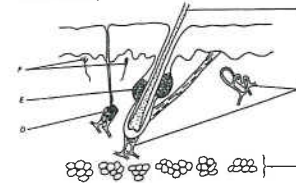


**Past HKCEE Questions**  
**Temperature Regulation in Mammals**  
**Paper I**

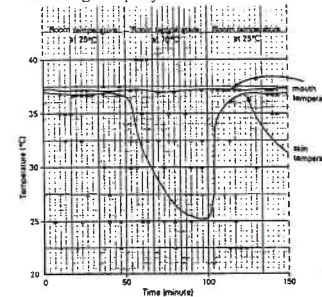
1. The diagram below shows a vertical section of rabbit skin: (The parts are not drawn to the same scale.)



- (i) State two structures which indicate that this skin sample belongs to a mammal.
- (ii) State, using the letters in the diagram,
  - (1) the parts which are concerned with the maintenance of a constant body temperature following exposure to rising air temperatures. Explain how these parts function.
  - (2) the parts which will undergo structural modifications in a cold winter.
- (iii) What two different stimuli can be detected by F?

(HKCEE 1984)

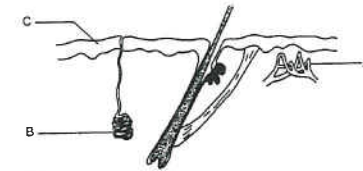
2. The following graph shows the variation in mouth temperature and skin temperature in a naked man in a room where the temperature can be changed rapidly:



- (i)
  - (1) Describe how the mouth temperature varies throughout the experimental period.
  - (2) What is the significance of this? (3 marks)
- (ii)
  - (1) Describe the change in skin temperature during the period from the 50th to the 100th minute.
  - (2) Explain the physiological process that

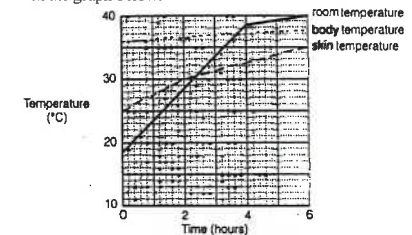
- occurs in the skin to bring about the change in skin temperature in (1). (3 marks)
- (iii) At the 90th minute would the skin still be losing heat to the environment? Explain your answer. (2 marks) (HKCEE 1989)

3. Below is a simplified diagram of a section of the human skin:



- (i)
  - (1) Name structures A and B. (2 marks)
  - (2) Explain how they help to speed up heat loss from the body when the body temperature rises. (6 marks)
- (ii) In a fire, a large area of C of a person was burnt. Give two reasons why this damage may endanger his life. (2 marks) (HKCEE 1995)

4. An experiment was performed to study the effect of environmental temperature on the skin temperature and the body temperature of a person. During the experiment, the person was kept in a room with a constant relative humidity of 65%. He was allowed to eat and move around freely but he was not allowed to change the amount of clothing. The results are shown in the graph below:



- (i)
  - (1) Describe the change in the skin temperature when the room temperature rose from 18°C to 28°C. (1 mark)
  - (2) What physiological change in the skin may cause this change in skin

- temperature? (2 marks)
- (ii) When the room temperature rose from 38°C to 40°C,  
 (1) describe the change in the body temperature. (1 mark)  
 (2) what was the main way by which body heat was lost to the environment?  
 Explain how you arrived at your answer. (3 marks)  
 (3) explain why the person's life might be endangered if the relative humidity of the room rose to 95%. (3 marks)  
 (HKCEE 1996)

5. A person spent two hot days on a beach. He drank plenty of water to avoid the danger of dehydration. The air temperature and the relative humidity at the beach on these two days are recorded in the table below:

	Air temperature (°C)	Relative humidity (%)
Day 1	38	65
Day 2	38	90

- (i) Explain why heat loss from the person's body was mainly effected through sweating on Day 1. (4 marks)  
 (ii) Compared to Day 1, explain why it would be more dangerous for the person to carry out vigorous exercise on the beach on Day 2. (5 marks)  
 (HKCEE 1999)

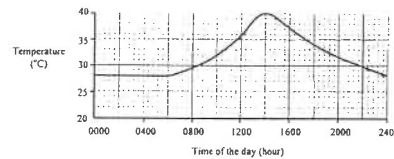
6. Simon went hiking in Sai Kung on a hot afternoon.  
 (i) After walking for half an hour, Simon's face became red.  
 (1) Explain why his face became red. (3 marks)  
 (2) Why is this response important? (2 marks)  
 (ii) After 4 hours of walking, he had drunk all the water he brought along and his sweat production became greatly reduced. His body temperature increased significantly. This might lead to heatstroke. Account for the increase in his body temperature. (2 marks)  
 (iii) The following table provides some information on the weather conditions in Sai Kung on three afternoons:

Day	Temperature (°C)	Relative humidity (%)	Ultra-violet light intensity	Wind speed (km h <sup>-1</sup> )
1	32.8	90	medium	5
2	33.1	72	high	15
3	32.6	80	high	31

On which afternoon would a person have the highest risk of developing heatstroke if he went hiking in Sai Kung?

Justify your answer by stating two special features of the weather of that afternoon as compared with the other two afternoons. (3 marks)  
 (HKCEE 2001)

7. Jane spent a day on the beach in the summer. The graph below shows the changes in the air temperature on the beach on that day:



- (a) Draw a line on the graph to show the possible changes in Jane's body temperature on that day. (1 mark)  
 (b) Referring to the change in the air temperature from 0600 to 1000 hour, explain how the blood vessels in Jane's skin are involved in the regulation of her body temperature during this period. (4 marks)  
 (c) What is the main way of heat loss from Jane's body at 1400 hour? Why do you think so? (3 marks)  
 (HKCEE 2005)

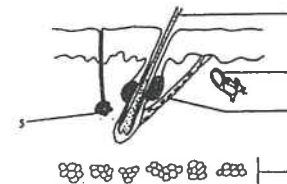
**Past HKCEE Questions**  
**Temperature Regulation in Mammals**  
**Paper II**

- 90-49  
 Which of the following structures of the mammalian skin is NOT involved in temperature regulation?  
 A. oil glands  
 B. nerve endings  
 C. erector muscles  
 D. blood capillaries

- 90-51  
 Under which of the following conditions would a person doing strenuous exercise lose most heat by evaporation?

	air temperature (°C)	relative humidity (%)
A.	10	60
B.	10	98
C.	30	60
D.	30	98

91.  
 Directions: Questions 46 and 47 refer to the diagram below which shows a section of the human skin:



- 91-46  
 Which of the following will happen when a man feels cold?  

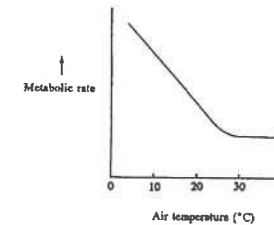
	Constricts	Contracts	Inactive
A.	1	5	3
B.	2	3	5
C.	3	2	4
D.	5	4	2

- 91-47  
 Which of the following are functions of structure 4?

- (1) energy reserve  
 (2) heat conservation  
 (3) body defence  
 A. (1) and (2) only  
 B. (1) and (3) only  
 C. (2) and (3) only  
 D. (1), (2) and (3)

- 93-36  
 In the regulation of body temperature in mammals, the skin acts as  
 A. a receptor.  
 B. an effector.  
 C. both a receptor and an effector.  
 D. a coordinating centre.

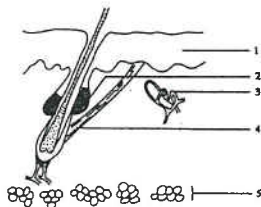
94.  
 Directions:  
 Questions 23 and 24 refer to the graph below which shows how the metabolic rate of a naked person varies with the temperature of the surrounding air:



- 94-23  
 Which of the following statements about the person is correct when the air temperature changes from 10°C to 20°C?  
 A. Oxygen consumption increases.  
 B. The rate of the heart beat increases.  
 C. Heat loss from the body decreases.  
 D. The body temperature decreases.

- 94-24  
 Which of the following is the main process of heat loss from the body when the air temperature is 40°C?  
 A. conduction  
 B. convection  
 C. radiation  
 D. evaporation

Directions:  
Questions 25 and 26 refer to the diagram below which shows a section of the skin of a man:



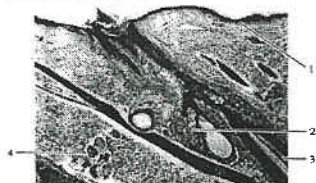
94-25  
Which of the following correctly describes the functions of the different structures of the skin?

- |    | <u>Structure 1</u>                 | <u>Structure 2</u>  | <u>Structure 3</u>        |
|----|------------------------------------|---------------------|---------------------------|
| A. | absorbs oxygen                     | produces sweat      | Absorbs vibration         |
| B. | prevents against mechanical damage | Stores food         | reduces heat loss         |
| C. | prevents the entry of bacteria     | reduces evaporation | stores food               |
| D. | detects changes in air temperature | kills bacteria      | supplies food to the skin |

94-26  
Which of the following correctly describes the immediate responses of the different structures of the skin when the man enters a cold room?

- |    | <u>Structure 3</u> | <u>Structure 4</u> | <u>Structure 5</u> |
|----|--------------------|--------------------|--------------------|
| A. | dilates            | contracts          | no change          |
| B. | constricts         | contracts          | no change          |
| C. | dilates            | relaxes            | becomes thicker    |
| D. | constricts         | relaxes            | becomes thicker    |

99.  
Directions: Questions 6 and 7 refer to the photomicrograph below, which shows a section of the mammalian skin:



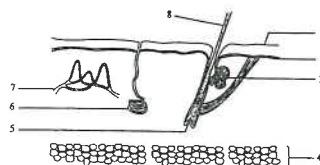
99-6  
Which structure produces a secretion that can reduce evaporation of water from the skin surface?

- A. 1  
B. 2  
C. 3  
D. 4

99-7  
Which structure contains cells capable of rapid cell division?

- A. 1  
B. 2  
C. 3  
D. 4

02  
Directions: Questions 52 to 54 refer to the diagram below, which shows a section of the human skin:



02-52  
On a cold day, which of the following changes will occur to help maintain the body temperature?  
(1) Structure 4 becomes thicker.  
(2) Structure 6 becomes less active.  
(3) Structure 7 constricts.

- A. (1) only  
B. (2) only  
C. (1) and (3) only  
D. (2) and (3) only

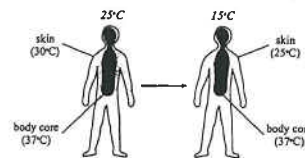
02-53  
Which structure(s) in the skin helps to prevent the entry of germs into the body?

- A. 1 only  
B. 1 and 3 only  
C. 3 and 8 only  
D. 1, 3 and 8

02-54  
Which parts of the skin are capable of active cell division?

- A. 2 and 5  
B. 2 and 8  
C. 4 and 5  
D. 4 and 8

03.  
Directions: Questions 35 and 36 refer to the diagram below, which shows the change in the heat distribution of a person's body when the air temperature drops from 25°C to 15°C



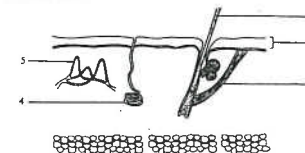
03-35  
Which of the following are responsible for the change in the skin temperature?

- (1) increase in heat loss  
(2) decrease in sweat secretion  
(3) constriction of the skin arterioles  
A. (1) and (2) only  
B. (1) and (3) only  
C. (2) and (3) only  
D. (1), (2) and (3)

03-36  
Which of the following will occur if the person stays at 15°C for 30 minutes without additional clothing?

- A. The metabolic rate of muscle will increase.  
B. The subcutaneous fat will become thicker.  
C. The urine will become more concentrated.  
D. The sebaceous glands will become more active.

03.  
Directions: Questions 47 to 49 refer to the diagram below, which shows a section of the human skin:



03-47  
Which structure has the ability to contract?

- A. 1  
B. 3  
C. 4  
D. 5

03-48  
In a fire, structure 2 of a person was damaged by burning. Which of the following may occur at the damaged part?

- (1) excessive evaporation of water  
(2) bacterial infection  
(3) bleeding  
A. (1) and (2) only  
B. (1) and (3) only  
C. (2) and (3) only  
D. (1), (2) and (3)

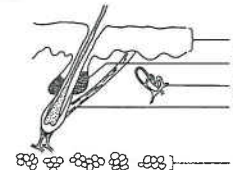
03-49  
Which of the following will occur in the skin to repair structure 2?

- (1) mitosis  
(2) cell specialization  
(3) increase in blood supply  
A. (1) and (2) only  
B. (1) and (3) only  
C. (2) and (3) only  
D. (1), (2) and (3)

05-33  
Which of the following is *not* a correct match of the structures in the skin and their functions?

- | Structure               | Function                                   |
|-------------------------|--|
| A. sweat gland          | regulating the water potential of the body |
| B. sebaceous gland      | preventing infection of the skin           |
| C. blood vessel         | regulating body temperature                |
| D. sensory nerve ending | detecting external stimuli                 |

06.  
Directions: Questions 17 and 18 refer to the diagram below, which shows a section of the human skin:



06-17  
Which of the following correctly describes structure 1?

- A. It consists of dead cells only.  
B. It reduces water loss from the body.  
C. It helps the removal of metabolic wastes.  
D. It has a pigment which absorbs infra-red radiation to produce vitamin D.

06-18  
Which of the above labelled structures are involved in temperature regulation in humans?

- A. 1, 3 and 4 only  
B. 1, 4 and 5 only  
C. 2, 3 and 5 only  
D. 3, 4 and 5 only

07-32  
Which of the following are the changes found in the skin when there is a sudden drop in environmental temperature from 25°C to 10°C?

	Sweating	Capillaries beneath the skin
A.	decrease	less blood flow
B.	decrease	more blood flow

C.	increase	less blood flow
D.	increase	more blood flow

**Past HKCEE Questions**  
**Temperature Regulation in Mammals**  
**Suggested Answers**

**Paper I**

1. (i) presence of hair / sebaceous gland / sweat gland (any 2) 1  
1

part	function	
B	by vasodilation to dissipate body heat through radiation	1 + 1
D	by sweating (perspiration) to lose heat through evaporation	1 + 1

- (iii) Touch / temperature change / heat / cold / pressure / pain (any 2) 1+1

2. (i) (1) remains relatively constant 1  
(2) mouth temperature approximates to internal temperature this indicates that enzyme activity / rate of metabolism remains relatively constant, irrespective of changes in external temperature 1  
OR  
Mouth temperature is better than skin temperature as an indicator of internal temperature 1  
(ii) (1) Skin temperature drops 1  
(2) vasoconstriction / blood vessels in skin constricts and less blood / heat is carried to the skin 1  
(iii) yes 1  
there is still a temperature gradient / difference between the skin and the environment 1
3. (i) (1) A - \* blood capillary 1  
B - \* sweat gland 1  
(2) More blood will reach A 1  
As A is close to the surface / provides a large surface area it will lead to faster heat loss by radiation / conduction / convection 1  
B will produce more sweat to the skin surface 1  
to increase heat loss by evaporation of water which absorbs body heat 1  
Communication skill (C) 1

- (ii) This damage may lead to excessive loss of water from the body and bacterial infection 1  
1

4. (i) (1) The skin temperature increased 1  
(2) Vasodilation occurs in the arterioles of the skin so that more blood bringing heat flows to the skin 1  
(ii) (1) The body temperature remains constant 1  
(2) Sweating 1  
As the room temperature was higher than the body temperature, heat could not be lost by conduction / convection / radiation so sweating was the main way of heat loss. 1  
(3) Evaporation of sweat is too slow to lose heat effectively while the body absorbs heat from the environment Thus the body becomes overheated 1

5. (i) On Day 1, the air temperature was higher than the body temperature Heat from the body could not be lost to the environment by conduction, convection and radiation However, he could lose heat through the evaporation of sweat which absorbs heat from the body surface 1  
Effective communication (C) 1  
(ii) Vigorous exercise would lead to the generation of large amount of heat in the body As sweat could not evaporate efficiently at the higher relative humidity on Day 2, less heat was lost from the body through sweating As a result, the body temperature would rise steadily and this would lead to the breaking down of normal metabolism / enzymatic action 1

6. (i) (1) During exercise, a large amount of heat was generated / Heat was absorbed from the sun  
As a result, the arterioles in the skin dilated and the blood flow to the skin increased thus the face became red  
Effective communication (C)  
(2) This helps to promote heat loss from the body so as to maintain a constant body temperature
- (ii) There was a decrease in heat loss by evaporation  
Thus the rate of heat gain by his body became greater than the rate of heat loss resulting in an increase in his body temperature.
- (iii) Day 1  
The relative humidity of the afternoon of day 1 is the highest and the wind speed is the lowest
7. (a) Correct line drawn showing a relatively constant body temperature at  $37 \pm 1$  °C
- (b) From 0600 to 1000 hour, the air temperature increases  
Blood vessels in the skin dilate so that more blood will flow near to the skin surface  
More heat can be lost from the blood by conduction, convection and radiation  
(effective communication)
- (c) Evaporation of sweat  
At 1400 hour, the air temperature is higher than the body temperature so heat cannot be lost by conduction, convection and radiation but evaporation can still occur

90-49	A
90-51	C
91-46	B
91-47	A
93-36	C
94-23	C
94-24	D
94-25	C
94-26	B
99-6	B
99-7	A
02-52	D
02-53	B
02-54	A
03-35	B
03-36	A
03-47	B
03-48	A
03-49	D
05-33	A
06-17	B
06-18	D
07-32	A

**Paper II**