HONG KONG EXAMINATIONS AND ASSESSMENT AUTHORITY

HONG KONG DIPLOMA OF SECONDARY EDUCATION EXAMINATION 2013

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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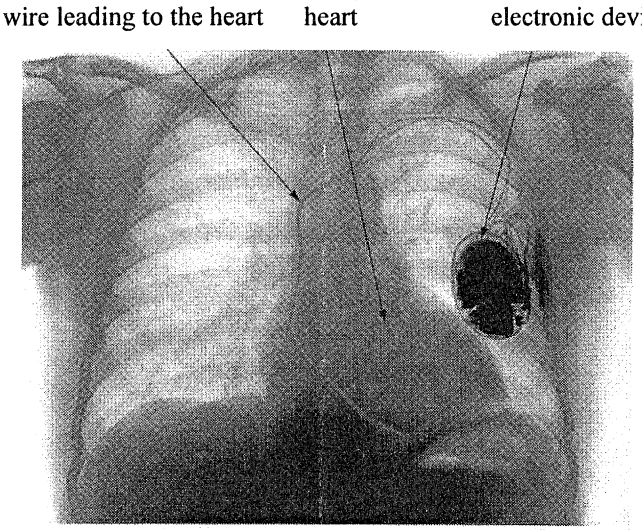
SECTION A Human Physiology: Regulation and Control

Answer **ALL** parts of the question.

1(a) The X-ray photograph below shows a small electronic device that has been surgically implanted into the chest cavity of a patient suffering from heart disease. This device maintains the proper rhythm of the patient's heart.



(i) Which structure of the heart does the device replace functionally? (1 mark)

(ii) The structure mentioned in (i) triggers a series of events that lead to the proper functioning of the heart. Describe these events. (4 marks)

(iii) During the cardiac cycle, there is a period of time in which both atria and ventricles are in a relaxed state. Briefly describe the pathway of blood flow returning from the lungs to the heart chambers during this period. (3 marks)

(iv) With reference to a hormone, describe how it can bring about an increase in cardiac output. (3 marks)

1(b) Kathy has been married for two years. In the first year, she took a progesterone-containing contraceptive pill. Then she stopped taking it and got pregnant. Three months later she noticed bleeding from her vagina. Her doctor gave her progesterone to stop the bleeding.

(i) Explain how progesterone in the contraceptive pill prevented Kathy from becoming pregnant. (5 marks)

(ii) (1) What was the possible cause and consequence of the bleeding from Kathy's vagina? (2 marks)

(2) How did the progesterone prescribed by the doctor help Kathy in this case? (2 marks)

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SECTION B Applied Ecology

Answer **ALL** parts of the question.

2(a) An experiment was conducted to study the effect of acid rain on the growth of bean seedlings planted in pots containing two different soils, either with or without heavy metal X. The same amount of water with a pH of either 6 or 3 was used to water the seedlings every day and their average increase in fresh weight was measured after 30 days. The results are shown in the table below:

	Average increase in fresh weight of bean seedling (g)	
	pH 6	pH 3
Soil without heavy metal X	13.0	7.7
Soil with heavy metal X	7.5	4.3

Note: Rainwater normally has a pH value of 6.

(i) What conclusion can you draw from the results of the experiment? (3 marks)

(ii) During the experiment, excess water that came out of the potted plants was collected and the amount of heavy metal ion X in it was determined. The table below shows the results:

	pH 6	pH 3
Amount of heavy metal ion X in excess water (arbitrary unit)	5	10

Based on this information, explain the effect of adding water of pH 3 to the seedlings in soil containing heavy metal X. (3 marks)

(iii) State the air pollutants that cause acid rain and state the human health problem associated with these air pollutants. (3 marks)

2(b) Pollutant Y was found in sewage discharge from industry, leading to bioaccumulation in organisms.

(i) Give ***three*** properties of chemicals that make them liable to bioaccumulation. (3 marks)

(ii) Specimens were collected from a site where pollutant Y was known to be discharged. The levels of pollutant Y in sea water, sediment and some organisms collected from the site are listed in the following table:

	Concentration of pollutant Y (arbitrary unit)
Seawater	2
Sediment	36
Clams	163
Birds	1557
Fish	519

Based on the information in the above table, which organism is most likely the top consumer of the food chain in the site? Explain your answer. (3 marks)

(iii) With reference to the functional role of organisms in an ecosystem, give ***one*** group of organisms not included in the above table. State the ecological significance of this group of organisms. (3 marks)

(iv) If humans consumed fish contaminated with pollutant Y, which human organ would have a high concentration of this pollutant? Explain your answer. (2 marks)

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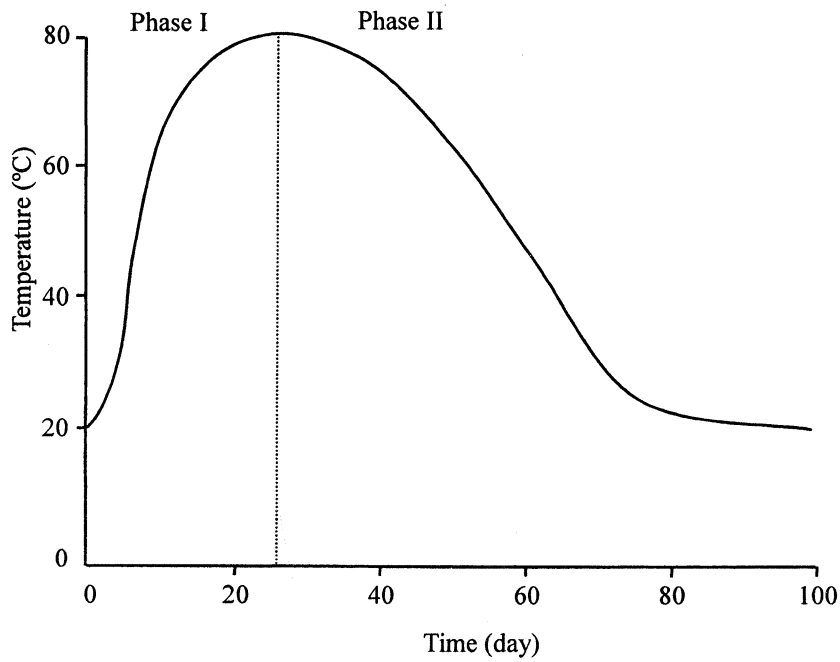
SECTION C Microorganisms and Humans

Answer **ALL** parts of the question.

3(a) Garden composting can effectively turn food waste into fertilizer. This is done by mixing the right amounts of food waste with soil containing various types of active microorganisms. The graph below shows the change in temperature inside a compost pile over 100 days:



(i) Describe and explain the changes in temperature inside the compost during Phase I and II. (5 marks)

(ii) It was noted that the diversity of microorganisms decreased during Phase I of the composting. With reference to the graph, suggest an explanation for this observation. (2 marks)

(iii) (1) Food waste should be chopped into small pieces before they are mixed with soil. What is the purpose of doing this? (1 mark)

(2) Adequate and continuous stirring of the food waste-soil mixture is essential for effective composting. Explain why this is important. (3 marks)

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3(b) *Aspergillus niger* is a fungus that spoils fruit. An enzyme called pectinase is secreted from the fungus during its colonisation on the fruit surface. This enzyme can be used in fruit juice production.

(i) With reference to the features of fungi, explain how *Aspergillus niger* makes use of pectinase to obtain nutrients from the inside of the fruit. (4 marks)

(ii) With reference to the action of pectinase, suggest why fruit juice produced by using pectinase

(1) has a higher yield, and (1 mark)

(2) is more nutritious. (2 marks)

(iii) People consuming food contaminated with microorganisms may suffer from food borne infection or food poisoning. Distinguish between food borne infection and food poisoning. (2 marks)

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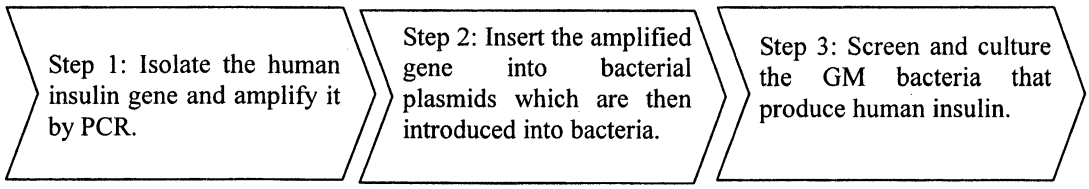
SECTION D Biotechnology

Answer **ALL** parts of the question.

4(a) In the past, diabetic patients were treated with insulin obtained from animal pancreases. With advances in recombinant DNA technology, insulin is now derived from genetically modified (GM) bacteria. Below shows a possible scheme for developing such a GM bacterium:



(i) Give ***two*** raw materials which are necessary in Step 1 for the amplification of the human insulin gene from a DNA template. (2 marks)

(ii) With reference to the immune response, explain why insulin from GM bacteria is used instead of that extracted from animal pancreas. (4 marks)

(iii) Explain why producing insulin from GM bacteria is cheaper than extracting it from animal pancreas. (2 marks)

(iv) To further cut the cost of insulin production, a GM crop which produces human insulin has recently been developed. However, an environmental group is worried that growing such GM crops may cause genetic pollution. Explain why growing the GM crops may cause genetic pollution. (2 marks)

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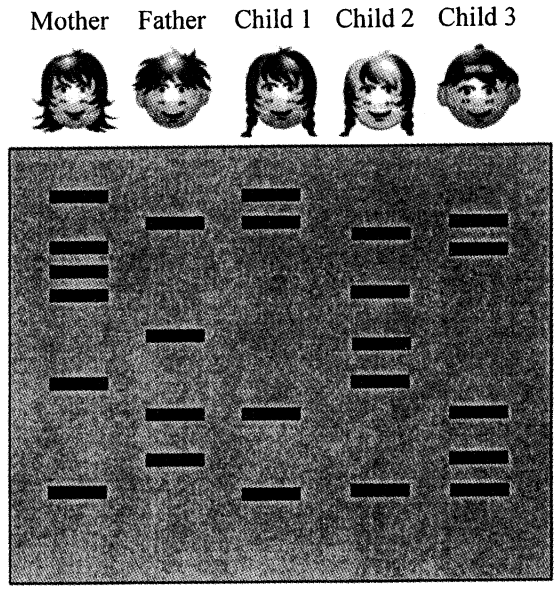
4(b) The diagram below shows the DNA fingerprints of five members of a family, which consists of a couple and three children. One of the children is from the mother's previous marriage.



(i) Based on the information above, deduce which child is from the mother's previous marriage. (3 marks)

(ii) Although the other two children are the biological children of the parents shown, their DNA fingerprints display different patterns. Explain why this is so. (3 marks)

(iii) The different patterns shown in the DNA fingerprinting are due to the presence of variable number tandem repeats (VNTRs) on human chromosomes. VNTRs are short sequences of repeated DNA on the non-coding region of chromosomes and the number of VNTRs varies greatly from person to person. Explain why a large number of variations can exist in VNTRs but fewer variations are found in functional genes. (4 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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