2022-DSE

BIO Mock Exam

Paper 2

Bishop Hall Jubilee School
2022 Mock Examination

F.6 BIOLOGY PAPER 2

Date: 24-2-2022
Time: 11:30am – 12:30pm
Duration: 60 mins
Total page no.: 9 (including cover page)
This paper must be answered in English

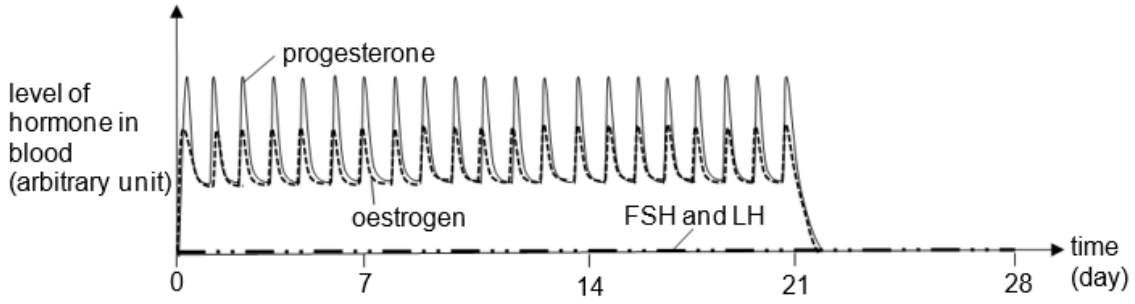
GENERAL INSTRUCTIONS

1. There are **THREE** sections, A, B and C 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 changes in the levels of four hormones in the blood of a woman during a 28-day period. The woman was taking combined oral contraceptive pills to prevent pregnancy.

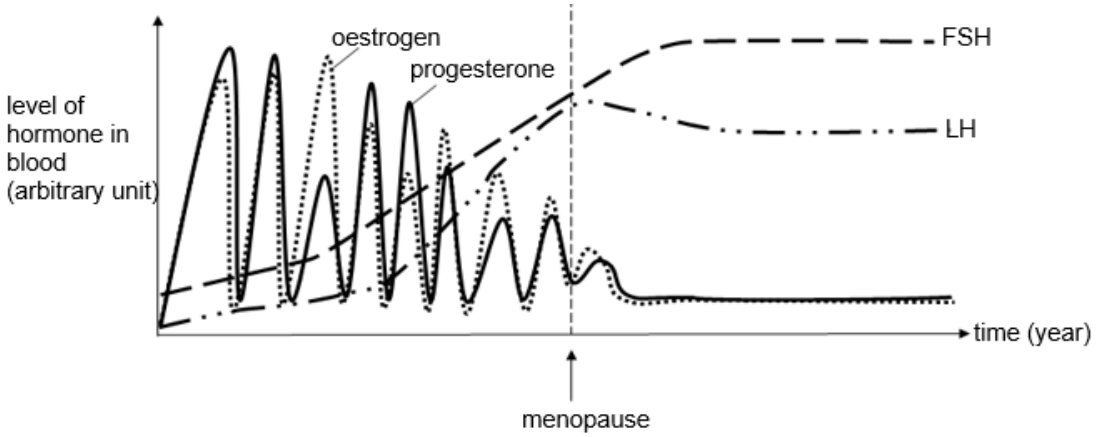


i Explain the periodic fluctuation in the levels of oestrogen and progesterone between day 0 and day 21. (2 marks)

ii Suggest a reason for the changes in the levels of oestrogen and progesterone from day 21 to day 28. What is the importance of this change? (2 marks)

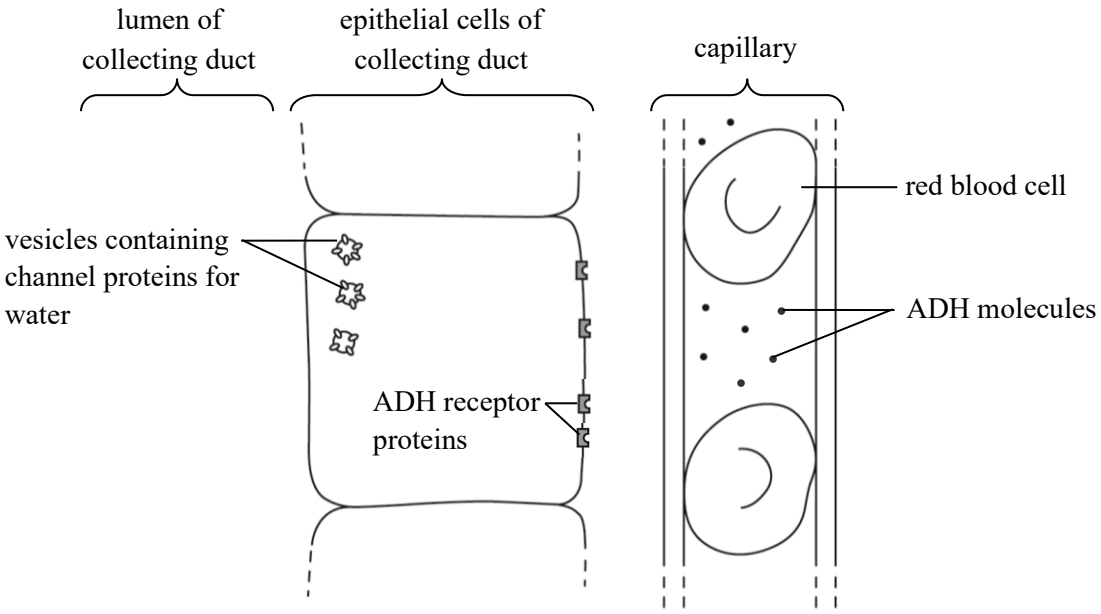
iii With reference to the graph, explain how the contraceptive pills help prevent pregnancy. (4 marks)

iv Menopause is the time when a woman's menstrual cycle stops permanently. The graph below shows the changes in the levels of the hormones in the blood of a woman in the years before and after menopause.



Based on the changes in the ovary, account for the changes in the levels of the hormones after menopause. (2 marks)

b The diagram shows the cells lining the collecting duct in a human kidney. ADH molecules are carried by blood. They bind to the receptor proteins on the epithelial cells of the collecting duct and trigger the vesicles containing channel proteins for water to fuse with the cell membrane facing the lumen of the collecting duct.



i **(1)** Using the information given, deduce the change in the number of channel proteins for water on the cell membrane of the epithelial cells of collecting duct with increased level of ADH in blood. (2 marks)

(2) Based on the answer in **(1)**, explain how the volume and concentration of urine is changed with increased level of ADH in blood. (2 marks)

b In some patients, the epithelial cells of the collecting duct are insensitive to ADH.

ii **(1)** Suggest two possible causes of such a condition. (2 marks)

(2) Explain why these patients are with higher blood ADH level than normal people. (4 marks)

SECTION B Applied Ecology

Answer ALL parts of the question.

2. a The table below shows some information of two fish species, P and Q.

	Fish species P	**Fish species Q**
Age of sexual maturity	2 years	20 years
Eggs laid per mass of fish	80 000	30 000
Maximum lifespan	20 years	150 years
Maximum length	45 cm	75 cm
Mean age of fish caught	2 years	10 years
Mean length of fish caught	30 cm	35 cm
Time of fishing	During breeding season	During breeding season
Habitat	Near water surface	Near seabed

i Based on the mean age of fish caught, deduce which fish species is being overfished. Briefly explain your answer. (3 marks)

ii Suggest one other piece of evidence from the table to explain why the fish species mentioned in **i** is more vulnerable to overfishing than the other. (2 marks)

iii Suggest a conservative measure that the government can adopt to protect the fish species mentioned in **i**. (1 mark)

iv A higher concentration of ciguatoxins, a type of toxin produced by algae, is usually found in fish species Q than in fish species P. Explain the difference based on the information in the above table. (4 marks)

2. b The polar bear is a carnivorous bear living in the Arctic Circle. Polar bears rely almost entirely on the marine sea ice environment for their survival. They mainly predate on seals which emerge on sea ice or around the edges of sea ice. There are estimated 19 sub-populations of polar bears in the Arctic Circle. **Figure 2A** shows the population trends of different sub-populations of polar bears in the Artic Circle in 2014, surveyed by World Wide Fund For Nature.

Figure 2A

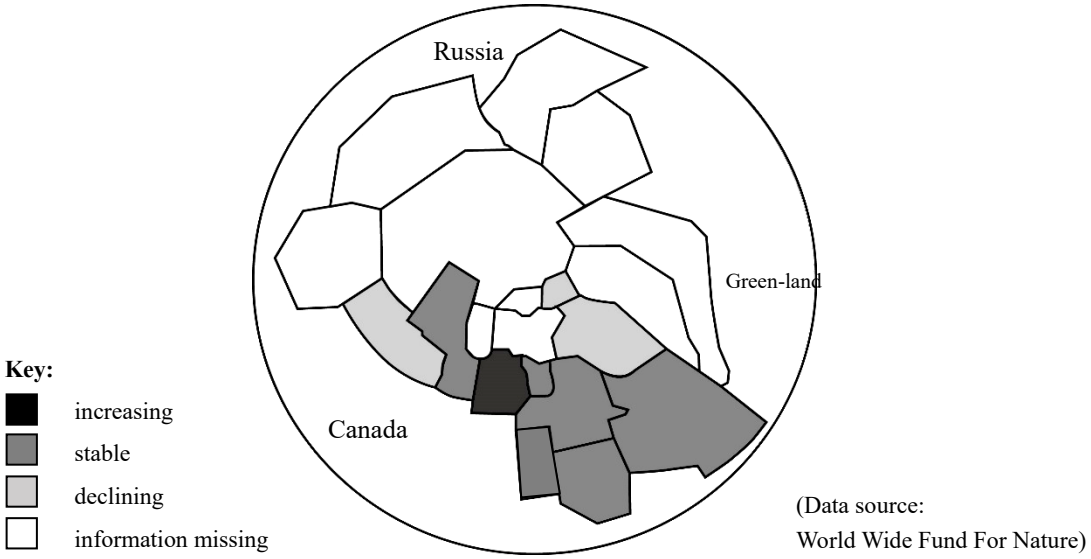
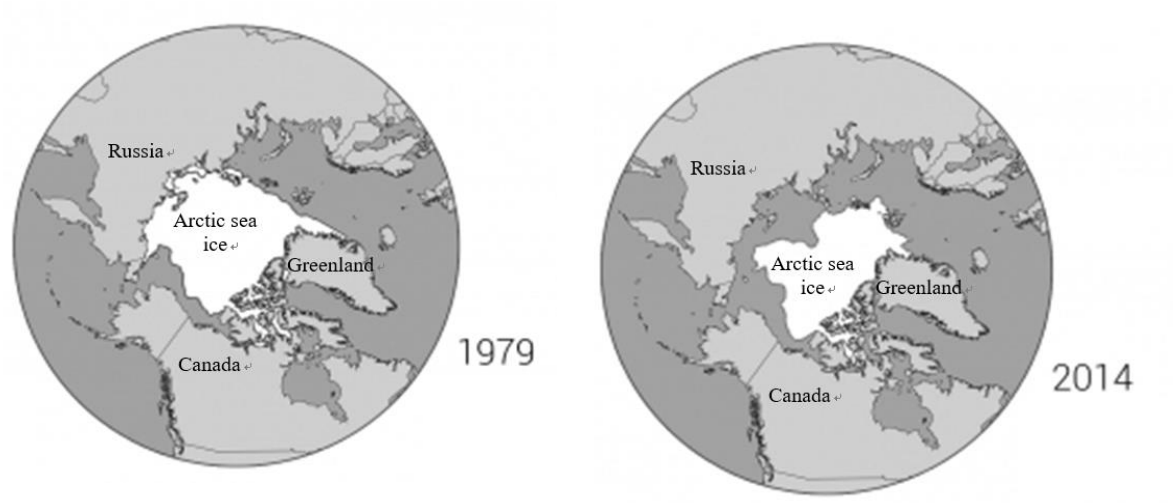


Figure 2B shows the visualized size of the average Arctic sea ice extent in 1979 and 2014.

Figure 2B



(Data source: globalchange.gov)

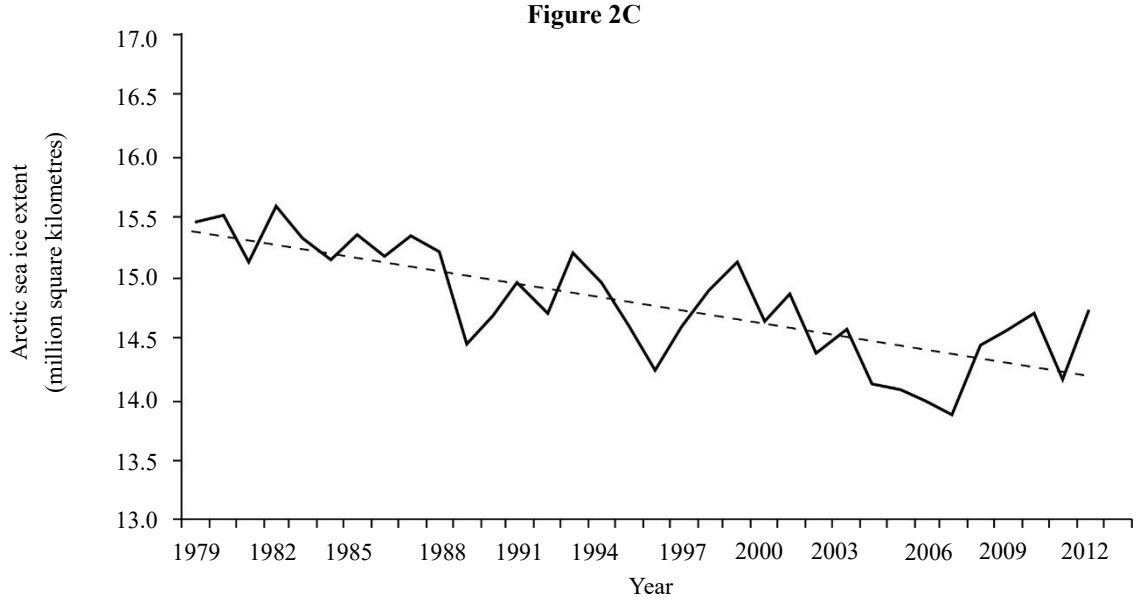
With reference to the above figures,

i account for the missing information in some of the areas shown in **Figure 2A**. (1 mark)

ii describe and explain the trend of polar bear sub-populations shown in **Figure 2A**. (4 marks)

Figure 2C shows the average monthly Arctic sea ice extent from 1979 to 2012.

Figure 2C



(Data source: National Snow and Ice Data Centre, University of Colorado, Boulder)

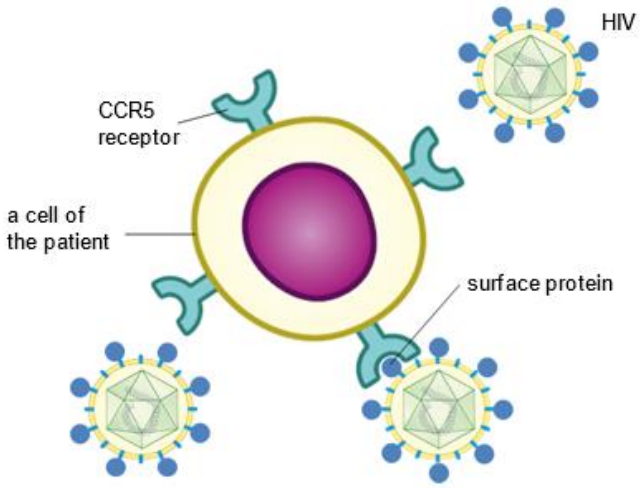
iii Scienctists believe that the overall change shown in **Figure 2C** is related to the increasing level of greenhouse gases in the atmosphere. Explain how greenhouse gases have caused the change shown in **Figure 2C**. (3 marks)

iv To slow down the increase in greenhouse gases level, someone suggests that we should plant more trees and use the wood as fuel to replace fossil fuels. Explain how this might help. (2 marks)

SECTION C Biotechnology

Answer ALL parts of the question.

3. a Developing treatments for AIDS patients is a hot research topic for the scientific community. Human immunodeficiency viruses (HIV), the viruses that cause AIDS, infect white blood cells of humans, for example helper T cells, by binding to CCR5 receptors as shown in the diagram below.
Recently, some scientists are developing a gene therapy which involves introducing a gene coding for an antibody into the patient's cells with the use of a viral vector. The antibody can bind to a surface protein on HIV. The diagram below shows a process involved when HIV infects a cell of a patient.



i With reference to the diagram, explain how the gene therapy described above can help prevent HIV from infecting the cells of the patients. (3 marks)

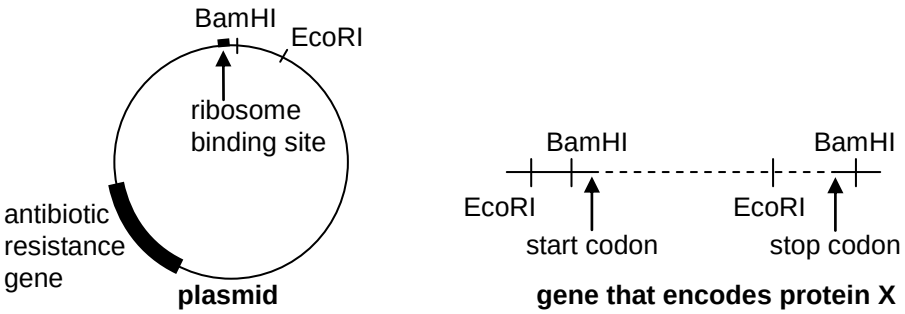
ii Another gene therapy for AIDS under investigation involves modifying the gene encoding CCR5 receptor in blood stem cells. Scientists deleted the base pair at position 32 of the gene. This introduced a premature stop codon.

(1) Explain why the deletion of base pair can prevent HIV from infecting the cells of the patients. (2 marks)

(2) Comparing this therapy with the one described in i, which one has a longer therapeutic effect? Explain your answer. (4 marks)

iii State one potential hazard of gene therapy. (1 mark)

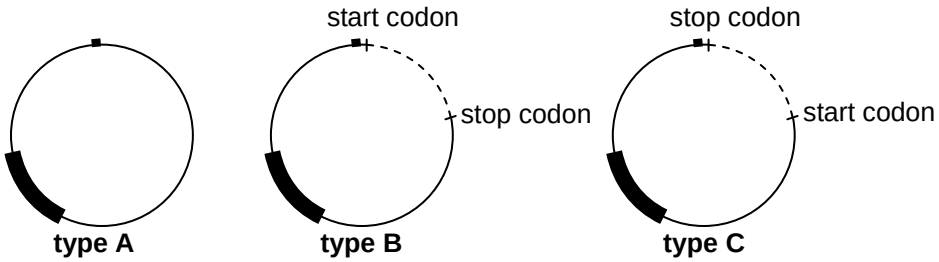
4. b A scientist would like to produce protein X using recombinant DNA technology. The diagrams below show the cut sites of two restriction enzymes (BamHI and EcoRI) on the plasmid and the gene that encodes protein X.



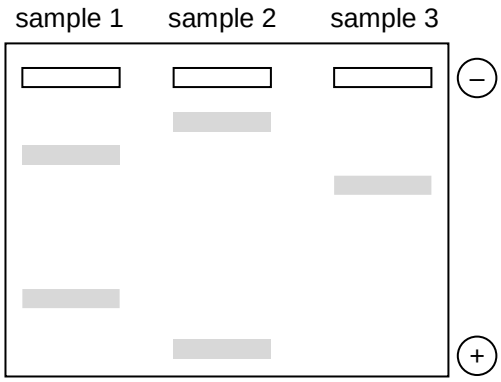
i Suggest which restriction enzyme(s) should be used to cut the plasmid and the gene. Explain briefly. (2 marks)

ii Describe a screening method that allows identification of the bacteria carrying the plasmid. (2 marks)

The scientist isolated and grew three samples of bacteria carrying the plasmid. Each sample of bacteria carries one of these types of plasmids:



The plasmids were extracted from the samples and digested with EcoRI. The samples were then separated by gel electrophoresis. The diagram below shows the results obtained.



iii State the type of plasmid carried by bacteria in sample 3. Explain your answer. (3 marks)

iv Suggest bacteria in which sample can produce functional protein X. Explain your answer. (3 marks)

~END OF PAPER~