Form Six Mock Examination 2017-2018

DSE BIOLOGY PAPER 2

Date: 5th Feb. 2018
11:25 am – 12:25 am (1 hour)
This paper must be answered in English

INSTRUCTIONS

1. There are **TWO** sections, A and B in this Paper. Attempt **ALL** questions in these **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** questions

1. Running under heat stress in a hot desert poses a great challenge to the thermoregulation system of the body. Three runners have joined a marathon in the Sahara desert. The air temperature during the race ranged from 39°C to 41°C. The relative humidity ranged from 58% to 61%. The three runners had their variation in skin temperatures and core temperatures recorded during the race. The results were illustrated in Diagram I and Diagram II respectively.

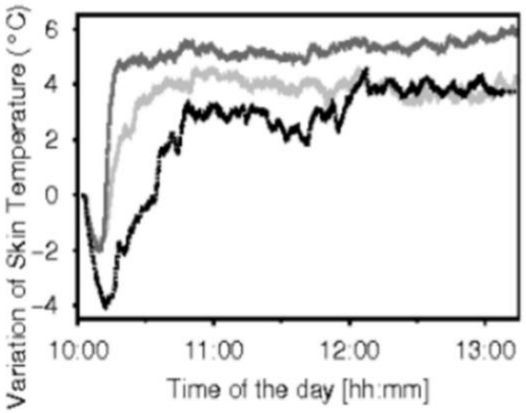


Diagram I: skin

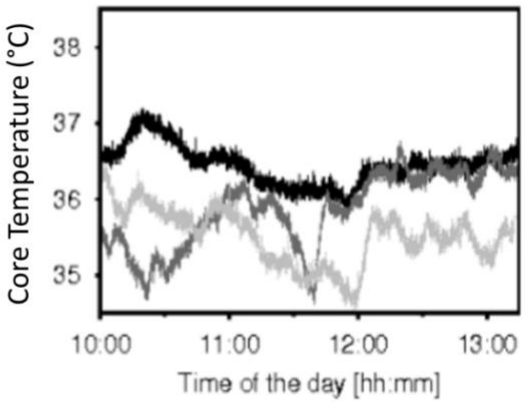


Diagram II: core temperature

(a) Describe the mechanism for regulating the core temperature during the race. (5 marks)

(b) Give an evidence with explanation from Diagram I to support your answer in part (a). (2 marks)

(c) A diabetic patient is planning to join a marathon in the Sahara desert in the next year. Based on the information given in the table below, state two risks with explanation related to the survival of the diabetic patient. (4 marks)

Table I: Flow rate and glucose concentration at different parts of the kidney tubule of a normal and diabetic patient at rest.

Sample	***Flow rate*** $(cm^3\ min^{-1})$		***Glucose concentration*** $(mg\ dL^{-1})$	
	Normal	***Diabetic***	***Normal***	***Diabetic***
Blood in the afferent arteriole	700.0	700.0	100	180
Filtrate in Bowman's capsule	125.0	125.0	100	180
Filtrate at the end of the proximal convoluted tubule	25.0	30	0	70
Urine in the collecting duct	1.3	1.5	0	500

2. (a) (i) When Kathy was 40-year-old, she has both oviducts blocked. She undergone the process of in vitro fertilization (IVF) to help her conceive. Before the collection of mature ova from her ovaries, her doctor gave her injections of a fertility drug, which is made of hormone X, for 10 days, followed by the injection of hormone Y.

Name hormones X. What is the purpose of these hormone injections? (2 marks)

(ii) This year Kathy is 50-year-old, she has reached menopause. Her ovaries stop producing mature follicles as the primary follicles fail to response normally to hormonal stimulus. Her menstruation stops. Her plasma oestrogen level drops by seven times while her plasma follicle stimulating hormone (FSH) level increases by five times than before.

(1) Explain why menstruation stops after a woman has reached menopause. (2 marks)

(2) Explain the very high level of FSH in blood after Kathy has reached menopause. (3 marks)

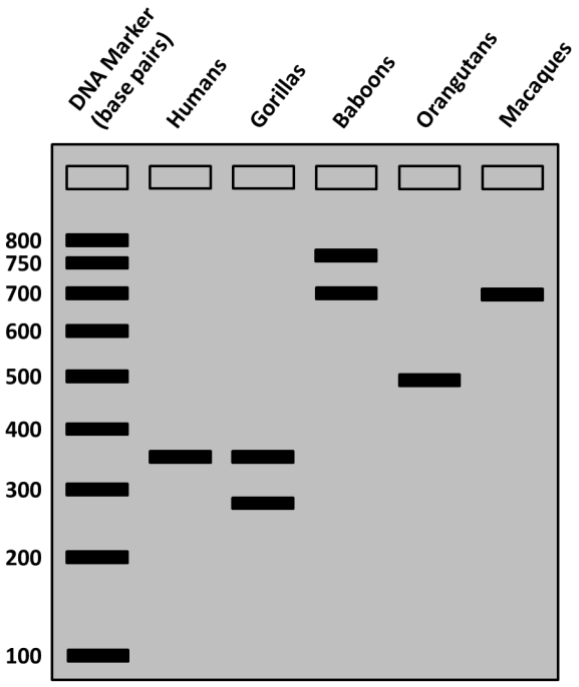
(iii) Kathy successfully got pregnant after undergoing the process of IVF at 40-year-old. If she wants to have another child at 50-year-old. Can the injections of hormones X and Y help her conceive at this age? Explain your answer. (2 marks)

Total 20 marks

Section B Biotechnology

Answer **ALL** questions.

1. (a) A specific type of tandem repeats was found within a gene called Mucin. Different primates contain different copy number of such tandem repeats. Below shows the DNA fingerprints of different primates from restriction fragment length polymorphism (RFLP) analysis, using DNA from the Mucin gene.



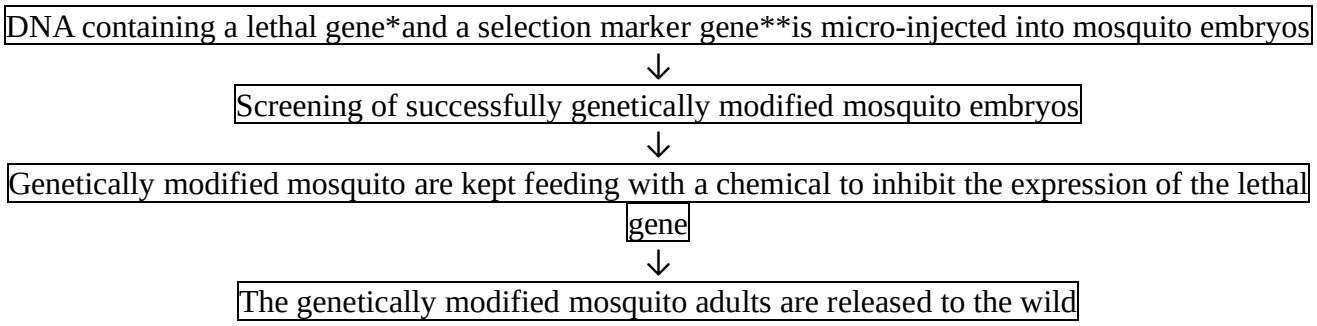
(i) Briefly describe the necessary procedures to produce the above DNA fingerprints after obtaining the DNA of Mucin gene from different primates. (5 marks)

(ii) It was hypothesized that the evolutionary relationship between two primates can be deduced by comparing their copy number(s) of such tandem repeats. Given that the repeating unit of the tandem repeats is 70 base pair long.

(1) Based on the above hypothesis, construct an evolutionary tree for the primates, assuming that they arose from the same ancestor. (2 marks)

(2) What is the assumption behind the evolutionary tree constructed above? (1 mark)

(b) A company proposed to produce genetically modified mosquitos in an effort to control the population of mosquito in the wild, which is a vector for numerous transmittable diseases. The flowchart below shows their proposal.



*That lethal gene encodes a toxic protein that inhibit cellular functions of mosquito only
**That selection marker gene encodes a protein that can glow under UV light

(i) Explain how the addition of that selection marker gene in the transgene facilitates the screening of genetically modified mosquitos. (2 marks)

(ii) The company expects the population growth of the mosquitos will drop after the genetically modified mosquitos are released to the wild. Explain their rationale from a genetic perspective.

(3 marks)

(iii) Traditional ways to control mosquito population include adding non-biodegradable chemicals to the ponds, the breeding site of mosquitos, to kill the mosquito larvae.

(1) Suggest one advantage using such biotechnology over the traditional method to control mosquito population in the wild. (1 mark)

(2) Suggest one ethical concern using such biotechnology to control mosquito population in the wild. (1 mark)

(iv) Malaria is one of the mosquito-borne diseases. Parasites invade into human body through mosquito bites and reproduce. Recently scientists discovered an antibody from rat that can target the parasites. They proposed to genetically modify human body cells *in vivo* to produce such antibody, so as to reduce the impact of malaria infections. Viral vector is proposed to deliver the gene to the body cells.

(1) Describe how the virus should be genetically modified to deliver the antibody encoding gene to the body cells. (3 marks)

(2) Explain why receiving such a treatment fails to guarantee long term immunity to malaria. (2 marks)

Total 20 marks

END OF PAPER