the gene pool of a species? (2 marks)

(2) Production of transgenic organisms is more controversial due to its effect on the gene pool of a species. Explain why. (3 marks)

4(b) DNA fingerprinting is used in the screening of a genetic disease known as sickle-cell anaemia. The disease is a result of a gene mutation which leads to the production of defective haemoglobin. To prepare the DNA fingerprint, copies of DNA fragments containing the gene associated with sickle cell anaemia are first produced by a polymerase chain reaction (PCR). The fragments are then treated by a restriction enzyme which cuts DNA at the middle of CCTNAGG, where N can be any nucleotide. The diagram below shows some nucleotide sequences of the DNA fragment containing the normal allele and the mutated allele for sickle-cell anaemia:



(i) How many restriction sites are found in the DNA fragment with the normal allele and that with the mutated allele respectively? (1 mark)

(ii) Based on the principle of gel electrophoresis, explain how the cutting of the two DNA fragments shown above would produce different DNA fingerprint patterns in a gel. (4 marks)

(iii) How many DNA bands would be observed in the DNA fingerprint of a carrier of sickle-cell anaemia? Explain your answer. (2 marks)

(iv) Explain why the gene mutation will result in the production of defective haemoglobin. (3 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.

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