HONG KONG EXAMINATIONS AND ASSESSMENT AUTHORITY

HONG KONG DIPLOMA OF SECONDARY EDUCATION EXAMINATION 2017

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) Ellen went swimming with her friends on a windy day. They competed to hold their breath under water for the longest time. Ellen finally won the competition by holding her breath for 2 minutes.

(i) When Ellen was holding her breath, which part of her brain was controlling the breathing actions? (1 mark)

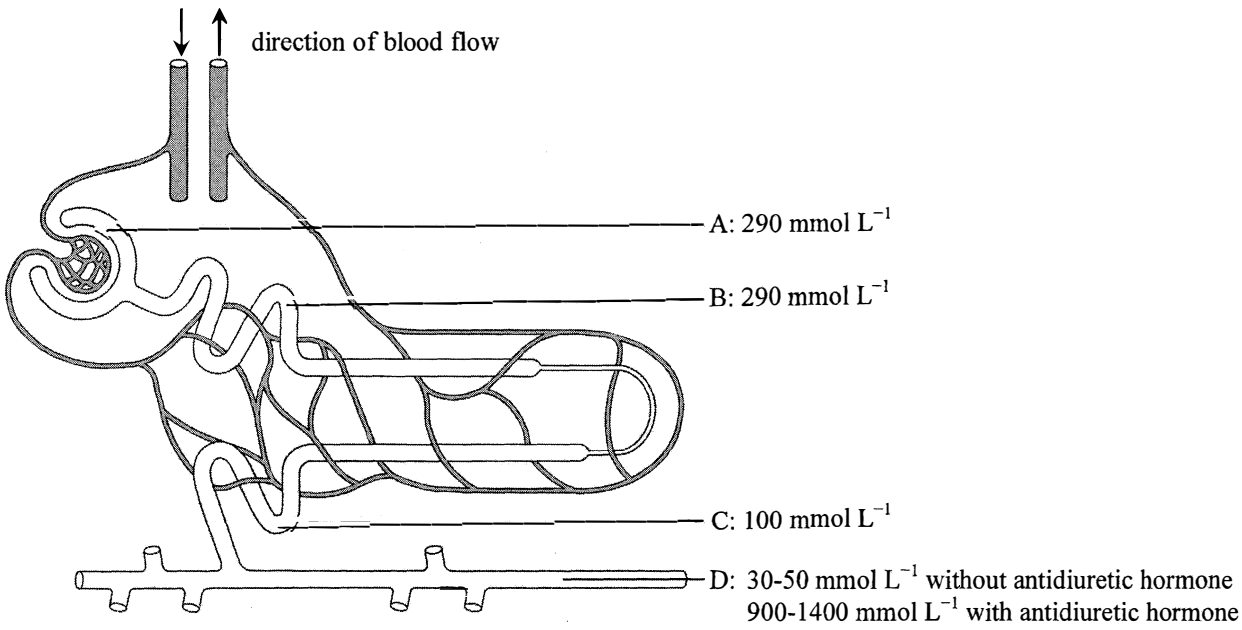
(ii) When Ellen left the water, she breathed rapidly and heavily.

(1) What was the stimulus leading to this response? How was this stimulus brought about when Ellen was holding her breath under water? (3 marks)

(2) Describe the nervous coordination leading to this response. (4 marks)

(iii) After Ellen had left the water, she felt cold in the wind. Give ***one*** physiological response her body would exhibit to help her regulate the body temperature. State the significance of this response. (3 marks)

1(b) The diagram below shows a nephron and its associated structures. The solute concentration of the fluid at different positions in the tubules are indicated:



(i) With reference to the physiological processes involved, explain why there is no change in the solute concentration of the fluid inside the tubule as the fluid flows from point A to point B. (4 marks)

(ii) Account for the difference in the solute concentration of fluid in point D with or without antidiuretic hormone (ADH). (3 marks)

(iii) If protein is present in the fluid in point D, which part of the nephron is most likely damaged? Explain your answer. (2 marks)

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SECTION B Applied Ecology

Answer **ALL** parts of the question.

2(a) A marine protected area is established in open sea where fishing is prohibited to ensure the fishery resources are sustainable. Outside the protected area, bottom trawling is allowed. A preliminary study was conducted to estimate the animal biomass (kg km^{-2}) at six randomly chosen sites as shown in Diagram I. The animal biomass of each site is shown in Diagram II.

Diagram I

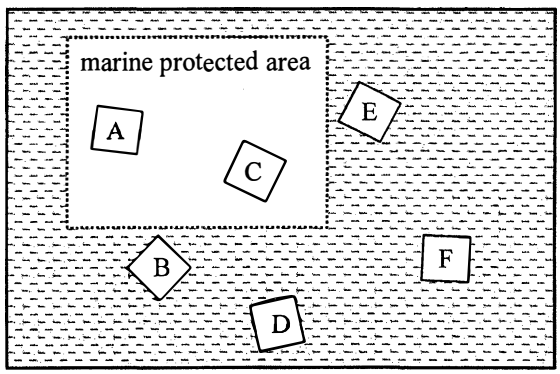
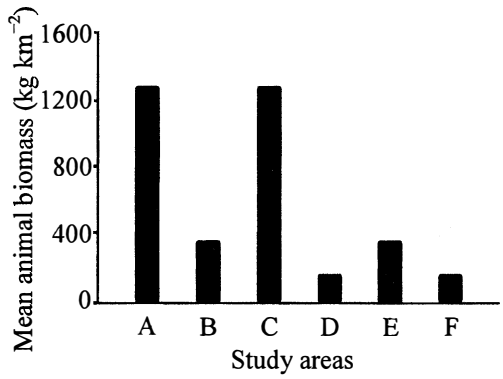


Diagram II



(i) Bottom trawling is a fishing method in which fish nets are laid on the sea bottom and towed by fishing boats. Suggest ***two*** potential effects caused by bottom trawling on the physical environment on the sea bottom. (2 marks)

(ii) (1) Comparing the biomass of the sites within and outside the protected area, what pattern do you observe? (2 marks)

(2) Suggest a possible explanation for this pattern. (3 marks)

(iii) What is the limitation of this preliminary study? What measurement should be taken to increase the validity of the study? (4 marks)

(iv) State ***one*** marine protected area in Hong Kong. (1 mark)

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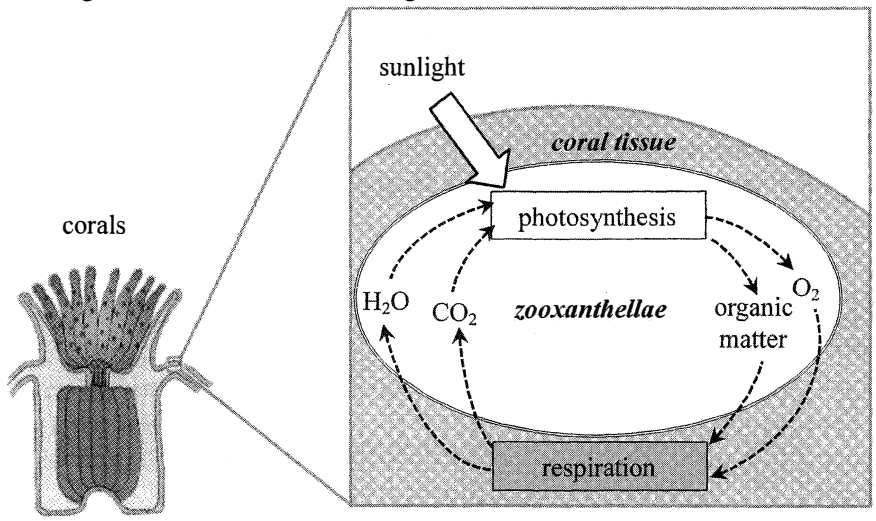
2(b) Corals appear colourful because they have mutualistic unicellular algae called zooxanthellae in their bodies. The diagram below shows the exchange of materials between them:



(i) When the seawater temperature increases, corals will expel zooxanthella. This is known as coral bleaching. After bleaching, the corals may eventually die due to a deterioration in their health. Based on the information from the diagram, suggest why the health of coral deteriorates. (1 mark)

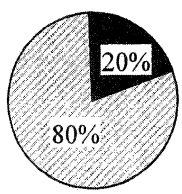
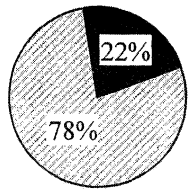
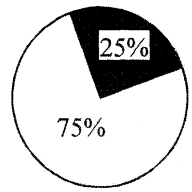
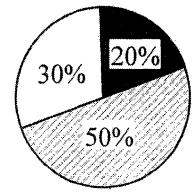
(ii) Increased atmospheric carbon dioxide level is believed to be the cause of increased seawater temperature. Explain why. (3 marks)

(iii) A transplantation experiment was conducted to study the effect of increased seawater temperature on the health of the corals, as follows:

Site A Temperature range: 27°C - 30°C	→ Corals from site A were transplanted to site B →	**Site B** Temperature range: 27°C - 35°C

After 14 months, native corals from Site A and transplanted coral from Site B were collected and put into tanks of seawater with different temperature settings. The charts below show the health of the corals after 6 months:

Key: ▨ Healthy ☐ Bleached ■ Dead

Tanks with seawater at 27°C		***Tanks with seawater at 32°C***	
Native corals from site A	Transplanted corals from site B	Native corals from site A	Transplanted corals from site B
			

(1) Compare the effect of increased seawater temperature on the health of the native corals and transplanted corals. Support your answer with information from the above charts. (3 marks)

(2) Under the threat of global warming, what is the implication of this study for coral bleaching? (1 mark)

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SECTION C Microorganisms and Humans

Answer **ALL** parts of the question.

3(a) Beer brewing includes some steps that involve biological activities, as follows:

Step	Description
Malting	Barley grains are soaked in water for 2 days and a sugar solution is collected at the end of the process.
Yeast culturing	A small amount of yeast is mixed with the sugar solution and air is continuously pumped into the mixture for several hours.
Yeast fermentation	The pumping of air is stopped and the mixture is allowed to ferment for several days.

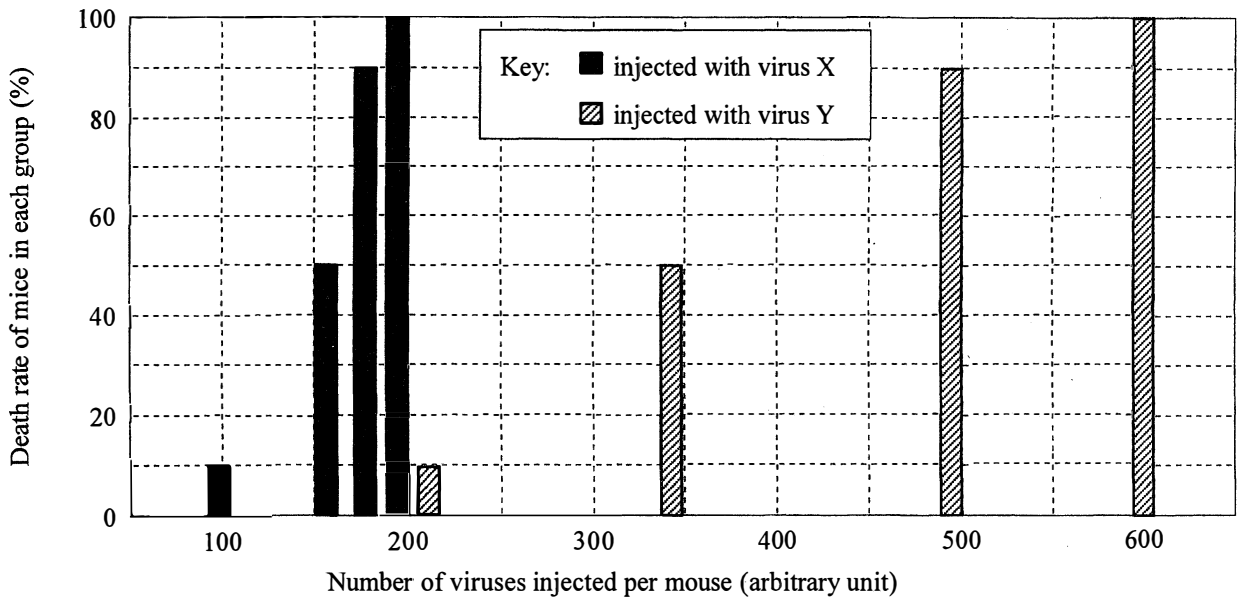
(i) Write a simple word equation of yeast fermentation. (2 marks)

(ii) Describe what happens to barley grains during malting. Why is this process necessary for the later fermentation? (4 marks)

(iii) Explain the importance of continuously pumping air into the mixture during yeast culturing. (3 marks)

(iv) How do the fermentation products contribute to the characteristics of beer? (2 marks)

3(b) An experiment was conducted to study the lethal effect of viruses X and Y on their host. Different amounts of viruses were injected into different groups of mice. The graph below indicates the relationship between the number of viruses injected per mouse and the death rate of mice in each group after 24 hours:



(i) With reference to the above graph, compare and contrast the lethal effect of viruses X and Y on the mice. Deduce which virus was more lethal to the mice. (3 marks)

(ii) Suggest why some viruses are more lethal than others. (2 marks)

(iii) Briefly describe how viruses reproduce in the mice. (4 marks)

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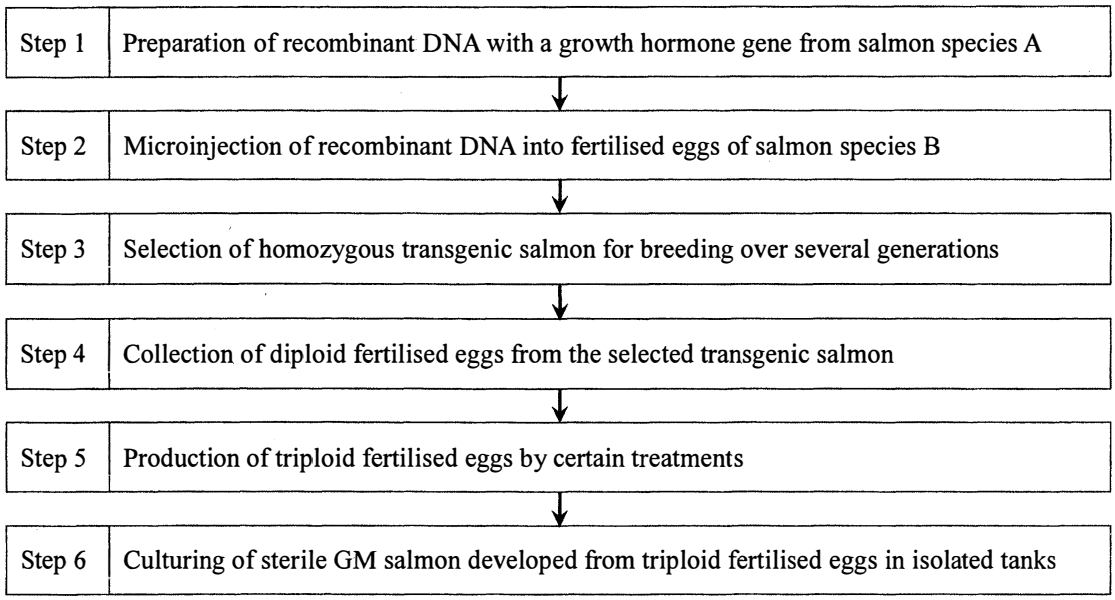
SECTION D Biotechnology

Answer **ALL** parts of the question.

4(a) A genetically modified (GM) salmon was approved for consumption in the United States in 2015. The flowchart below shows some simplified steps involved in the production of the GM salmon:



(i) What is the advantage of culturing this type of GM salmon over non-GM salmon? Explain your answer. (2 marks)

(ii) Microinjection method is used in step 2.

(1) Give ***one*** advantage of using the microinjection method instead of viral vectors for producing the GM salmon. (1 mark)

(2) Give ***one*** disadvantage of using the microinjection method. (1 mark)

(iii) With reference to step 3, suggest ***two*** reasons why the selection was made over several generations rather than one generation. (2 marks)

(iv) In step 5, the triploid fertilised eggs produced contain three sets of chromosomes.

(1) With reference to the process of gamete formation, explain why the GM salmon developed from triploid eggs are sterile. (2 marks)

(2) Explain why this can act as a safety precaution for protection of wild lifes. (2 marks)

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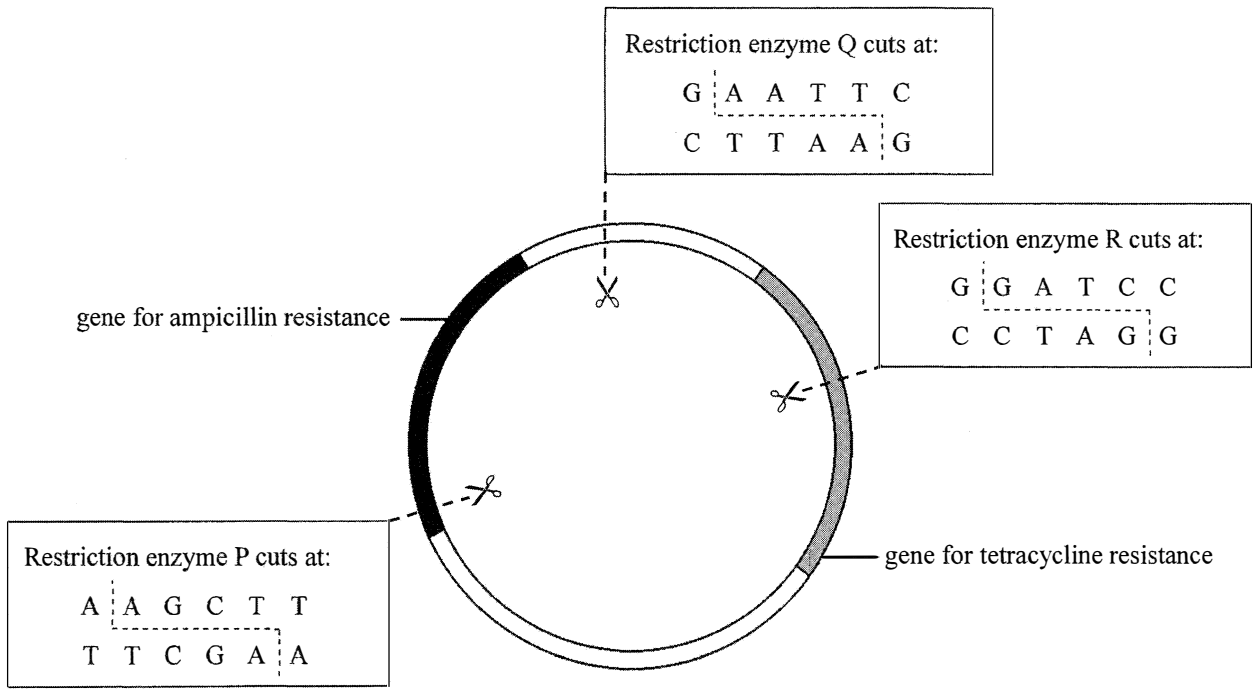
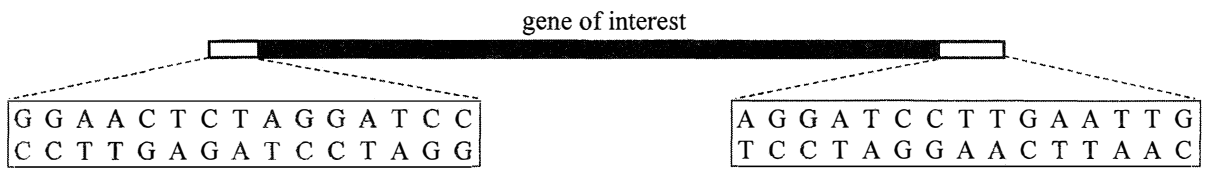
4(b) The diagram below shows a plasmid with two antibiotic resistance genes and three cut sites for restriction enzymes P, Q and R:



A student wanted to insert the following DNA fragment into this plasmid which was then used to transform bacteria. Only part of the nucleotide sequence of the two ends of the DNA fragment is shown:



(i) Based on the information above, choose one restriction enzyme to cut both the plasmid and the DNA fragment so that they can be successfully recombined together. Explain your answer. (4 marks)

(ii) After transformation, the bacteria were transferred to an agar plate containing ampicillin for selection. Explain the importance of this step. (3 marks)

(iii) For the bacterial colonies formed on the agar plate containing ampicillin, some of them have tetracycline resistance while some do not. Explain this phenomenon. (3 marks)

END OF PAPER

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

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