

Shek Lei Catholic Secondary School
Final Examination 2021-2022
F6 Biology Paper II

Time allowed: 1 hour

This paper must be answered in English.

Name: _____

Class: _____ ()

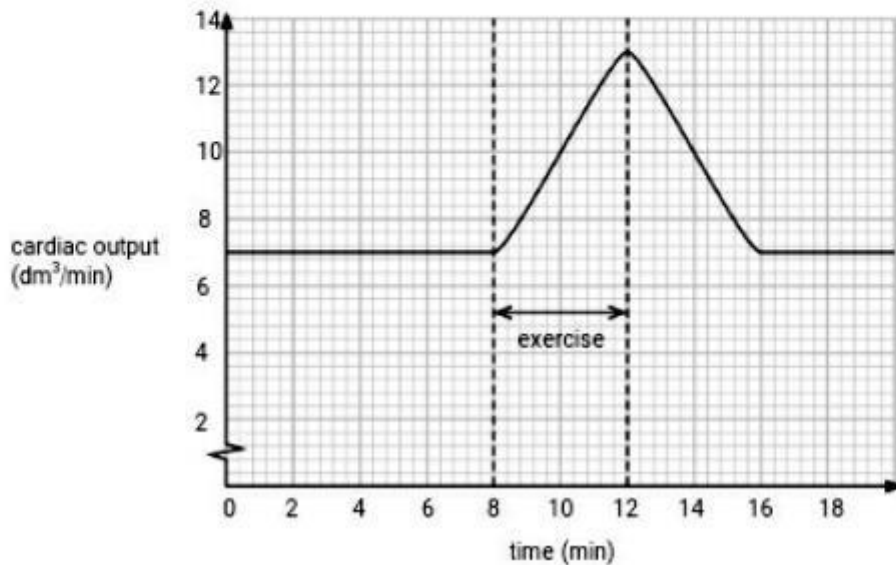
INSTRUCTIONS

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 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) The graph below shows the cardiac output of a person when he was at rest and doing exercise.



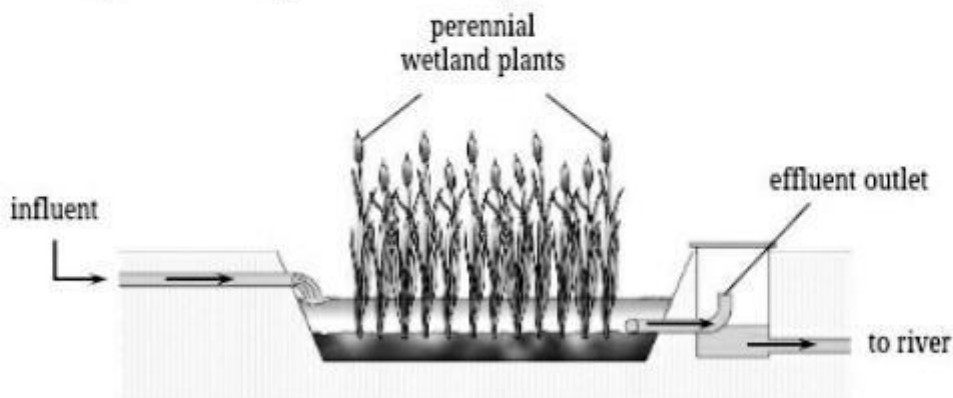
- (i) What is the maximum increase in the cardiac output of the person when he was doing exercise? Show your working. (2 marks)
- (ii) Describe how the nervous system and the endocrine system bring about the maximum cardiac output during exercise. (5 marks)
- (iii) When the cardiac output is increased during exercise, more oxygen is supplied to the skeletal muscles. State *two* other changes in the body that produce the same result. (2 marks)

1. (b) A couple were eager to have a baby, but they failed to conceive naturally. They decided to have *in vitro* fertilization (IVF) for treating infertility.
- (i) Suggest *two* reasons why the couple failed to conceive, *one* for the husband and *one* for the wife. (2 marks)
 - (ii) In the process of IVF, the wife was given follicle stimulating hormone (FSH) injections prior to the collection of ova from her ovaries. Right after embryos are transferred to her uterus, she was given progesterone. Explain the uses of FSH and progesterone in IVF. (4 marks)
 - (iii) Some women try to prevent pregnancy by taking contraceptive pills. Explain how hormones in the contraceptive pills help prevent pregnancy. (5 marks)

SECTION B Applied Ecology

Answer ALL parts of the question.

2. (a) Artificial wetlands are man-made ecosystems that use vegetation and microorganisms to improve water quality. The diagram below shows an artificial wetland constructed in a village to treat sewage from surrounding farmlands.

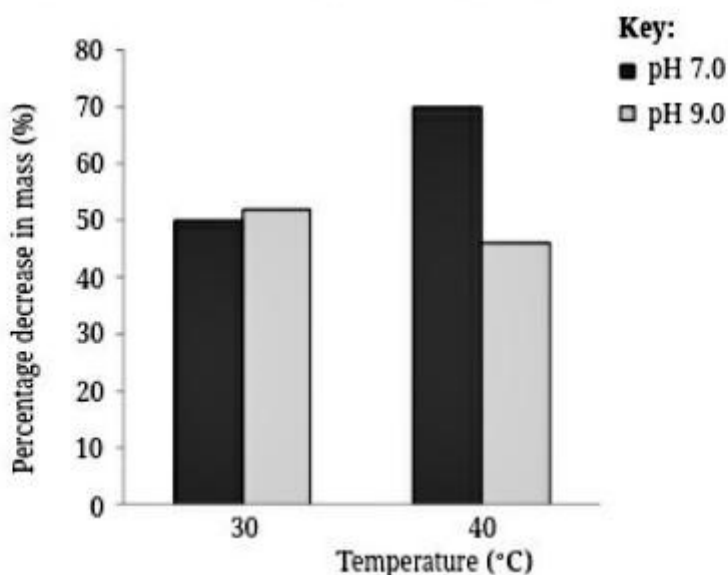


Samples were collected in the influent and the effluent of the wetland for analysis. The table below shows the results.

	Influent	Effluent
Biochemical oxygen demand (BOD) (mg L^{-1})	60	7
Nitrogen content (mg L^{-1})	33	8
Phosphate content (mg L^{-1})	24	9

- (i) Explain why BOD is used as an indicator of water quality. (3 marks)
- (ii) Leaching of chemical fertilizers from farmlands into waters can cause nitrite and phosphate pollution. Describe how excess nitrate and phosphate in the water can lead to a reduction in aquatic organisms. (3 marks)
- (iii) With reference to the biological processes in the artificial wetland, explain the difference in the nitrogen content in the influent and the effluent. (4 marks)
- (iv) Explain the advantage of growing perennial plants instead of annual plants in artificial wetlands. (2 marks)

2. (b) The indiscriminate use of plastic shopping bags has become a major environmental problem in Hong Kong. Most plastic bags are made from petroleum, and they do not decompose easily. Every day, a large number of plastic bags are disposed of at landfills. These take up a lot of space. To ease this problem, scientists have developed starch-based plastics which are biodegradable.
- Suggest why starch-based plastics are considered as a more sustainable alternative to conventional plastics. (1 mark)
 - Suggest **two** substances likely to be produced when biodegradable plastics are decomposed by microorganisms. (2 marks)
 - Suggest **one** way in which we can reduce the amount of plastic waste. (1 mark)
 - Scientists investigated the effects of pH and temperature on the breakdown of a starch-based plastic. Starch-based plastic sheets were immersed in enzyme solutions at different pH conditions and temperatures. The percentage decrease in mass of the plastic sheets was recorded. The results are shown in the graph below.

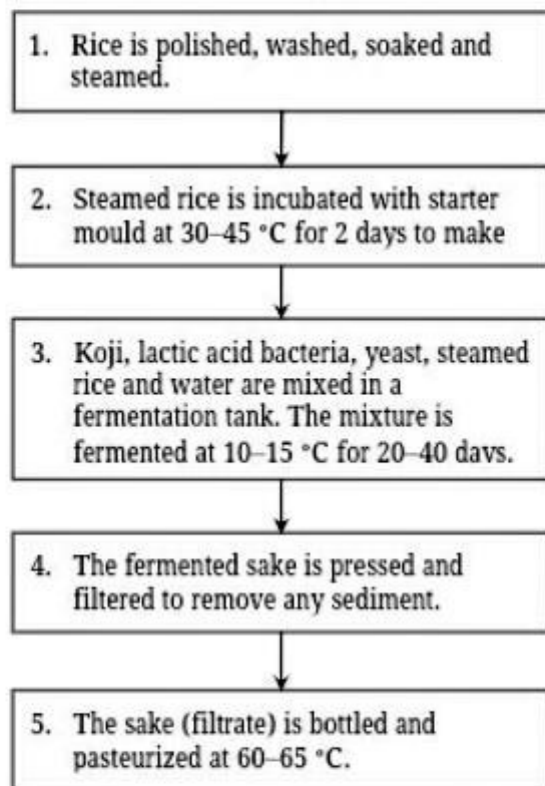


- With reference to the graph, describe the effect of temperature on the breakdown of the starch-based plastic. (2 marks)
- State **two** factors that would need to be kept constant in this investigation. (2 marks)

SECTION C Microorganisms and Humans

Answer **ALL** parts of the question.

3. (a) The flow chart below outlines the steps involved in sake brewing.



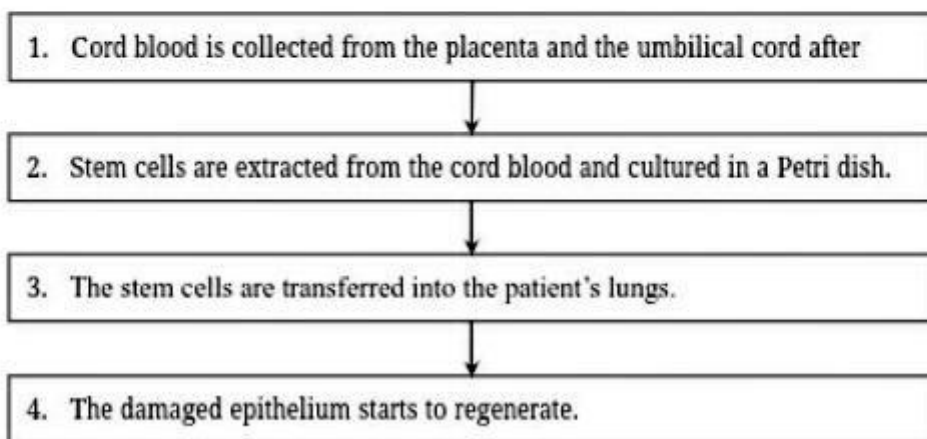
- (i) Write a simple word equation of yeast fermentation. (2 marks)
- (ii) The starter mould is a filamentous fungus. It is used to convert the starch in the rice into simple sugars. Describe the features of the starter mould which enable it to perform this function. (3 marks)
- (iii) State the roles of the starter mould and the lactic acid bacteria in sake brewing. (2 marks)
- (iv) What is the advantage of pasteurizing the sake over boiling it? (1 mark)
- (v) Sake should be kept refrigerated even though it has been pasteurized. Explain why. (2 marks)

3. (b) In October 2021, the Hospital Authority (HA) reported to the Centre for Health Protection (CHP) a surge in the number of invasive Group B Streptococcus (GBS) bacterial infection. Investigations showed that some of the patients had a history of handling raw freshwater fish. In 2015, the same strain of GBS caused a major invasion foodborne outbreak in Singapore.
- (i) Suggest why handling raw freshwater fish may be related to the cases of GBS infection. (2 marks)
 - (ii) State **two** precautions that can be taken to prevent food-borne infection caused by GBS, when buying and handling freshwater fish. (2 marks)
 - (iii) To identify the strain of bacteria responsible for the cases of infection, samples of bacteria are collected from patients and cultured in the laboratory for analysis.
 - (1) It is important that the culture medium in which the bacteria grow is not contaminated with other microorganisms. Describe **one** commonly used aseptic technique to prevent such contamination and outline its principle. (3 marks)
 - (2) Suggest **one** technique of biotechnology that can be used to identify the strain of bacteria causing the infection. (1 mark)
 - (iv) If doctors suspect an invasive GBS infection, they should only prescribe antibiotics if the patients test positive for the infection. Explain why. (2 marks)

SECTION D **Biotechnology**

Answer **ALL** parts of the question.

4. (a) COVID-19 pneumonia and hyperactive immune response can lead to epithelial damage and fibrotic scarring in lungs. Scientists are investigating the use of stem cells to help regenerate the damaged epithelium. In one of such studies in China, a patient was injected with stem cells isolated from cord blood. The patient's lung functioning began to improve after 7 days of the injection. The flow chart below outlines the procedure.



- (i) Briefly describe how the stem cells collected from cord blood could be used to treat the damaged epithelium in the lungs. (4 marks)
- (ii) One of the concerns with this type of stem cell therapy is rejection by the immune system. Describe and explain how the transplanted stem cells may trigger undesirable immune responses in the patient. (3 marks)
- (iii) Besides immune rejection, suggest another potential hazard associated with the use of stem cells in this therapy. (1 mark)
- (iv) Embryonic stem cells are pluripotent stem cells that are more capable than cord blood stem cells. However, scientists prefer to use the less capable cord blood stem cells due to ethical concerns. Discuss the ethical concerns regarding the use of embryonic stem cells. (2 marks)

4. (b) Human growth hormone (HGH) plays important roles in growth during childhood and in regulation of metabolism in adults. HGH deficiency may lead to decreased muscle mass and bone density. Patients with HGH deficiency require regular injections of HGH, which can be produced on a large scale using recombinant DNA technology.

Diagram 1 shows a segment of DNA containing the HGH gene. Diagram 2 shows a plasmid. The restriction sites for three different restriction enzymes (NotI, BamHI and EcoRV) are shown in the diagrams.



Diagram 1

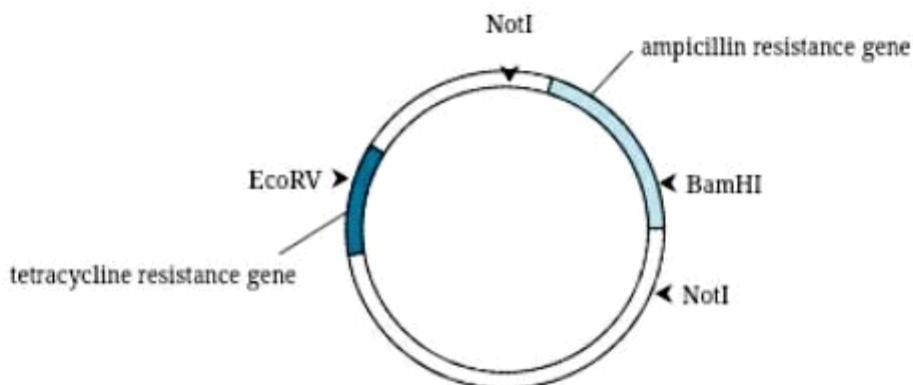


Diagram 2

- (i) Explain whether the three restriction enzymes could be used to cut the DNA segment and the plasmid for constructing recombinant plasmids. (3 marks)
- (ii) Name the enzyme required for joining the HGH gene with the plasmid.(1 mark)

The plasmids were mixed with bacteria. The bacteria were then cultured on an agar plate (A) containing tetracycline. When bacterial colonies were observed, plate A was gently pressed onto another agar plate (B). This way, the colonies on plate A were transferred to plate B. Plate B contained ampicillin.

- (iii) Why were the bacteria being cultured on the agar plate containing tetracycline? (2 marks)

Diagram 3 shows the bacterial colonies on the two agar plates.

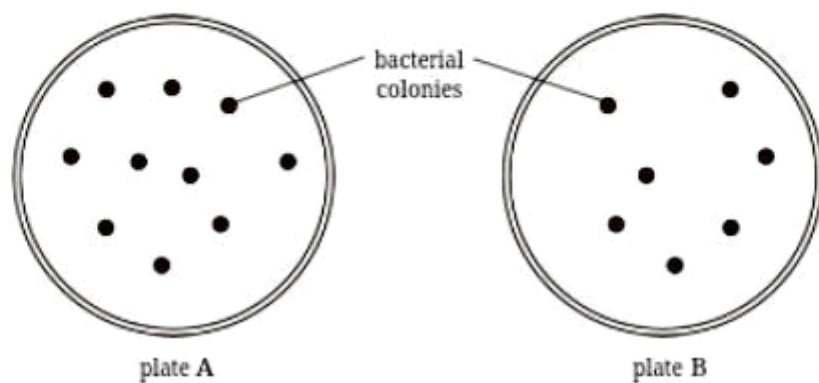


Diagram 3

- (iv) How many bacterial colonies contain the recombinant plasmids? Explain your answer. (4 marks)

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