

### Temperature regulation

- 5 (a) (i) Conditions in the human body must be regulated to maintain a stable internal environment.

Name the process that maintains a stable internal environment.

(1)

- (ii) Complete the sentence by putting a cross (☒) in the box next to your answer.

The temperature that enzymes work most effectively in the human body is

(1)

A 31 °C

B 33 °C

C 35 °C

D 37 °C

- (b) Receptor cells in the skin detect temperature changes in the external environment.

Explain how this information is transmitted to the brain.

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\*(c) In the UK, the external temperature can drop below 0 °C.

Explain how the human body maintains a stable internal temperature when the external temperature is 0 °C.

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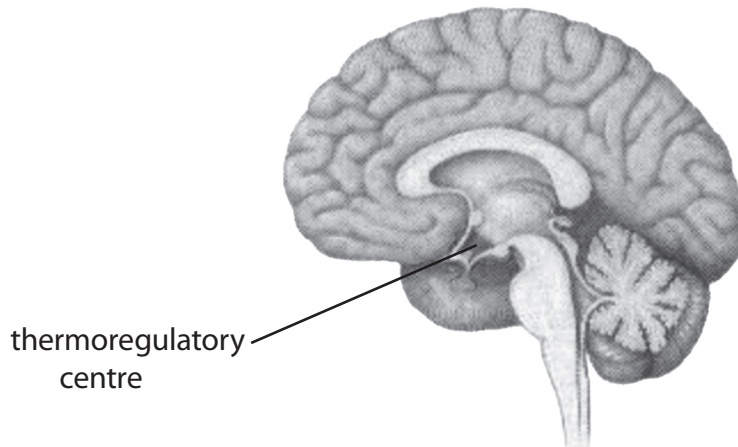
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**(Total for Question 5 = 12 marks)**



## Homeostasis

6 The diagram shows a brain with the thermoregulatory centre labelled.



(a) (i) Complete the sentence by putting a cross (☒) in the box next to your answer.

The part of the brain that contains the thermoregulatory centre is the

(1)

- A cerebrum
- B cerebellum
- C hypothalamus
- D medulla

(ii) The thermoregulatory centre controls internal body temperature.

Explain how the blood vessels in the skin help to control internal body temperature.

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(b) Water content is also controlled within the human body.

State the name given to the control of water content in the body.

(1)

\* (c) The human body prevents blood glucose levels from becoming too high or too low.

Explain how the human body maintains blood glucose levels within a narrow range.

(6)

(Total for Question 6 = 12 marks)

**TOTAL FOR PAPER = 60 MARKS**



- 9 The kangaroo rat is a mammal that can survive in desert environments and can tolerate much higher concentrations of sodium ions in their bloodstream than humans.

Figure 16 shows an image of the kangaroo rat.



(Source: Richard R. Hansen/Science Photo Library)

**Figure 16**

(a) The name of the process that controls water levels in the body is

(1)

- A diffusion
- B osmosis
- C osmoregulation
- D thermoregulation

(b) (i) Explain how the blood entering the nephron of the kangaroo rat is filtered to remove excess sodium ions and water.

(3)

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The kangaroo rat has a longer loop of Henle than most mammals.

(ii) Explain why this adaptation is beneficial to the kangaroo rat.

(2)

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### Blood glucose

3 Humans regulate the glucose concentration of their blood.

A scientist recorded the blood glucose concentration of an individual over a seven-hour period.

The results are shown in the table.

time of day	blood glucose concentration / mg per 100 cm <sup>3</sup>
06.00	76
07.00	77
08.00	124
09.00	91
10.00	83
11.00	81
12.00	79
13.00	130

(a) (i) Describe the trend in blood glucose concentration for this seven-hour period.

(2)

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(ii) Suggest reasons for the changes in blood glucose concentration.

(2)

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(iii) Complete the sentence by putting a cross (☒) in the box next to your answer.

Excess blood glucose is converted into

(1)

- A glucagon in the liver
- B glucagon in the pancreas
- C glycogen in the liver
- D glycogen in the pancreas

(b) (i) Scientists have discovered that a high body mass index (BMI) is a risk factor that may cause Type 2 diabetes.

Calculate the BMI for a female who has a mass of 67.5 kg and a height of 1.50 m.

$$\text{BMI} = \frac{\text{mass in kg}}{(\text{height in metres})^2}$$

(2)

answer = .....

(ii) Explain how a Type 2 diabetic can regulate their blood glucose concentration.

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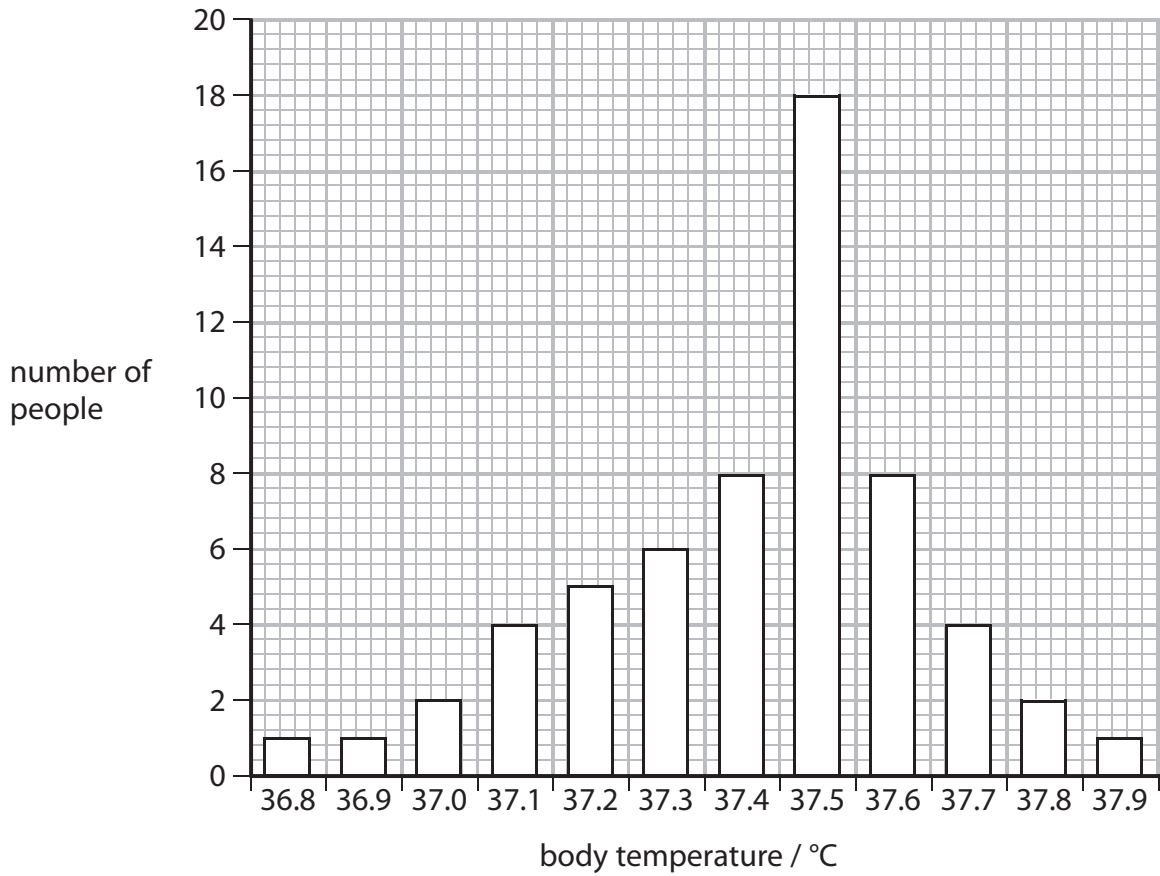
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**(Total for Question 3 = 10 marks)**



### Thermoregulation

3 (a) The graph shows the body temperature of 60 people.



(i) Complete the sentence by putting a cross (☒) in the box next to your answer.

The range in body temperature is

(1)

- A 0.1
- B 1.1
- C 11.0
- D 11.1

(ii) State the type of variation, shown in the graph, that results in a normal distribution curve.

(1)



(iii) Calculate the percentage of people with a body temperature of 37.5 °C. (2)

answer = ..... %

(b) A person with a body temperature of 37.9 °C had a body temperature of 37.5 °C one hour later.

(i) Explain how thermoregulation causes this reduction in body temperature. (4)

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(ii) Explain how exercise can cause body temperature to increase. (2)

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**(Total for Question 3 = 10 marks)**



### Thermoregulation

5 The temperature of Rebecca's brain and of one of her fingers was recorded at six different external temperatures.

temperature / °C		
external	brain	finger
20	36.9	37.0
15	37.0	36.8
10	36.7	36.5
5	36.9	36.2
0	36.8	35.6
-5	37.0	34.3

(a) (i) Calculate the maximum temperature range for Rebecca's finger. (1)

answer ..... °C

(ii) Compare the temperature of Rebecca's brain and her finger as the external temperature decreased. (2)

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(iii) Explain why the temperature of Rebecca's finger showed this response to the decrease in the external temperature. (3)

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\*(b) Explain how the human body responds to an external temperature of 40 °C.

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**(Total for Question 5 = 12 marks)**

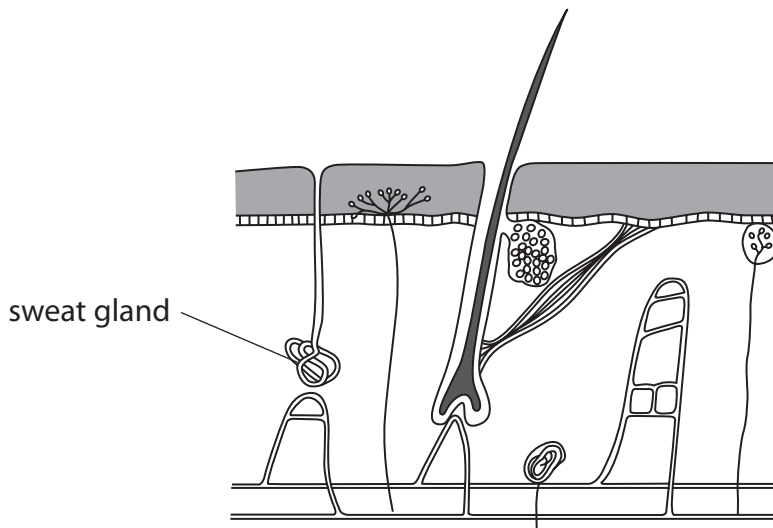


**Answer ALL questions**

**Some questions must be answered with a cross in a box ☒.**  
**If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.**

**A changing environment**

**1** The diagram shows a section through human skin.



(a) (i) Complete the sentence by putting a cross (☒) in the box next to your answer.

The maintenance of a stable internal environment is called

(1)

- A** speciation
- B** homeostasis
- C** hybridisation
- D** variation

(ii) Explain how sweat glands can help the human body to cool down.

(2)

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(b) Blood vessels in the skin help to regulate body temperature.

Explain how blood vessels reduce the amount of heat lost from the body.

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(c) Body temperature can vary.

Describe how the brain is involved in thermoregulation.

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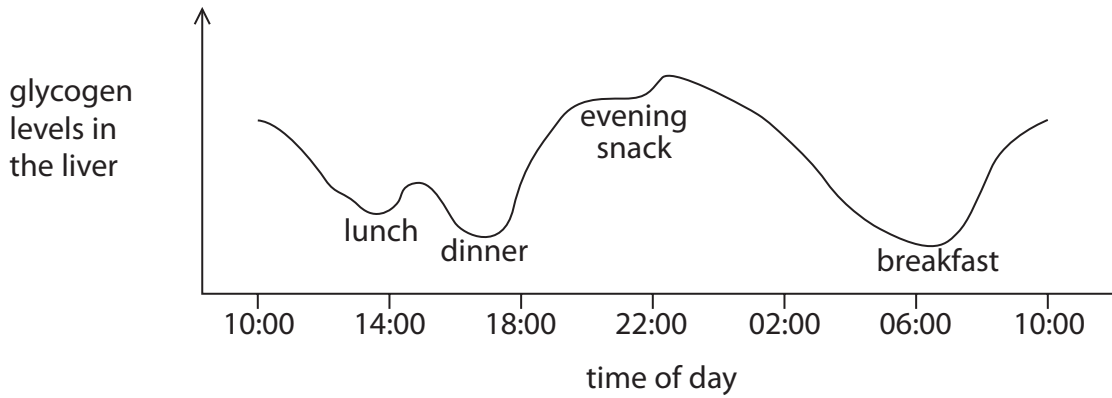
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**(Total for Question 1 = 8 marks)**



### Blood glucose regulation

2 The graph shows the glycogen levels in the liver of a healthy male during 24 hours.



(a) State the time when the glycogen in the liver is at its highest level.

(1)

(b) Explain why glycogen levels in the liver increase after a meal.

(4)

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(c) A male with untreated Type 2 diabetes ate lunch with the same carbohydrate content as the healthy male in the graph.

Explain why the glycogen level in the liver of the male with untreated Type 2 diabetes would be different from the healthy male after this meal.

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**(Total for Question 2 = 8 marks)**



### Messages in the body

6 (a) (i) Complete the sentence by putting a cross (☒) in the box next to your answer.

A person with diabetes cannot control

(1)

- A the water content of their blood
- B the glucose content of their blood
- C their body temperature
- D their body mass index

(ii) Explain how Type 1 diabetes can be controlled.

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