Class		Class number	
Name			
Biology Group			

Diocesan Girls' School

2022 HKDSE MOCK EXAM

BIOLOGY PAPER 2

Time allowed: 1 hour
This paper must be answered in English.

INSTRUCTIONS

1 This Paper consists of **TWO** sections, A and B. Answer **ALL** questions.

2 Each section carries 20 marks.

3 Write your answers in the answer book provided. Start each question (not part of a question) on a new page.

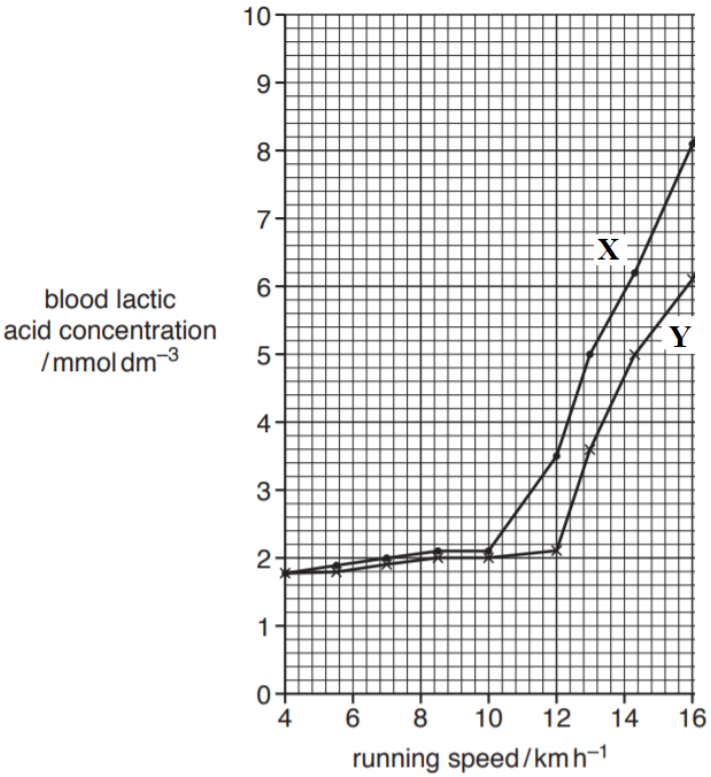
4 Present your answers in paragraphs and illustrate your answers with diagrams wherever appropriate.

5 The diagrams in this section are **NOT** necessarily drawn to scale.

SECTION A Human Physiology – Regulation and Control

Answer **ALL** parts of the question. Put your answers in the answer book provided.

1(a) Lactate threshold is the exercise intensity at which the blood lactic acid concentration begins to increase rapidly. In a study of the effect of training on lactate threshold of a long-distance runner, the change in blood lactic acid concentration during running tests conducted before and after training was monitored. During the running tests, the exercise intensity was progressively increased.



(i) Explain the increase in blood lactic acid concentration when exercise intensity increases above lactate threshold. (4 marks)

(ii) It is given that curve Y represents the results of the running test conducted after training. With reference to the above graph, state the significance of training on the runner's performance. (3 marks)

(iii) Describe how the stimulation of the sympathetic nervous system brings about physiological changes to sustain running in the test. (4 marks)

1(b) A worker performed the same outdoor construction work on the same site for five days of different environmental conditions. The table below shows his average core body temperature and some parameters measured during these five days.

Day	Core body temperature (°C)	Air temperature (°C)	Relative humidity (%)	Volume of water drunk during the day (L)
1	37.0	37.0	19.0	1.5
2	36.8	34.5	18.0	1.5
3	38.9	37.0	92.0	1.5
4	37.0	37.1	20.0	4.0
5	36.9	34.2	19.0	4.0

(i) With reference to thermoregulation, describe and explain the physiological responses which took place when the worker performed his work on day 4. (4 marks)

(ii) State the parameter which contributed most to the increase in his core body temperature on day 3. Support your answer with an evidence from the table. (2 marks)

(iii) Discuss how the parameter stated in part (b) upsets the thermoregulatory processes and brings about the increased core body temperature. (2 marks)

(iv) State the adverse effect of increased core body temperature on the worker. (1 mark)

SECTION B Biotechnology

Answer **ALL** parts of the question. Put your answers in the answer book provided.

2(a) Blindness caused by abnormality of the the cornea is called corneal blindness. It is the fourth leading cause of blindness globally. Corneal blindness can be treated by transplantation of cornea from a deceased donor.

In 2019, a woman in Japan had the first successful treatment of corneal blindness using induced pluripotent stem (iPS) cells. Some skin cells from an adult donor were 'reprogrammed' to iPS cells with properties similar to that of embryonic stem cells. A sheet of corneal stem cells was made from the iPS cells and transplanted into the woman's eye. After the treatment, her clouded cornea turned clear and her vision gradually improved.

(i) Explain how the sheet of corneal stem cells transplanted into the woman's eye could restore her vision. (3 marks)

(ii) Suggest TWO advantages of treating corneal blindness using iPS cells over transplanting cornea from a deceased donor. (2 marks)

(iii) Explain why the development of iPS cells can help overcome some problems associated with the supply of embryonic stem cells for stem cell research or therapy. (2 marks)

2(b) A scientist wanted to develop a genetically modified (GM) crop plant by introducing the *nif* genes from nitrogen-fixing bacteria into the crop plant. The *nif* genes are a cluster of genes coding for the synthesis of a group of enzymes that catalyse nitrogen fixation.

The scientist produced a recombinant plasmid to transform *Agrobacterium*. The transformed *Agrobacterium* was then used to transfer the *nif* genes into the crop plant.

Figure I below shows several genes in the chromosome of nitrogen-fixing bacteria and the cut sites for restriction enzymes X, Y and Z in the chromosome.

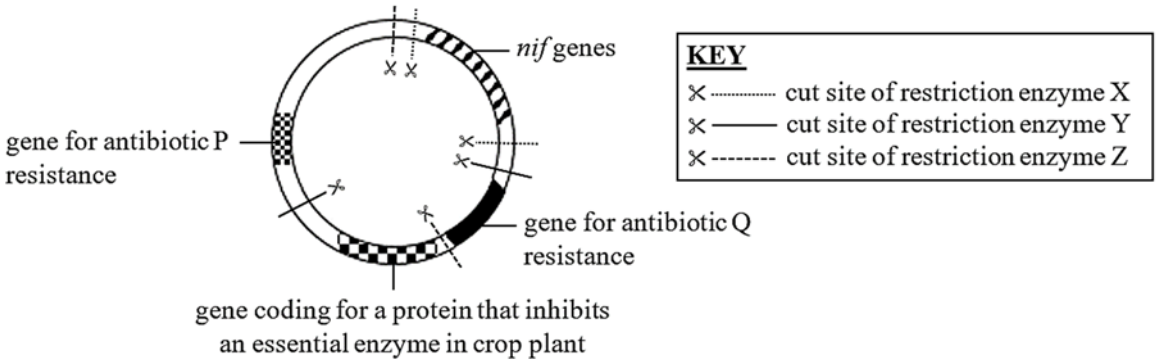


Figure I

Figure II shows the plasmid obtained from *Agrobacterium*.

Figure III shows the recombinant plasmid produced to transform *Agrobacterium*.

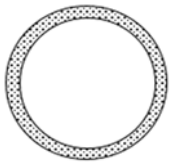


Figure II

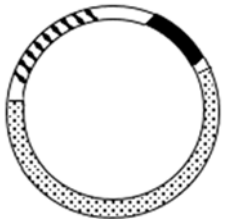


Figure III

(i) (1) Based on Figures I and III, deduce the restriction enzyme used by the scientist. (2 marks)

(2) Suggest another criterion for the scientist to select the restriction enzyme. (1 mark)

(ii) Briefly outline the procedural steps to transform the *Agrobacterium* after obtaining the chromosomes from nitrogen-fixing bacteria. (3 marks)

(iii) (1) Explain why *Agrobacterium* could be used to transfer the *nif* genes into the crop plant. (2 marks)

(2) After transformation of some *Agrobacterium*, the scientist cultured each *Agrobacterium* into a clone. He then obtained two samples from each clone and grew them on agar plates containing antibiotic P and antibiotic Q respectively.

Explain the purpose of growing the *Agrobacterium* on the agar plates before using them to transfer the *nif* genes into the crop plant. (3 marks)

(iv) Suggest TWO advantages of growing this GM crop plant to the farmers. (2 marks)

END OF PAPER