

**PRACTICE PAPER**  
**BIOLOGY PAPER 2**

(1 hour)

This paper must be answered in English

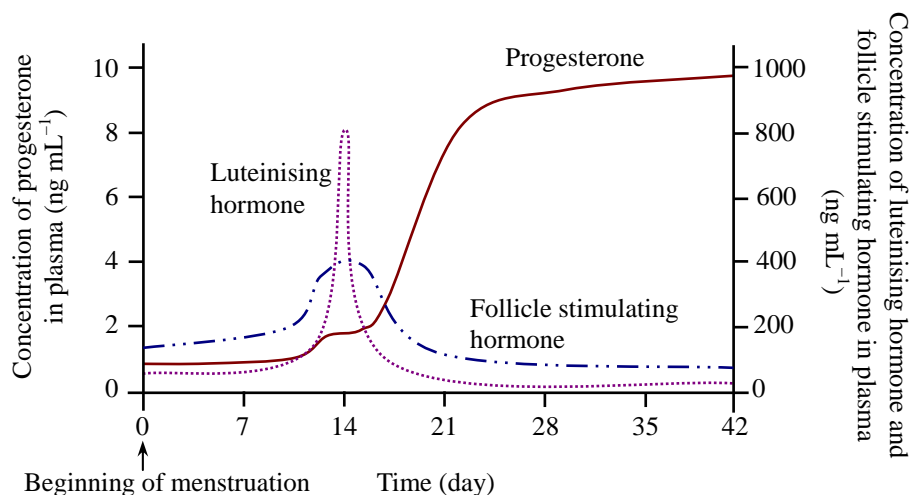
**INSTRUCTIONS**

- (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 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 following graph shows the plasma concentrations of progesterone, luteinising hormone and follicle stimulating hormone of a woman over a period of time:



- (i) Name the process that took place in the ovary on day 14. (1 mark)
- (ii) Account for the change in the plasma concentration of progesterone from day 14 to day 42. (3 marks)
- (iii) What would happen to the woman if the progesterone level dropped significantly on day 35? (1 mark)
- (iv) With reference to the changes in the concentration of the hormones shown in the above graph, explain why progesterone can be used as a drug for contraception. (3 marks)

1. (b) The table below shows the data of some parameters of the cardiovascular and respiratory systems of a healthy untrained person at rest, during light exercise and during vigorous exercise:

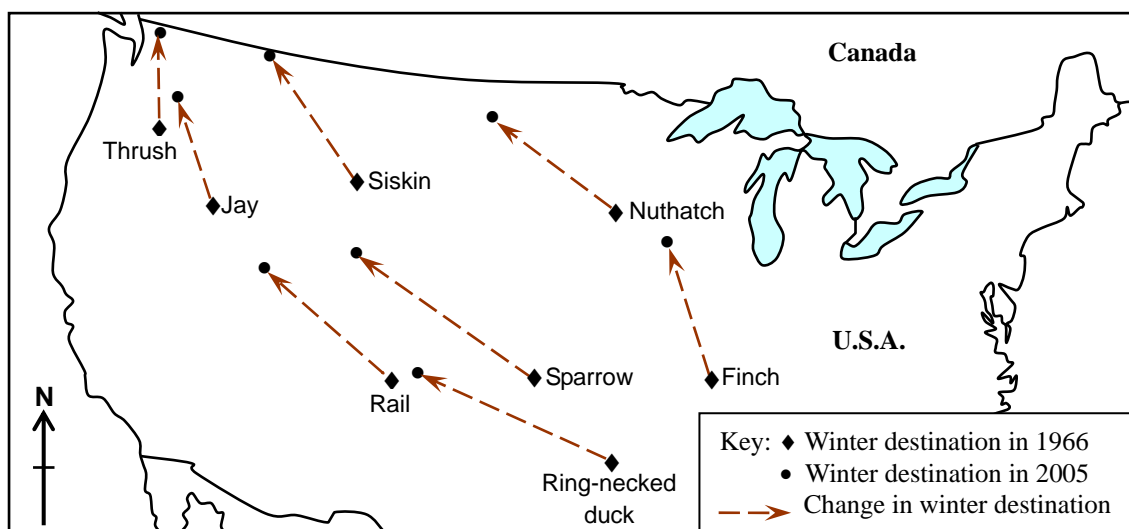
|                                 | At rest | Light exercise | Vigorous exercise |
|---------------------------------|---------|----------------|-------------------|
| Heart rate (beats / min)        | 75      | 145            | 190               |
| Stroke volume ( $\text{dm}^3$ ) | 0.07    | 0.09           | 0.11              |
| Breathing rate (breaths / min)  | 14      | 24             | 40                |
| Tidal volume ( $\text{dm}^3$ )  | 0.86    | 1.67           | 2.50              |

- (i) Using the data provided, calculate the cardiac output ( $\text{dm}^3 / \text{min}$ ) and ventilation rate ( $\text{dm}^3 / \text{min}$ ) of this person when he is at rest, when he is doing light exercise and when he is doing vigorous exercise respectively. (2 marks)
- (ii) State the changes in this person's cardiac output and ventilation rate with the increasing level of exercise. What is the importance of these changes? (4 marks)
- (iii) Describe how the person's sympathetic nerve brings about the change in the cardiac output during exercise. (2 marks)
- (iv) Explain why the volume of urine produced by this person after vigorous exercise is less than usual. (4 marks)

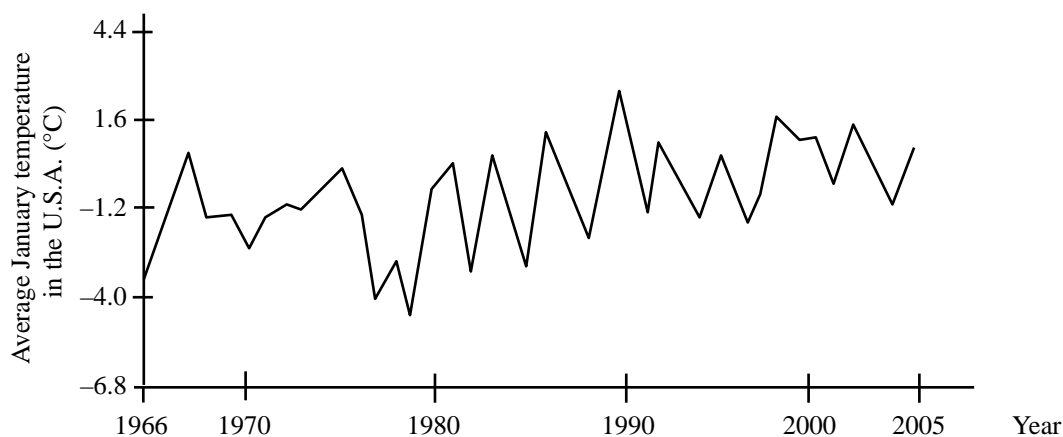
## SECTION B Applied Ecology

Answer **ALL** parts of the question.

2. (a) Many bird species living in Canada migrate southwards to the U.S.A. to spend the winter. The diagram below shows the destinations of some of these bird species in the U.S.A. in the winters of 1966 and 2005:



The average January temperatures in the U.S.A. from 1966 to 2005 are shown in the following graph:



- (i) Suggest one way which can be used to track the migration route of birds. (1 mark)
- (ii)
  - (1) State the general trend shown in the average January temperature in the U.S.A. from 1966 to 2005. (1 mark)
  - (2) Relate the change in the winter destination of bird species in the U.S.A. with the change in average January temperature in the U.S.A. from 1966 to 2005. Suggest, from an ecological point of view, a reason for the change in the winter destination. (2 marks)
  - (3) Suggest **two** possible effects caused by the change in the winter destination of these migratory bird species on native bird species. (2 marks)
  - (4) It is believed that the trend in the average January temperature in the U.S.A. is due to human activities. Explain how human activities may have caused this trend. (4 marks)

2. (b) Forests provide humans with valuable resources. Proper forest management is needed when exploring new uses of forests to ensure sustainable forestry.

- (i) The combustion of fossil fuel releases acidic gases which may cause acid rain. State and explain **two** environmental impacts of acid rain. (4 marks)
- (ii) Some scientists are exploring the use of forest woody biomass to replace the fossil fuel used in power plants. Trees are logged from two forests, A and B, for this research and other uses. The table below shows the distribution of the inorganic nutrients nitrogen and magnesium in these two forests:

|                            | Forest A     |               | Forest B     |               |
|----------------------------|--------------|---------------|--------------|---------------|
|                            | Nitrogen (%) | Magnesium (%) | Nitrogen (%) | Magnesium (%) |
| Biomass above forest floor | 35           | 70            | 5            | 25            |
| Biomass on forest floor    | 5            | 5             | 5            | 5             |
| Biomass below forest floor | 60           | 25            | 90           | 70            |
| Total                      | 100          | 100           | 100          | 100           |

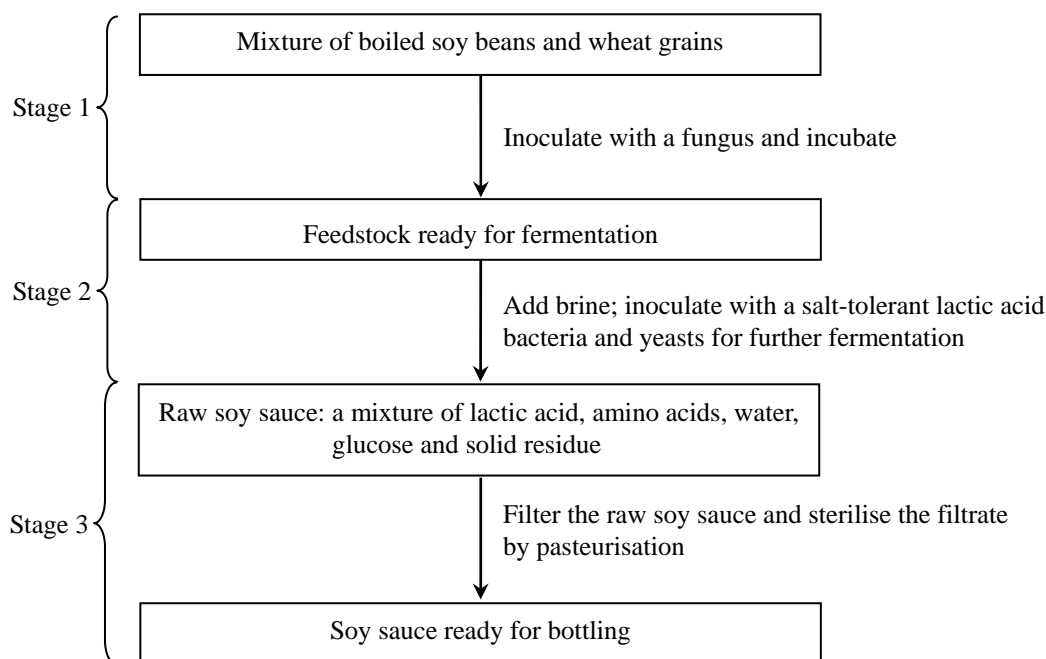
Based on the difference in the distribution of inorganic nutrients of the two forests, explain which forest will reestablish itself more quickly after logging. (3 marks)

- (iii) Over-exploitation of forest resources leads to a decrease in biodiversity.
- (1) Provide **one** reason why biodiversity is important. (1 mark)
- (2) Reforestation is a way to restore a forest. In earlier years, reforestation depended mainly on exotic tree species imported from other countries and most of the plantations were formed by a single exotic tree species. State **one criterion** when choosing an appropriate exotic tree species for reforestation. Give **one disadvantage** of forming a plantation using a single tree species. (2 marks)

## SECTION C Microorganisms and Humans

Answer **ALL** parts of the question.

3. (a) Soy sauce is made by fermentation of a combination of soy beans, wheat grains, water and salt. The production of soy sauce consists of three stages: incubating boiled soy beans and wheat grains with a fungus to produce the feedstock, fermenting the feedstock in the brine added, and pasteurising the raw soy sauce for bottling. An outline of the manufacturing process is given in the flow chart below:



- (i) Explain why Stage 1 is an essential preparatory step for Stage 2. (2 marks)
- (ii) Explain the importance of adding brine to the mixture in Stage 2. (2 marks)
- (iii) Why is it necessary to use pasteurisation in Stage 3 to sterilise the raw soy sauce? (2 marks)
- (iv) Aseptic techniques are used in food manufacturing processes involving microbes. State the principles of aseptic techniques. (3 marks)

3. (b) The bacterium *E. coli* is a natural inhabitant of the human intestine.

- (i) Figure 1 shows an *E. coli* infected by microbe M. Figure 2 is the magnified image of a part of Figure 1.

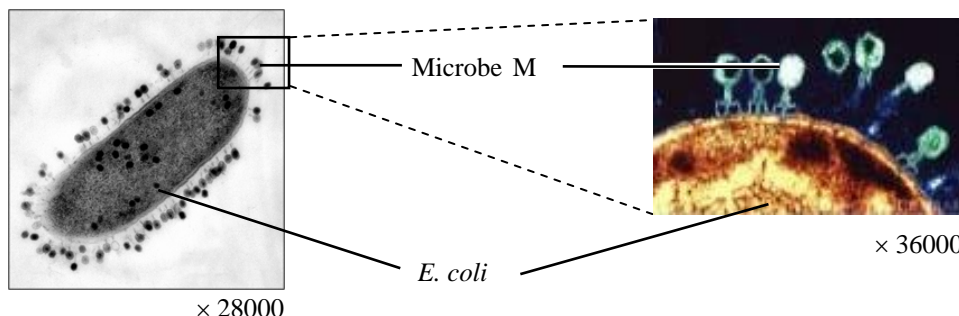
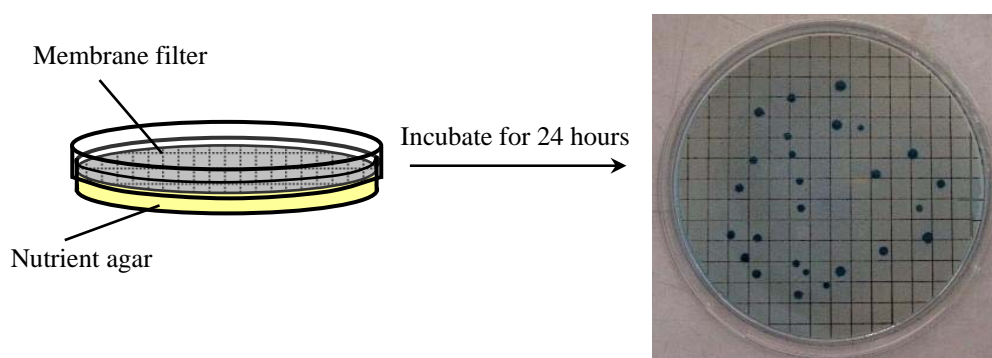


Figure 1

Figure 2

- (1) Identify microbe M. With reference to the above figures, state **one** observable difference between *E. coli* and microbe M. (2 marks)
  - (2) Describe briefly the events shown in Figure 2. (2 marks)
  - (3) In the mass production of human insulin, *E. coli* is genetically modified to carry the human insulin gene. Explain why bacteria (e.g. *E. coli*) are suitable for use in recombinant DNA technology. (2 marks)
- (ii) *E. coli* is used as a water pollution indicating organism. A beach with an *E. coli* count exceeding 1600 per 100 cm<sup>3</sup> seawater is graded 'Very Poor' by the Environmental Protection Department. A 'Very Poor' beach is not suitable for swimming.
- (1) Suggest why there is a health risk to people swimming in a 'Very Poor' beach. (1 mark)
  - (2) A student collects a water sample from a beach to determine its *E. coli* count. He filters 50 cm<sup>3</sup> of the water sample through a membrane filter, on which bacteria are retained. The membrane filter is then placed on a nutrient agar plate suitable for the growth of *E. coli* and incubated for 24 hours. This step and the result after incubation are shown in the figure below:



- (I) Explain how this method can be used to determine the *E. coli* count of the water sample. (2 marks)
- (II) Calculate the *E. coli* count per 100 cm<sup>3</sup> of the water sample. Based on your calculation, determine if this beach is 'Very Poor'. (2 marks)

## SECTION D                      Biotechnology

Answer **ALL** parts of the question.

4. (a) Severe combined immune deficiency (SCID) is an inherited disease. One form of SCID is caused by a gene mutation which renders the person unable to produce lymphocytes. Thus, people with this disease are susceptible to infections and, if untreated, rarely live past the age of two. To cure the disease, patients are transplanted with stem cells from the bone marrow of a healthy person. In 2000, it was first demonstrated that the disease could be cured by somatic gene therapy. In this therapy, a virus is used as a vector to incorporate the normal gene into the bone marrow cells of the patient.
- (i) Why can transplanting bone marrow stem cells to SCID patients be used for treating the disease? (1 mark)
  - (ii) What is the basis of using somatic gene therapy for treating SCID? Give **one** advantage of treating SCID patients with somatic gene therapy over transplanting normal bone marrow stem cells to the patients. (2 marks)
  - (iii) There is another type of gene therapy called 'germ line gene therapy'. State **two** differences in the biological consequences of using germ line gene therapy and using somatic gene therapy for treating SCID. (2 marks)
  - (iv) In 2002, three out of eleven SCID children who received this somatic gene therapy treatment got leukemia (a type of blood cancer). Some scientists believe that the occurrence of the blood cancer is related to the incorporation of the normal gene into the bone marrow cells using a virus as the vector. Suggest an explanation for this belief. (2 marks)



4. (b) Polymerase chain reaction (PCR) is a technique in modern biotechnology. A cycle of PCR consists of three principal steps, which operate at 95°C, 55°C and 72°C in sequence.

(i) Outline what happens in the three principal steps in a cycle of PCR. (3 marks)

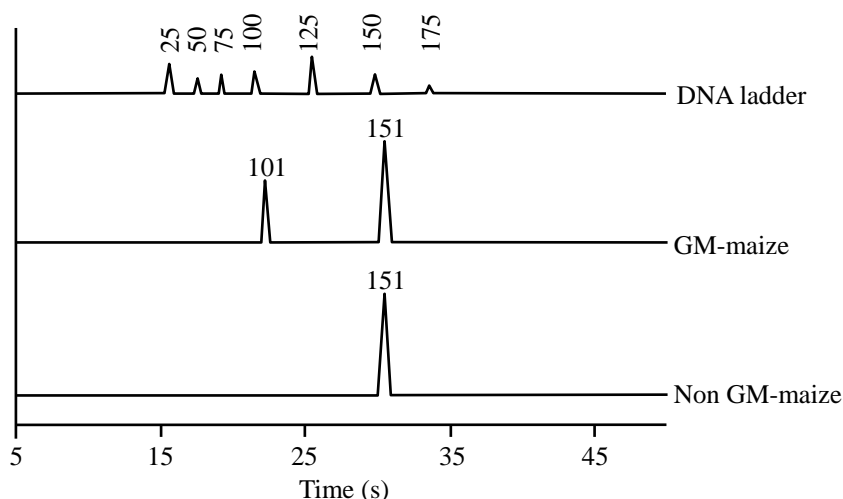
(ii) One application of PCR is Polymerase Chain Reaction–Short Tandem Repeat Analysis (PCR–STR analysis) which can be used in forensics. In a crime scene, a piece of hair suspected to be the criminal’s is found. A suspect is arrested one week later.

(1) With reference to the above case, state the significance of PCR in PCR–STR analysis. (1 mark)

(2) Describe how the products of PCR are used in PCR–STR analysis to produce evidence for verifying whether the suspect has committed the crime. (3 marks)

(iii) Another application of PCR is for identifying GM organisms. The following shows the analysis of the DNA of a GM maize and a non-GM maize:

[Note: The number above each peak in the figure indicates the number of base pairs (bp).]



(1) A marker (a polynucleotide chain) with 101 bp is introduced to the maize in producing the GM maize. With reference to the above analysis, suggest the purpose of introducing a marker to the maize in the process of producing the GM maize. (2 marks)

(2) Illustrate with an example how GM plants can help promote people’s health. (2 marks)

(3) What are the possible impacts on the ecosystem of growing GM plants that produce a toxin to kill insects? Describe **two** possible impacts. (2 marks)

**END OF PAPER**

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