Name: _____ **Class:** _____ **No:** _____ **Block:** _____

Mock
BIO
PAPER 2

Christian Alliance S. C. Chan Memorial College

MOCK EXAMINATION (2020-2021)
BIOLOGY PAPER 2

25-Feb-2021
(1 hour)
This paper must be answered in English

INSTRUCTIONS

(1) There are **TWO** sections, A and D in this paper. Attempt **ALL** questions.

(2) Write your answers in the Answer Book provided. Start each question (not part of a question) on a new page.

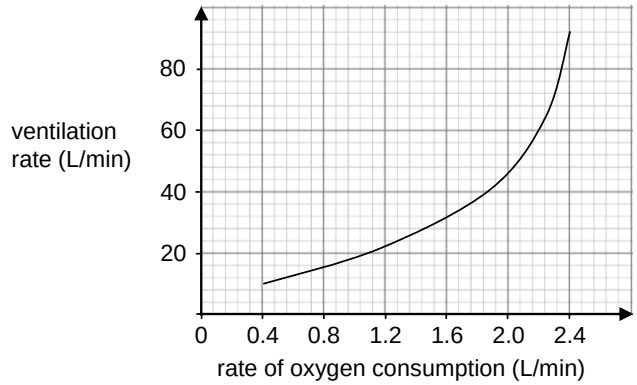
(3) Present your answers in paragraphs wherever appropriate.

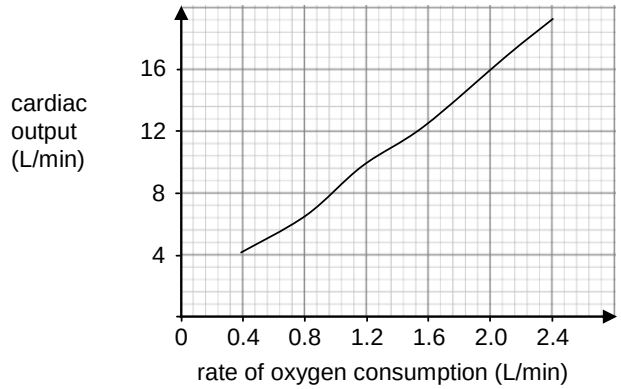
(4) Illustrate your answers with diagrams wherever appropriate.

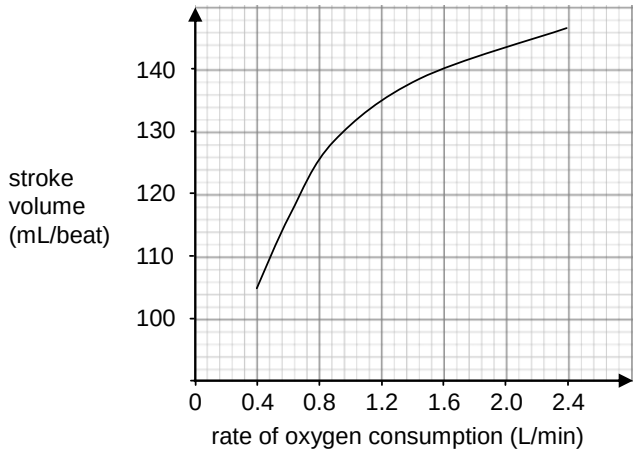
(5) The diagrams in this paper are **NOT** necessarily drawn to scale.

SECTION A Human Physiology: Regulation and Control

1.(a) An investigation was carried out to study how the intensity of exercise affects the ventilation rate, cardiac output and stroke volume. Exercise of varying intensity was performed by a man using an exercise bicycle. The intensity of exercise is expressed as the rate of oxygen consumption of the man. The results are shown in the graphs below.







(i) At which heart chamber is the pacemaker located? (1 mark)

(ii) With reference to the graphs, describe the changes in ventilation rate and cardiac output when the rate of oxygen consumption changed from 1.2 to 1.6 L/min. (1 mark)

(iii) Describe the regulatory pathway by the nervous system that leads to the change in cardiac output in the answer to (ii). (3 marks)

(iv) Calculate the heart rate of the man when the rate of oxygen consumption is 2 L/min. Show your working. (2 marks)

(v) Training increases stroke volume. Suggest why training increases stroke volume. (2 marks)

1.(b) The thermoregulatory centre in our brain regulates our body temperature within a narrow range about the set point (37 °C).

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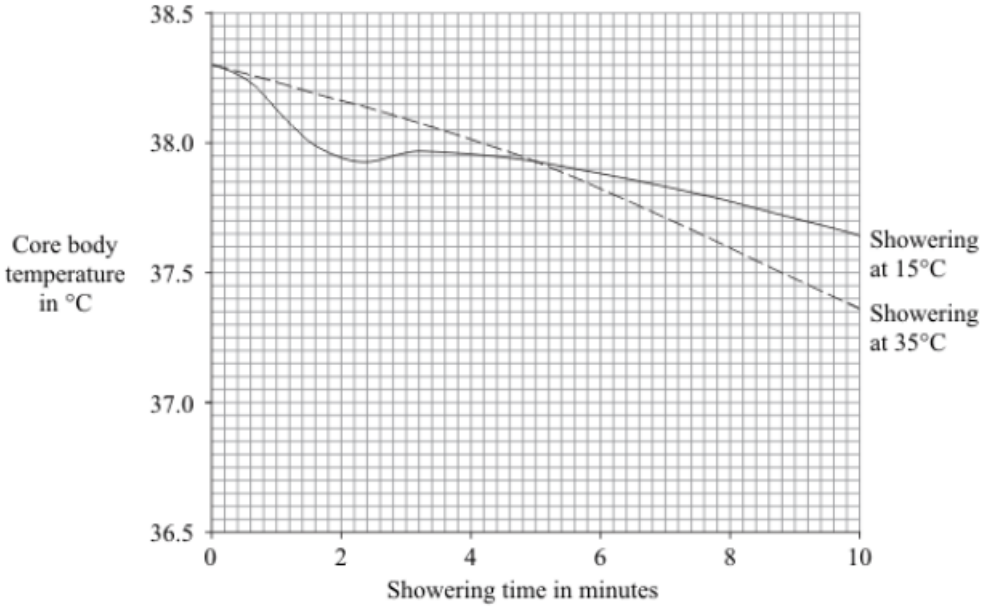
(i) When people have a fever due to a bacterial infection, the temperature set point is raised above the normal level (e.g. 38 °C).

(1) At the onset of a fever, our body may shiver to raise the body temperature to meet the new set point. Describe how such response is initiated. (3 marks)

(2) Explain how shivering can raise the body temperature. (2 marks)

(ii) In the old days, some people suffering from a fever rubbed their bodies with alcohol. Why can rubbing alcohol bring down the body temperature? (2 marks)

(iii) Take a shower is another way to lower the body temperature. An experiment is conducted to study the effects of showering for ten minutes at 15 ℃ and at 35 ℃ on core body temperature after a long race. The graph below shows the result.



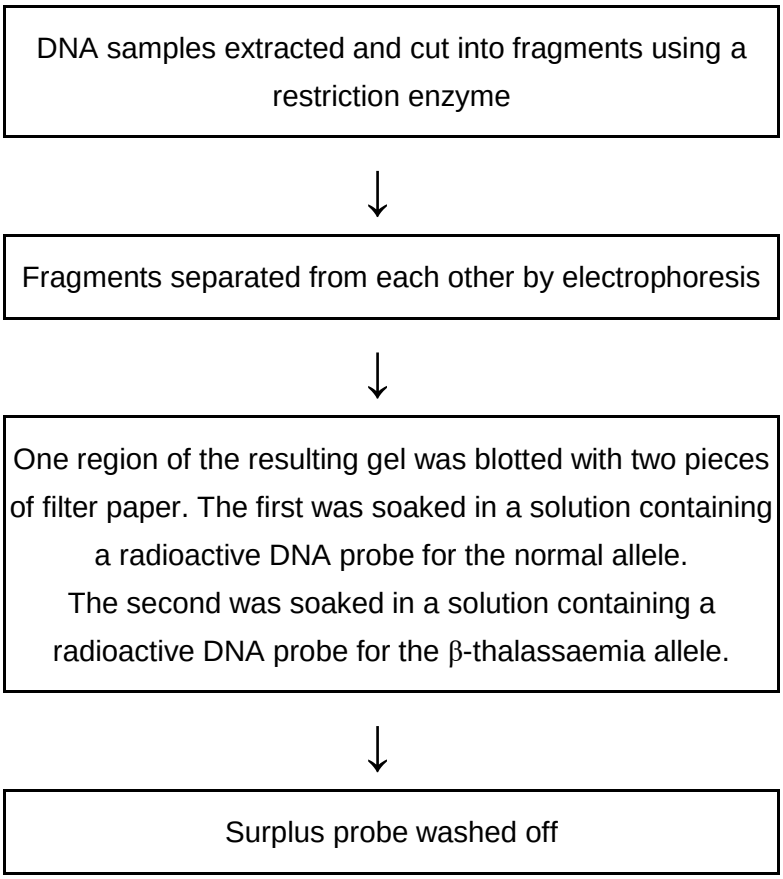
Suggest an explanation for

(1) a lower core body temperature when showering at 15 ℃ between 0 and 2 minutes, as compared with showering at 35 ℃. (1 mark)

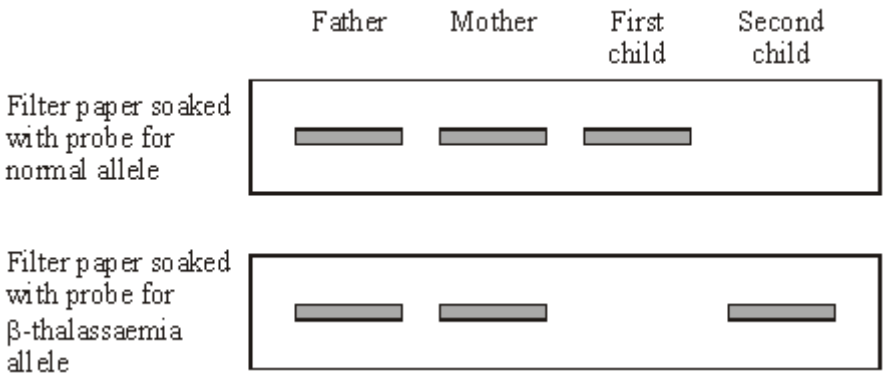
(2) a higher core body temperature when showering at 15 ℃ between 4 and 10 minutes, as compared with showering at 35 ℃. (3 marks)

SECTION D Biotechnology

4.(a) β-thalassaemia is a genetic condition in which abnormal haemoglobin is produced. In one form, the recessive allele for β-thalassaemia, **t**, differs from the normal allele, **T**, by a single base-pair. A radioactive DNA probe was used to investigate the genotypes of four members of one family. The flowchart summarises the technique involved.



The diagram below shows the appearance of the two pieces of filter paper which resulted from the investigation.

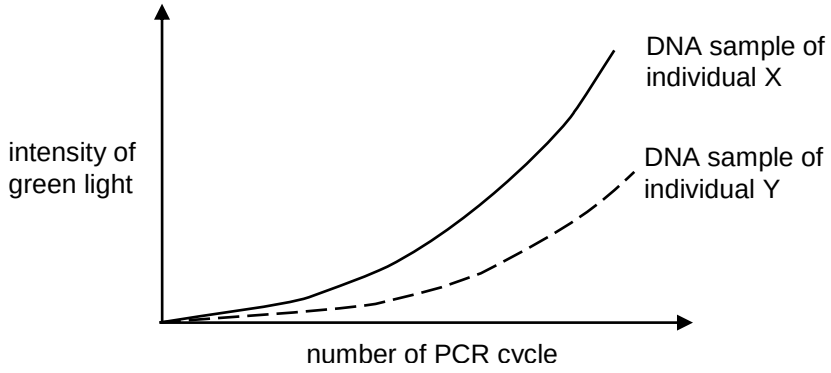


(i) (1) Both the bands of the normal allele and the β-thalassaemia allele moved to the same distance on the gel. Explain why. (2 marks)

(2) The allele for β-thalassaemia differs from the normal allele by only one base-pair. Explain why the probe used to identify these alleles consists of a piece of DNA twenty bases in length and not just one base. (2 marks)

(ii) Based on the results of the test, deduce the genotypes of the couple. (1 mark)

(iii) Scientists are developing another test for β-thalassaemia. In the test, same concentration of DNA samples are obtained from individuals and polymerase chain reaction (PCR) is carried out. A DNA probe complementary to the diseased allele and with a dye attached is added to the reaction mixture. The dye gives out green light only when the DNA probe binds to the target sequence. The graph below shows the intensity of green light detected when PCR is carrying out.



(1) Suggest why heat resistant DNA polymerase has to be used in polymerase chain reaction (PCR). (1 mark)

(2) Describe and explain the shape of the curve for individual X. (3 marks)

(3) Suggest a reason to explain the difference in the intensities of green light detected when PCR is carried out on the two samples. (2 marks)

4. (b) *Bacillus thuringiensis* is a bacterium that produces a protein which is toxic to leaf-eating caterpillars. This protein has been used as a natural insecticide. Recently, the gene that codes for the toxin (Bt gene) has been isolated and inserted into several crop plants.

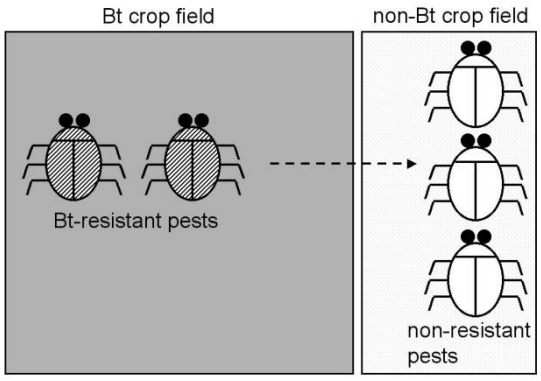
The effects of pests on non-transgenic crops (left) and transgenic crops (right)

(i) Explain why it is important to insert the gene into an isolated plant cell, rather than into a cell within a whole plant. (2 marks)

(ii) The production of Bt plant is a means of crop protection against insect pests. Describe ***two*** advantages of using this approach over the use of insecticides. (2 marks)

(iii) Some scientists argued that if the Bt gene is integrated into wide range of crop plant, the effectiveness will be loss gradually.
Explain how this loss of effectiveness of the toxin might occur. (3 marks)

(iv) It is suggested to plant Bt crops in a field adjacent to a non-Bt crop field. In this way, the Bt-resistant pests present in the Bt crop field are encouraged to visit the non-Bt crop field where there are more non-resistant pests (see diagram below). What is the purpose of this strategy? (2 marks)



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