AQA GCSE Biology | 8461

SPECIFICATION POINT 4.5.2.4

# Control of body temperature (biology only)

## Past-paper questions

| | |
|---|---|
| Tier | **Higher** |
| Question groups | **23** |
| Available paper years | **2008–2025** |

## Using this booklet

1. Answer the questions in order and show your working.
2. Original question numbers and marks are retained.
3. Print at actual size (100%) for measuring questions.
4. Use the companion answer booklet to check your work.

**Name:** _____ **Date:** _____

Whole questions are retained for context, so some parts assess other specification points. Current and legacy sources are labelled. Continue on extra paper if needed.

### 4.5.2.4 Control of body temperature (biology only)

**Question 01**

June 2008 | BLY1AP | Original Q5 | Legacy

## QUESTION FIVE

**5A** During a race, a runner produces a lot of sweat.

This can be dangerous because . . .

**1** less water is lost as urine due to an increase in sweating.

**2** less energy is available for running, as more energy is used to cool the body.

**3** the ion concentration in the blood rises because more water is lost by increased sweating.

**4** the rates of chemical reactions in the body decrease.

**5B** Carbohydrates are necessary in a sports drink in order to . . .

**1** replace the ions lost in sweat during a race.

**2** replace the sugars used in energy release during the race.

**3** balance the amount of water lost in sweat during the race.

**4** increase the growth of muscle during a race.

**4.5.2.4 Control of body temperature (biology only)**

**Question 01 · continued** June 2008 | BLY1AP | Original Q5 | Legacy

The table shows the composition of four different sports drinks, **P**, **Q**, **R** and **S**.

| Drink | Glucose in g per $dm^3$ | Ions in mg per $dm^3$ | Fats in mg per $dm^3$ | Protein in g per $dm^3$ |
|---|---|---|---|---|
| **P** | 110 | 23 | 0 | 1.2 |
| **Q** | 68 | 96 | 0.1 | 0 |
| **R** | 78 | 82 | 0.3 | 0 |
| **S** | 136 | 25 | 0 | 0.2 |

**5C** During a race, a runner drinks 5 bottles of drink **Q**. Each bottle contains 0.5 $dm^3$ of the drink.

Which line correctly shows his intake of glucose and ions?

| | Intake of glucose in g | Intake of ions in mg |
|---|---|---|
| **1** | 17 | 24 |
| **2** | 65 | 95 |
| **3** | 170 | 240 |
| **4** | 272 | 384 |

**5D** One factor which influences the rate of uptake of ions from a sports drink into an athlete's blood is the ratio of the ion concentration to the glucose concentration. The nearer this ratio is to 1:1, the greater the rate of ion uptake from the drink.

Considering **only** this factor, from which drink would the rate of ion uptake be the greatest?

**1** **P**

**2** **Q**

**3** **R**

**4** **S**

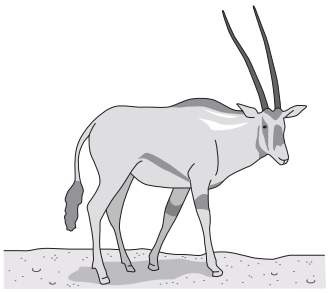
**4.5.2.4 Control of body temperature (biology only)**

**Question 02**

June 2008 | BLY1BP | Original Q6 | Legacy

## QUESTION SIX

The picture shows an oryx. Oryx live in hot, dry deserts.



**6A** Oryx have very light coloured skin with short hairs.

How might their skin help to prevent oryx from overheating?

**1** The light colour camouflages them.

**2** The light colour reflects heat.

**3** The short hairs trap heat.

**4** The short hairs prevent sweat from evaporating.

**6B** Oryx have a layer of fat under their skin.

How might this layer of fat help to prevent oryx from overheating?

**1** It reduces the amount of heat absorbed into the body from the skin.

**2** It increases the amount of heat radiated by the skin.

**3** It increases the surface area of the skin.

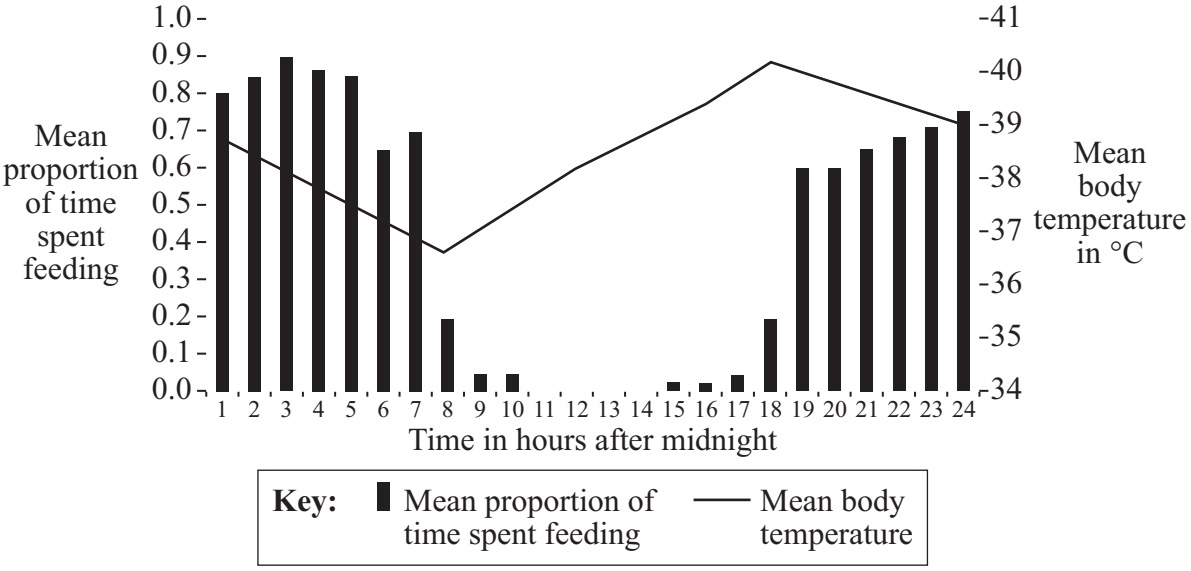
**4** It prevents sweat from rising to the surface of the skin.

**4.5.2.4 Control of body temperature (biology only)**

**Question 02 · continued** June 2008 | BLY1BP | Original Q6 | Legacy

Oryx spend part of their time resting in shade and the remainder of the time feeding.

The graph shows data from a group of 14 oryx.




**6C** This data shows that . . .

**1** low body temperature increases the mean proportion of time spent feeding.

**2** feeding causes the body temperature of oryx to rise.

**3** feeding causes body temperature to rise during the day and to fall during the night.

**4** there is no causal relationship between feeding and body temperature.

**6D** Most mammals maintain their body temperature constant at about 37 °C.

The body temperature of oryx is allowed to rise to about 40 °C during the day.

This helps oryx to survive in the hot, dry desert by . . .

**1** allowing them to be more active during the day.

**2** increasing the amount of heat lost via radiation.

**3** enabling their food to be digested faster.

**4** reducing the amount of water lost via sweating.

**4.5.2.4 Control of body temperature (biology only)**

**Question 03**

January 2009 | BLY2H | Original Q5 | Legacy

**5** During exercise an athlete's core body temperature may rise.

**5** (a) What causes this rise in core body temperature?

.....

.....

*(1 mark)*

**5** (b) During a long race one athlete did not drink any liquid. Towards the end of the race the amount of sweat he produced began to fall.

**5** (b) (i) This athlete's core body temperature increased more than that of other similar athletes who had drunk enough liquid during the race.

Explain why.

.....

.....

.....

.....

.....

*(2 marks)*

**5** (b) (ii) Describe **one** other way in which this athlete's body would respond in order to reduce core body temperature.

.....

.....

.....

.....

.....

*(2 marks)*

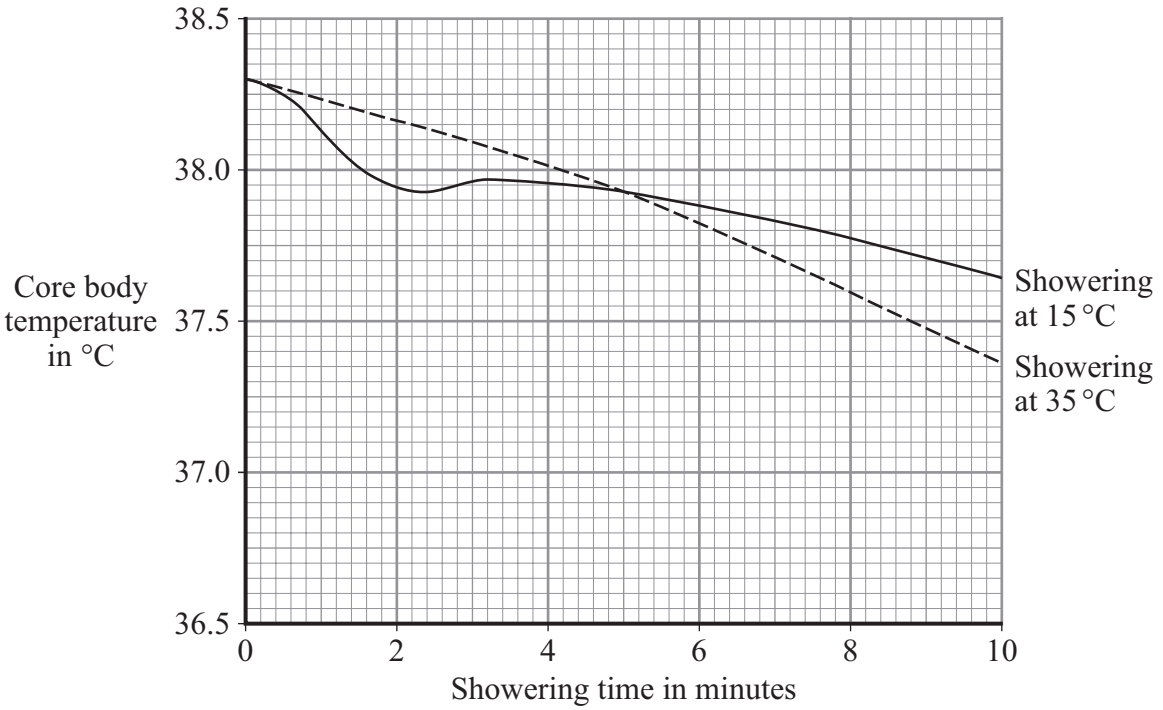
4.5.2.4 Control of body temperature (biology only)

Question 03 · continued



*for mark*

**5** (c) The graph shows the effects of showering for ten minutes at 15 °C and at 35 °C on core body temperature after a long race.




Suggest an explanation for the differences in core body temperature:

**5** (c) (i) between 0 and 2 minutes

.....

.....

.....

*(1 mark)*

**5** (c) (ii) between 4 and 10 minutes.

.....

.....

.....

.....

.....

*(2 marks)*

8

### 4.5.2.4 Control of body temperature (biology only)

**Question 04**

March 2010 | BLY1AP | Original Q1 | Legacy

**QUESTION ONE**

Most long-distance runners drink sports drinks during a race.

Match words, **A**, **B**, **C** and **D**, with the numbers **1–4** in the sentences.

**A** energy

**B** enzymes

**C** mass

**D** sweat

Ions and water are lost during a race in . . . **1** . . . .

Sugar is added to sports drinks to replace the sugar used to release . . . **2** . . . .

In hot conditions, the athlete's body temperature may rise. This affects the working of . . . **3** . . . .

An athlete who drinks too much water during a race will probably gain . . . **4** . . . .

### 4.5.2.4 Control of body temperature (biology only)

**Question 05**

June 2010 | BLY1H | Original Q5 | Legacy

**5** Drinking after exercise to replace the water lost in sweat is called rehydration. Scientists at a Spanish university investigated rehydration after exercise.

- 24 students took part in the investigation.
- All the students ran on a treadmill in a temperature of 40 °C until they were exhausted.
- 12 of the students were each given half a litre of beer to drink.
- The other 12 students were each given half a litre of tap water to drink.
- Both groups of students were then allowed to drink as much tap water as they wanted.
- The scientists measured how quickly each student rehydrated.
- The students who had been given beer rehydrated 'slightly better' than the ones given only water.

A newspaper reported the investigation.

The headline was

**'Forget water after a workout ... drink some beer instead.'**

The newspaper headline was **not** justified.

Explain why.

.....

.....

.....

.....

.....

.....

.....

.....

*(3 marks)*

3

### 4.5.2.4 Control of body temperature (biology only)

**Question 06**

June 2010 | BLY2H | Original Q5 | Legacy

**5** Conditions inside the body must be kept constant.

**5 (a)** Urea must be removed from the body.

**5 (a) (i)** Name the organ which makes urea.

.....

*(1 mark)*

**5 (a) (ii)** Which organ removes urea from the body?

.....

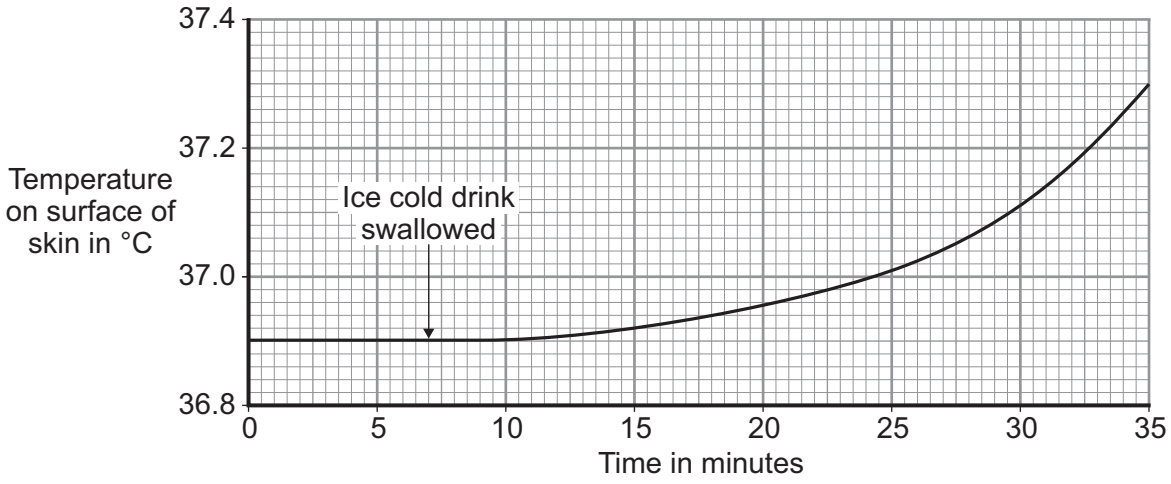
*(1 mark)*

**5 (a) (iii)** What is urea made from?

.....

*(1 mark)*

A man sat in a room where the temperature was maintained at 40 °C.
The temperature on the surface of his skin was monitored for 35 minutes.
He swallowed an ice cold drink at the time indicated on the graph.



4.5.2.4 Control of body temperature (biology only)

Question 06 · continued



**5 (b)** The sweat glands contribute to the change in the temperature on the surface of the skin shown on the graph.

Explain how.

.....

.....

.....

.....

.....

.....

*(2 marks)*

**5 (c)** The blood vessels near the surface of the skin also contribute to the changes in skin temperature shown on the graph.

**5 (c) (i)** How do the blood vessels in the skin change when the core body temperature falls?

.....

.....

*(1 mark)*

**5 (c) (ii)** How does this change in the blood vessels explain the change in the skin temperature shown on the graph?

.....

.....

*(1 mark)*

7

### 4.5.2.4 Control of body temperature (biology only)

Question 07

November 2010 | BLY1AP | Original Q8 | Legacy

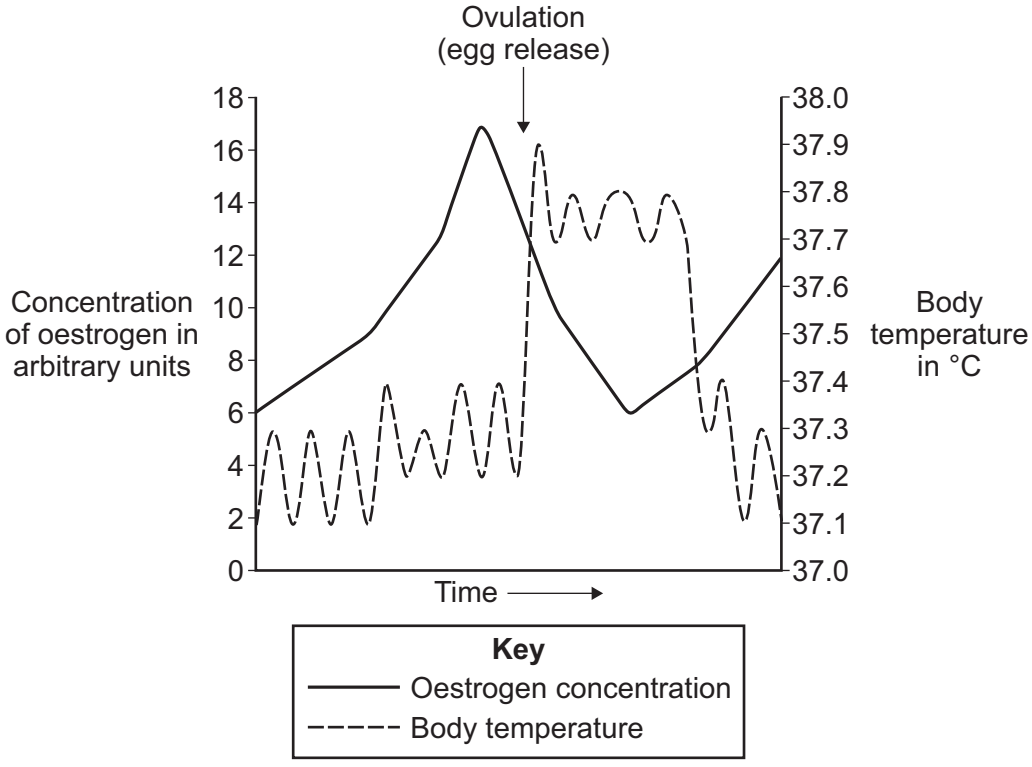
## QUESTION EIGHT

Hormones control the menstrual cycle.

**8A** Which row in the table shows where oestrogen and FSH are produced?

| | Oestrogen | FSH |
|---|---|---|
| **1** | ovaries | ovaries |
| **2** | pituitary gland | pituitary gland |
| **3** | ovaries | pituitary gland |
| **4** | pituitary gland | ovaries |

The graph shows the changes in the concentration of oestrogen in a woman's blood during part of the menstrual cycle. The graph also shows the changes in her body temperature.



4.5.2.4 Control of body temperature (biology only)

Question 07 · continued



**8B** By how much does the woman's temperature rise (in °C) when the egg is released?

**1** 0.55

**2** 0.60

**3** 0.65

**4** 0.70

**8C** What is the relationship between the woman's body temperature and the concentration of oestrogen in her blood?

**1** A rise in oestrogen concentration causes a rise in temperature.

**2** Low oestrogen concentration is linked to high temperatures.

**3** There is a link between a fall in oestrogen concentration and a rise in temperature.

**4** A high temperature causes a rise in oestrogen concentration.

**8D** The rise in oestrogen before ovulation will . . .

**1** inhibit FSH production and stimulate LH production.

**2** stimulate FSH production and inhibit LH production.

**3** inhibit FSH production and inhibit LH production.

**4** stimulate FSH production and stimulate LH production.

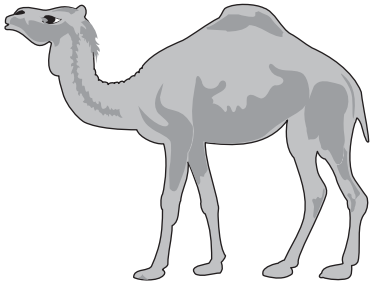
### 4.5.2.4 Control of body temperature (biology only)

**Question 08**

November 2010 | BLY1BP | Original Q1 | Legacy

**QUESTION ONE**

Camels live in deserts. Deserts are dry and hot in the day, but can be very cold at night. Camels have adaptations. These adaptations help camels to survive in desert conditions.



Match desert conditions, **A**, **B**, **C** and **D**, with the adaptations **1–4** in the table.

**A** the wind blows sand around

**B** very cold nights

**C** soft ground

**D** dry conditions

| | **Adaptation** |
|---|---|
| **1** | camels produce very little sweat |
| **2** | camels have feet with a large surface area |
| **3** | camels can shut their nostrils |
| **4** | camels have thick fur to trap air |

### 4.5.2.4 Control of body temperature (biology only)

**Question 09**



**8** The temperature in a sauna is much hotter than core body temperature.

A woman sits in a sauna.
The high temperature of the sauna causes the woman's core body temperature to rise.

**8 (a)** When the woman's core body temperature rises, the woman's rate of sweating increases.

Explain why.

.....

.....

.....

.....

*(2 marks)*

**8 (b)** The woman comes out of the sauna.
The woman's skin looks redder than when she went into the sauna.

Describe what happened to the blood circulation in her skin to cause this change in colour.

.....

.....

.....

.....

*(2 marks)*

**8 (c)** After coming out of the sauna the woman gets into a bath of icy water.
This makes the woman shiver.

**8 (c) (i)** What process brings about shivering?

.....

.....

*(1 mark)*

### 4.5.2.4 Control of body temperature (biology only)

**Question 09 · continued**



**8 (c) (ii)** Shivering increases body temperature.

Explain how.

.....

.....

.....

.....

*(2 marks)*

7

### 4.5.2.4 Control of body temperature (biology only)

**Question 10**

June 2011 | BLY1AP | Original Q6 | Legacy

**QUESTION SIX**

Sometimes, athletes train in hot countries. The athletes need to get used to hot conditions.

In an investigation:

- eight athletes did three different physical exercises before starting to train in hot conditions
- the sweat from the athletes was analysed after each exercise
- the athletes trained in hot conditions for ten days
- the athletes repeated the three different exercises that they had done before training in hot conditions
- the athletes' sweat was analysed after each exercise.

**6A** The athletes were told that it did not matter if they ate a lot of salt (containing sodium ions) during the 10 days of training in hot conditions.

The athletes could eat a lot of salt because the excess sodium ions . . .

**1** are removed by sweating.

**2** are removed by the kidneys.

**3** cannot be carried by the blood.

**4** cannot enter the blood.

**6B** The athletes were told that they must not go without sodium ions in their diet because . . .

**1** the athletes would lack the energy to carry out their exercises.

**2** the athletes' blood would become too concentrated.

**3** the athletes' body cells would not work efficiently.

**4** the athletes' blood pressure would increase.

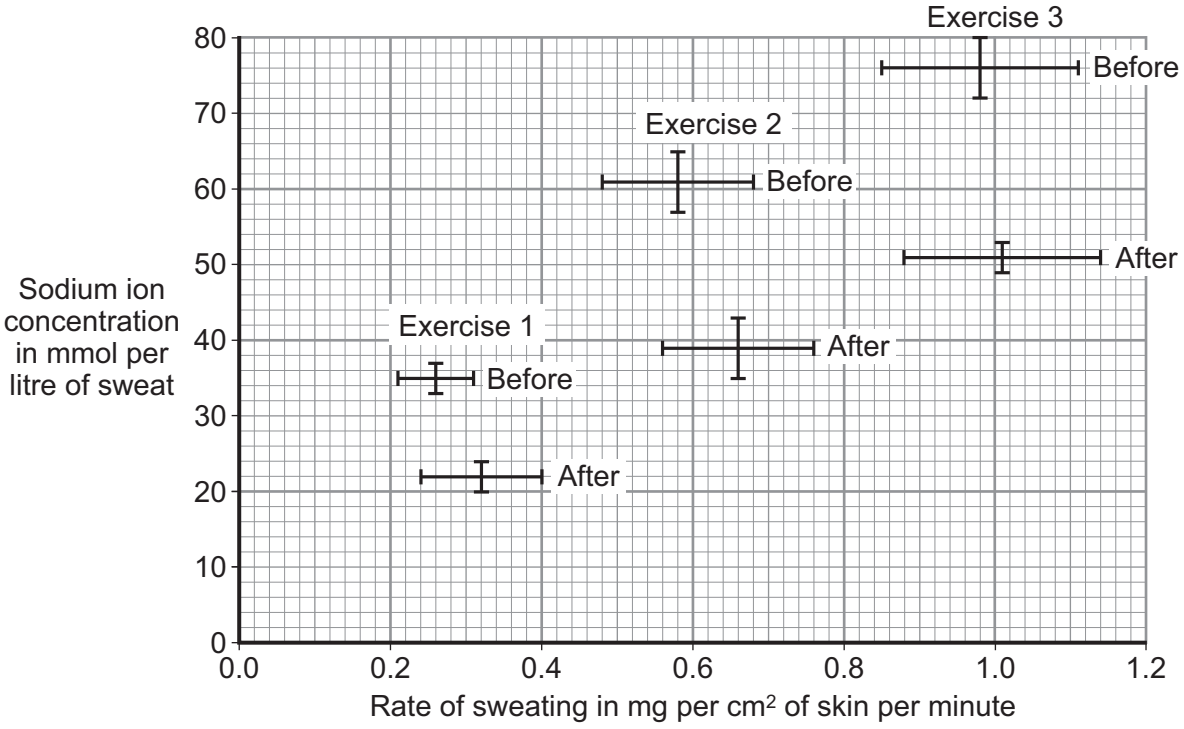
4.5.2.4 Control of body temperature (biology only)

**Question 10 · continued** June 2011 | BLY1AP | Original Q6 | Legacy

The graph below shows the results of the investigation for each of the three exercises before and after 10 days of training in hot conditions.

The bars at each plot show:

- the range of the rate of sweating (horizontal bar)
- the range of the concentration of sodium ions in the sweat (vertical bar).




**6C** The data suggests that for each of the three physical exercises after 10 days of training in hot conditions, . . .

**1** there was a large difference in the sodium ion concentration but not in the rate of sweating.

**2** there was a large difference in the rate of sweating but not in the sodium ion concentration.

**3** there was a large difference in the sodium ion concentration and a large difference in the rate of sweating.

**4** there was no difference in the sodium ion concentration and no difference in the rate of sweating.

**6D** The best conclusion from the graph is that . . .

**1** training in hot conditions increases the concentration of sodium ions in sweat.

**2** an increase in the rate of sweating reduces the concentration of sodium ions lost in sweat.

**3** the rate of sweating is decreased by training in hot conditions.

**4** training in hot conditions reduces the concentration of sodium ions lost in sweat.

### 4.5.2.4 Control of body temperature (biology only)

**Question 11**

June 2011 | BLY2H | Original Q7 | Legacy

**7** A walker falls through thin ice into very cold water.



The walker's core body temperature falls. He may die of hypothermia (when core body temperature falls too low).

**7 (a) (i)** Which part of the brain monitors the fall in core body temperature?

.....

*(1 mark)*

**7 (a) (ii)** How does this part of the brain detect the fall in core body temperature?

.....

.....

.....

.....

*(2 marks)*

**7 (b)** While in the water the walker begins to shiver.

Shivering helps to stop the core body temperature falling too quickly.

Explain how.

.....

.....

.....

.....

*(2 marks)*

4.5.2.4 Control of body temperature (biology only)

Question 11 · continued



**7 (c)** The walker had been drinking alcohol.

Alcohol causes changes to the blood vessels supplying the skin capillaries, making the skin look red.

**7 (c) (i)** Describe the change to the blood vessels.

.....

.....

*(1 mark)*

**7 (c) (ii)** The walker is much more likely to die of hypothermia than someone who has not been drinking alcohol.

Explain why.

.....

.....

.....

.....

*(2 marks)*

8

### 4.5.2.4 Control of body temperature (biology only)

**Question 12**

June 2011 | BLY3H | Original Q4 | Legacy

**4** Oxygen is transported round the body by the blood.

Blood leaving the human lung can carry about 250 milligrams of oxygen per litre. However, only 7 milligrams of oxygen will dissolve in one litre of water at body temperature.

**4 (a)** Suggest an explanation for the difference.

.....

.....

.....

.....

*(2 marks)*

**4 (b)** Blood leaving the skeletal muscles during exercise may contain only 30 milligrams of oxygen per litre.

Explain what causes the difference in oxygen concentration between the blood leaving the lungs and the blood leaving the skeletal muscles.

.....

.....

.....

.....

.....

.....

.....

.....

*(4 marks)*

6

### 4.5.2.4 Control of body temperature (biology only)

**Question 13**

June 2013 | BL3HP | Original Q6 | Legacy

**6** Humans maintain an almost constant body temperature.

**6 (a)** Describe the role of blood vessels in the control of body temperature.

.....

.....

.....

.....

.....

.....

.....

.....

.....

*(4 marks)*

**6 (b)** An athlete can run a marathon in 2 hours 15 minutes on a dry day in outside temperatures up to 35 °C.

If the air is dry, his body will **not** overheat.

In humid conditions the same athlete can run the marathon in the same time. However, in humid conditions, if the outside temperature goes over 18 °C then his body **will** overheat.

Suggest an explanation for the athlete overheating in humid conditions.

.....

.....

.....

.....

.....

.....

.....

*(3 marks)*

7

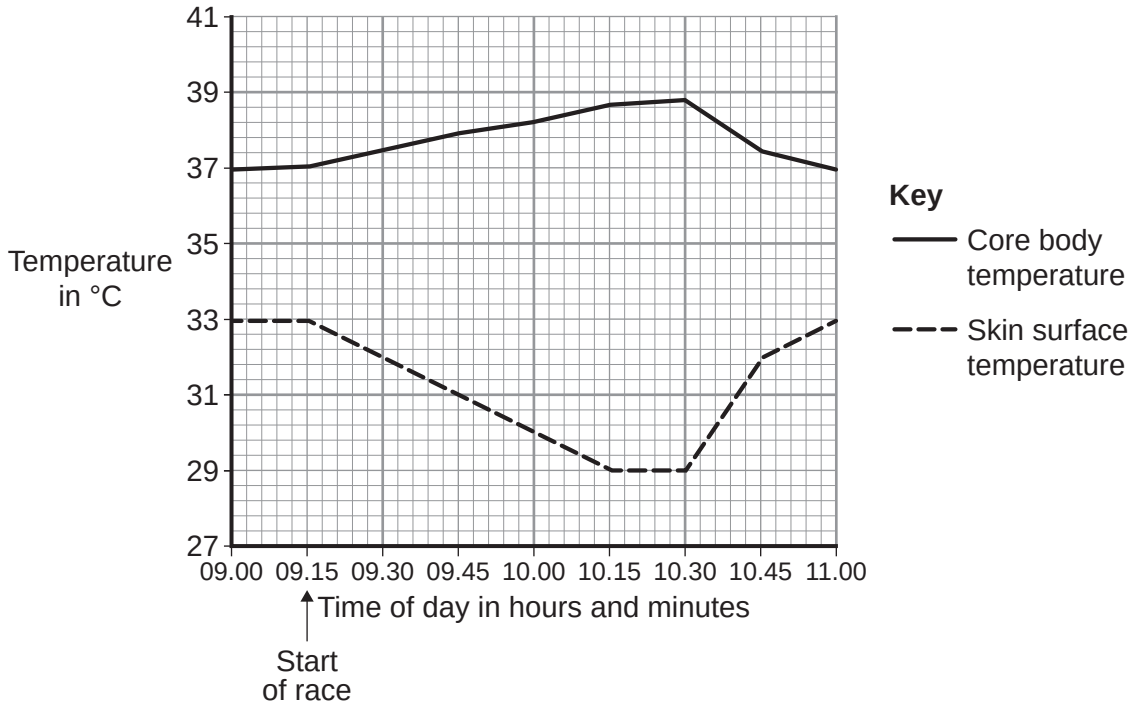
### 4.5.2.4 Control of body temperature (biology only)

**Question 14**

June 2014 | BL3HP | Original Q6 | Legacy

**6** **Figure 6** shows the core body temperature and the skin surface temperature of a cyclist before, during and after a race.

**Figure 6**




**6 (a) (i)** When the cyclist finished the race, his core body temperature started to decrease.

How long did the race last?

**[1 mark]**

.....

**6 (a) (ii)** Describe and explain the different patterns shown in the core body temperature and skin surface temperature between 09.15 and 10.15.

**[6 marks]**

.....

.....

.....

.....

.....

.....

.....

4.5.2.4 Control of body temperature (biology only)

Question 14 · continued



.....

.....

.....

.....

.....

**6 (a) (iii)** After 10.30, the core body temperature decreased.

Explain how changes in the blood vessels supplying the skin caused the skin surface temperature to increase.

**[2 marks]**

.....

.....

.....

.....

.....

.....

**6 (b)** During the race, the cyclist's blood glucose concentration began to decrease.

Describe how the body responds when the blood glucose concentration begins to decrease.

**[3 marks]**

.....

.....

.....

.....

.....

.....

.....

.....

12

## 4.5.2.4 Control of body temperature (biology only)

**Question 15**

June 2015 | BL1HP | Original Q7 | Legacy

**7** This question is about the nervous system.

**7 (a)** Describe the function of receptors in the skin.

**[2 marks]**

.....

.....

.....

.....

**7 (b)** A response is caused when information in the nervous system reaches an effector.

**7 (b) (i)** There are two different types of effector.

Complete **Table 4** to show:

- the two different types of effector
- the response each type of effector makes.

**[4 marks]**

**Table 4**

| Type of effector | Response the effector makes |
|---|---|
| 1 ..... | ..... ..... |
| 2 ..... | ..... ..... |

**7 (b) (ii)** Some effectors help to control body temperature.

Give **one** reason why it is important to control body temperature.

**[1 mark]**

.....

.....

7

### 4.5.2.4 Control of body temperature (biology only)

**Question 16**

June 2015 | BL3HP | Original Q5 | Legacy

**5** Many runners drink sports drinks to improve their performance in races.

A group of students investigated the effects of three brands of sports drink, **A**, **B** and **C**, on the performance of three runners on a running machine. One of the runners is shown in **Figure 4**.

**Figure 4**



**Table 2** gives information for each drink.

**Table 2**

| | Brand of sports drink | | |
|---|---|---|---|
| **Nutrient per $dm^3$** | **A** | **B** | **C** |
| Glucose in g | 63 | 31 | 72 |
| Fat in g | 9 | 0 | 2 |
| Ions in mg | 312 | 332 | 495 |

## 4.5.2.4 Control of body temperature (biology only)

**Question 16 · continued**



**5 (a) (i)** In the investigation, performance was measured as the time taken to reach the point of exhaustion.

Exhaustion is when the runners could not run anymore.

All three runners:
- ran on a running machine until the point of exhaustion
- each drank 500 $cm^3$ of a different brand of sports drink
- rested for 4 hours to recover
- ran on the running machine again and recorded how much time they ran until the point of exhaustion.

The speed at which the runners ran was the same and all other variables were controlled.

The students predicted that the runner drinking brand **B** would run for the shortest time on the second run before reaching the point of exhaustion.

Use information from **Table 2** to suggest an explanation for the students' prediction.

**[2 marks]**

.....

.....

.....

.....

**5 (a) (ii)** If the balance between ions and water in a runner's body is not correct, the runner's body cells will be affected.

Describe **one** possible effect on the cells if the balance between ions and water is **not** correct.

**[1 mark]**

.....

.....

**5 (b)** When running, a runner's body temperature increases.

Describe how the brain monitors body temperature.

**[3 marks]**

.....

.....

.....

.....

.....

.....

4.5.2.4 Control of body temperature (biology only)

Question 16 · continued



**5 (c) (i)** **Table 2** is repeated here to help you answer this question.

**Table 2**

| | Brand of sports drink | | |
|---|---|---|---|
| **Nutrient per $dm^3$** | **A** | **B** | **C** |
| Glucose in g | 63 | 31 | 72 |
| Fat in g | 9 | 0 | 2 |
| Ions in mg | 312 | 332 | 495 |

People with diabetes need to be careful about drinking too much sports drink.

Use information from **Table 2** to explain why drinking too much sports drink could make people with diabetes ill.

**[3 marks]**

.....

.....

.....

.....

.....

.....

**5 (c) (ii)** Other than paying attention to diet, how do people with diabetes control their diabetes?

**[1 mark]**

.....

.....

10

### 4.5.2.4 Control of body temperature (biology only)

**Question 17**

June 2016 | BL3HP | Original Q7 | Legacy

**7** Humans keep their internal conditions almost constant.

Body temperature is kept within a narrow range.

When the core body temperature is too low, this is detected by the thermoregulatory centre in the brain.

Describe how the body responds when a decrease in core body temperature is detected.

**[6 marks]**

6

### 4.5.2.4 Control of body temperature (biology only)

**Question 18**

June 2017 | BL3HP | Original Q7 | Legacy

**7** A climber falls down a mountain slope into a small pool of cold water.
He is injured and cannot move.
He starts to get cold.

**7 (a)** How does the body detect a decrease in blood temperature?

**[1 mark]**

**7 (b)** The man starts shivering.

Explain how shivering helps to raise his body temperature.

**[3 marks]**

**7 (c)** Apart from shivering, explain how the man's body responds to raise his core body temperature.

**[3 marks]**

7

### 4.5.2.4 Control of body temperature (biology only)

**Question 19**

November 2021 | 8461/2H | Original Q3

**0 3** Human body temperature is controlled within very narrow limits.

Scientists investigated the effect of drinking ice-cold water on:

- internal body temperature
- the rate of sweating.

This is the method used.

1. Sit a person inside a room kept at a constant temperature of 25 °C.
2. Measure the person's internal body temperature near the brain.
3. Measure the person's rate of sweating.
4. After 20 minutes, give the person 500 $cm^3$ of ice-cold water to drink.
5. Continue to measure the person's internal body temperature and sweating rate for a further 50 minutes.

**0 3 . 1** Give the reason why the person should **not** move during the investigation.

**[1 mark]**

**Question 3 continues on the next page**

4.5.2.4 Control of body temperature (biology only)

Question 19 · continued



**Figure 5** and **Figure 6** show the scientists' results.

**Figure 5**

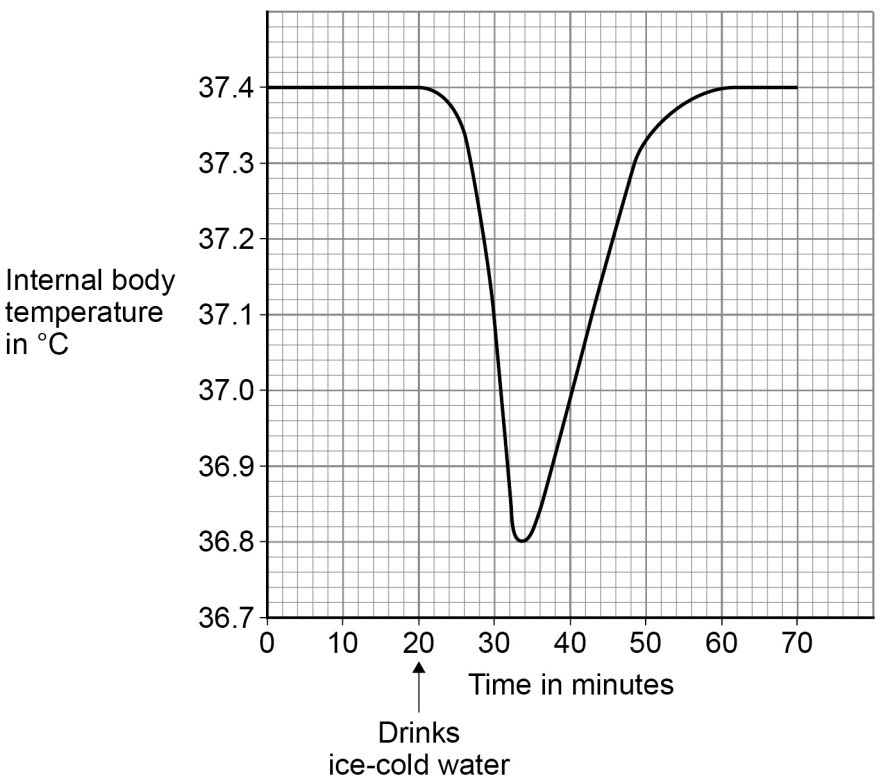
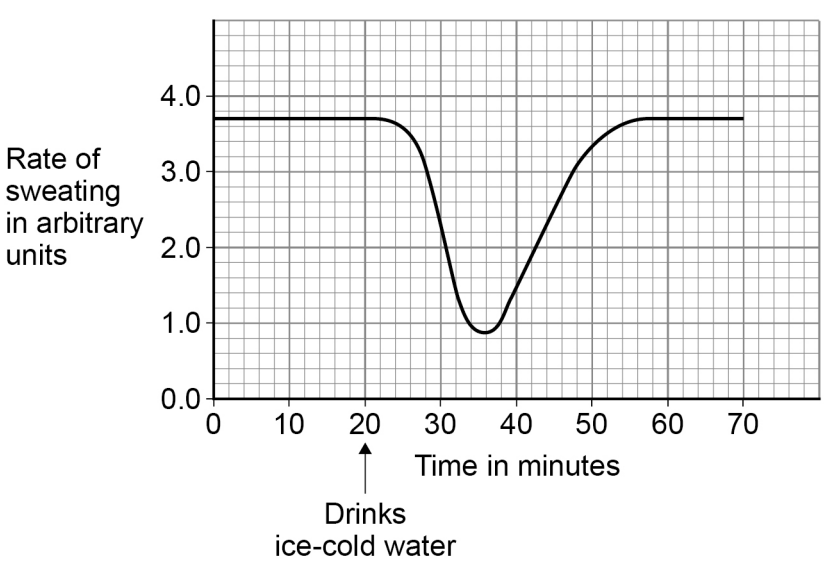



**Figure 6**



4.5.2.4 Control of body temperature (biology only)

Question 19 · continued



**0 3 . 2** What is this person's normal internal body temperature?

**[1 mark]**

Tick (✓) **one** box.

36.8 °C ☐ 37.0 °C ☐ 37.4 °C ☐

The results show that when the ice-cold water was drunk, the temperature near the brain decreased.

**0 3 . 3** Explain why the temperature near the brain decreased.

**[2 marks]**

**0 3 . 4** The thermoregulatory centre in the brain responds to the decrease in temperature.

How does the thermoregulatory centre send information to sweat glands in the skin?

**[1 mark]**

**0 3 . 5** The rate of sweating changes between 24 minutes and 36 minutes.

Explain how this change helps to maintain the person's normal body temperature.

**[2 marks]**

**Question 3 continues on the next page**

4.5.2.4 Control of body temperature (biology only)

Question 19 · continued



**0 3 . 6** During exercise, the skin appears red.

What causes the skin to appear red?

**[1 mark]**

Tick (✓) **one** box.

- Blood vessels moving closer to the skin surface ☐
- Constriction of blood vessels in the skin ☐
- Decrease in heart rate ☐
- Dilation of blood vessels in the skin ☐

8

**Turn over for the next question**

4.5.2.4 Control of body temperature (biology only)

Question 20

June 2022 | 8461/1H | Original Q6

**0 6** **Table 6** shows information about five different organisms.

**Table 6**

| Organism | Surface area in $m^2$ | Volume in $m^3$ | Surface area to volume ratio |
|---|---|---|---|
| **A** | $6.04 \times 10^{-8}$ | $1.65 \times 10^{-12}$ | 36606:1 |
| **B** | $3.21 \times 10^{-3}$ | $1.25 \times 10^{-6}$ | 2568:1 |
| **C** | $9.96 \times 10^{-3}$ | $1.35 \times 10^{-4}$ | **X**:1 |
| **D** | $4.61 \times 10^{-1}$ | $1.57 \times 10^{-2}$ | 29:1 |
| **E** | $1.99 \times 10^{1}$ | $6.12 \times 10^{0}$ | 3:1 |

**0 6 . 1** Calculate value **X** in **Table 6**.

Give your answer to the nearest whole number.

**[3 marks]**

**X** (nearest whole number) = _____

**0 6 . 2** What is the relationship between the size of an organism and its surface area to volume ratio?

Use **Table 6**.

**[1 mark]**

4.5.2.4 Control of body temperature (biology only)

Question 20 · continued



**0 6 . 3** Organism **B** exchanges gases with the environment directly through its skin.

Organism **D** exchanges gases with the environment using its respiratory system.

Explain why organism **D** requires a respiratory system, but organism **B** does **not** require a respiratory system.

**[2 marks]**

**Question 6 continues on the next page**

4.5.2.4 Control of body temperature (biology only)

Question 20 · continued



**Table 6** is repeated below.

**Table 6**

| Organism | Surface area in $m^2$ | Volume in $m^3$ | Surface area to volume ratio |
|---|---|---|---|
| **A** | $6.04 \times 10^{-8}$ | $1.65 \times 10^{-12}$ | 36606:1 |
| **B** | $3.21 \times 10^{-3}$ | $1.25 \times 10^{-6}$ | 2568:1 |
| **C** | $9.96 \times 10^{-3}$ | $1.35 \times 10^{-4}$ | **X**:1 |
| **D** | $4.61 \times 10^{-1}$ | $1.57 \times 10^{-2}$ | 29:1 |
| **E** | $1.99 \times 10^{1}$ | $6.12 \times 10^{0}$ | 3:1 |

**Table 7** shows information about organism **D** and organism **E**.

**Table 7**

| Organism | Metabolic rate in arbitrary units |
|---|---|
| **D** | 890 |
| **E** | 75 |

4.5.2.4 Control of body temperature (biology only)

Question 20 · continued



**0 6 . 4** Organisms **D** and **E** both keep a constant body temperature (warm-blooded).

Explain why the metabolic rate of organism **D** is greater than the metabolic rate of organism **E**.

Use information from **Table 6** and **Table 7**.

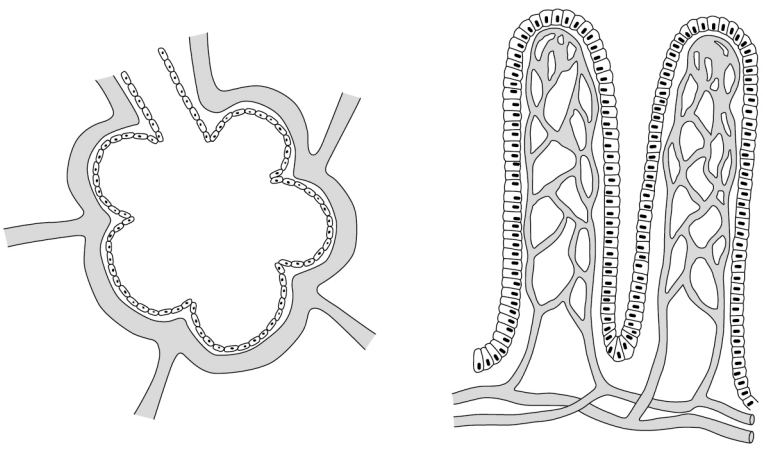
**[4 marks]**

**Question 6 continues on the next page**

**0 6 . 5** Organism **D** and organism **E** both have alveoli in the lungs and villi in the small intestine.

**Figure 8** shows some alveoli and some villi.

**Figure 8**



**Alveoli** **Villi**

Describe how the alveoli and the villi are adapted to increase absorption.

**[4 marks]**

14

4.5.2.4 Control of body temperature (biology only)

Question 21

June 2022 | 8461/2H | Original Q8

**0 8** An echidna is a mammal that lives in Australia.

**Figure 10** shows an echidna.

**Figure 10**



**Figure 11** shows how the body temperature of the echidna varies in warm weather and in cold weather.

**Figure 11**

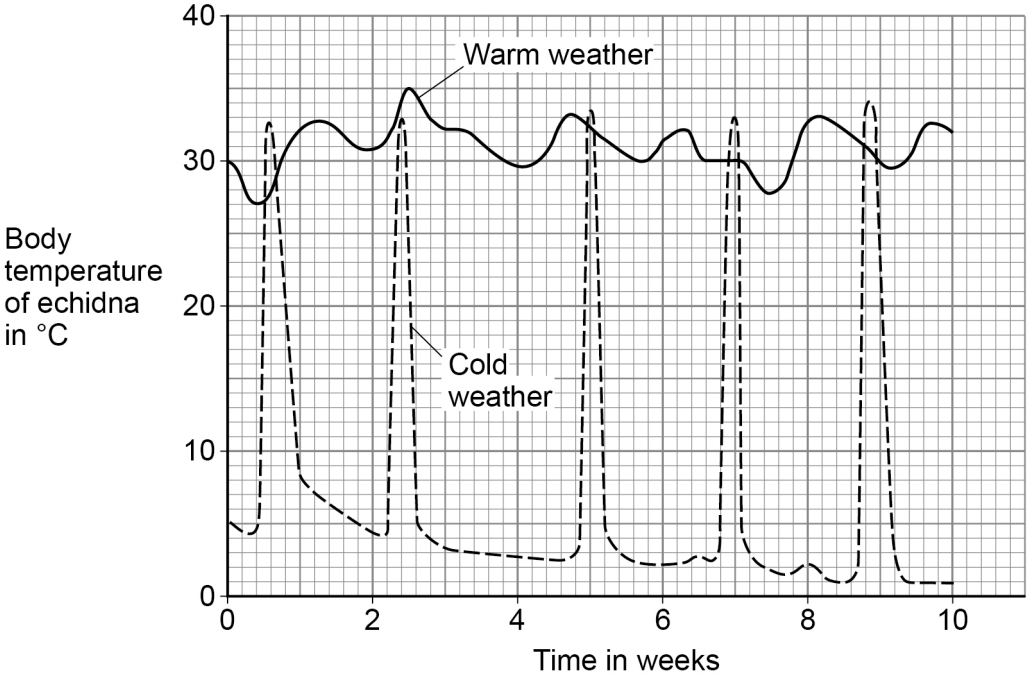
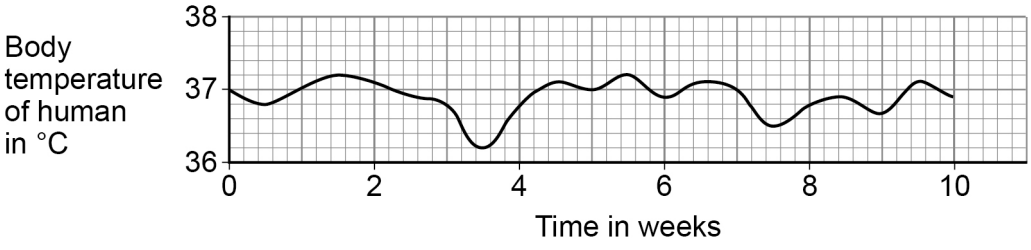



**Figure 12** shows how human body temperature varies.

**Figure 12**



4.5.2.4 Control of body temperature (biology only)

Question 21 · continued

June 2022 | 8461/2H | Original Q8

**0 8 . 1** Compare the variation in body temperature of the echidna in warm weather with the variation in body temperature of the human.

Use data from **Figure 11** and **Figure 12**.

**[2 marks]**

In the cold winter months, the echidna hibernates.

During hibernation:

- the echidna's body temperature decreases to below 5 °C
- the echidna sleeps for up to 17 days at a time
- the echidna's rate of metabolism slows down.

**0 8 . 2** Explain why the decrease in body temperature is an advantage to the echidna during hibernation.

**[2 marks]**

**Question 8 continues on the next page**

4.5.2.4 Control of body temperature (biology only)

Question 21 · continued



**0 8 . 3** During hibernation the echidna wakes up several times.

Each time the echidna wakes up it becomes active and its body temperature increases to over 30 °C.

Explain why the echidna has a higher body temperature when it is active.

**[2 marks]**

**0 8 . 4** An echidna can dilate and constrict blood vessels in its skin.

Explain how the **dilation** of blood vessels in the skin can help to decrease body temperature.

**[3 marks]**

4.5.2.4 Control of body temperature (biology only)

Question 21 · continued



An athlete trained in a hot climate.

The athlete lost a large volume of water each day in sweat.

**0 8 . 5** The athlete's energy intake each day from food was 20 000 kJ.

Evaporation of 1 $cm^3$ of sweat requires 2.5 kJ of energy.

40% of the athlete's daily energy intake was used to evaporate sweat.

Calculate the volume of sweat the athlete lost each day.

Give your answer in $dm^3$

1 $dm^3$ = 1 000 $cm^3$

**[3 marks]**

Volume of sweat lost in one day = _____ $dm^3$

**0 8 . 6** Suggest why the athlete was advised to take salt tablets each day.

**[1 mark]**

13

4.5.2.4 Control of body temperature (biology only)

Question 22

June 2023 | 8461/2H | Original Q5

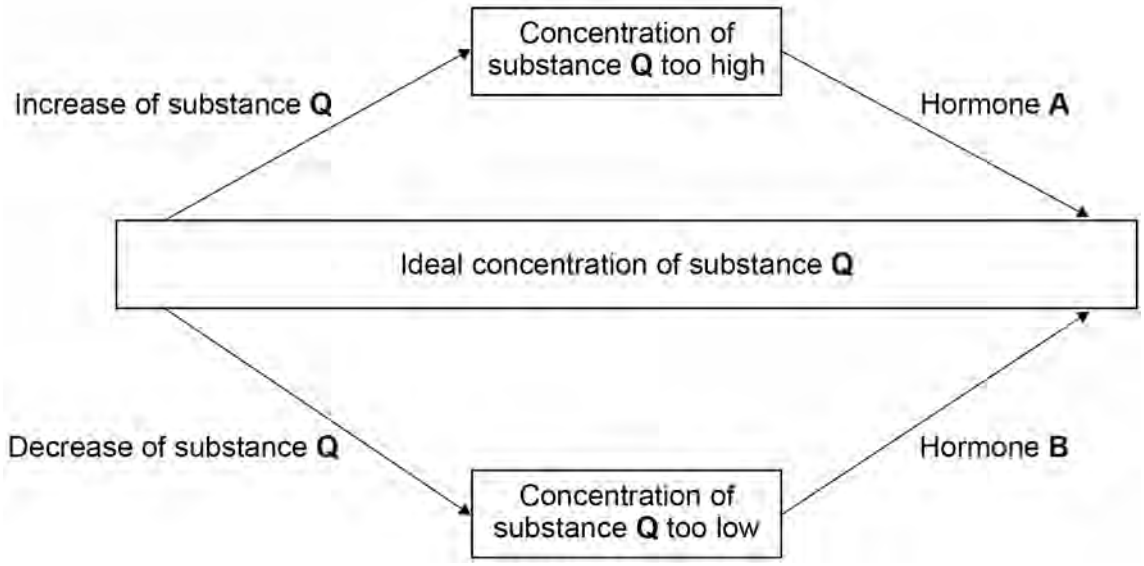
**0 5** Homeostasis is the regulation of the body's internal conditions.

Many internal conditions are controlled by hormones.

Homeostasis works by negative feedback control.

**0 5 . 1** **Figure 8** shows how the concentration of substance **Q** in the blood is controlled by negative feedback.

**Figure 8**




Explain how the concentration of substance **Q** in the blood is controlled by negative feedback.

Use information from **Figure 8**.

**[3 marks]**

4.5.2.4 Control of body temperature (biology only)

Question 22 · continued



**0 5 . 2** Thyroxine is a hormone produced by the thyroid gland.

A decrease in body temperature causes an increase in thyroxine production.

Explain how the production of thyroxine causes an **increase** in body temperature.

**[2 marks]**

**Question 5 continues on the next page**

4.5.2.4 Control of body temperature (biology only)

Question 22 · continued



**0 5 . 3** ADH is a hormone made by the pituitary gland.

ADH controls how much water is reabsorbed from the kidney tubules.

**Table 2** shows effects of ADH.

**Table 2**

| Concentration of ADH in the blood in nanograms/dm$^3$ | Concentration of dissolved substances in urine in arbitrary units | Rate of urine production in cm$^3$/minute |
|---|---|---|
| 0.0 | 50 | 20.0 |
| 1.25 | 700 | 8.8 |
| 2.50 | 980 | 3.9 |
| 3.75 | 1110 | 1.8 |
| 5.00 | 1170 | 0.9 |

The concentration of ADH in a man's blood was 3.75 nanograms/dm$^3$.

The concentration of ADH in his blood decreased to 1.25 nanograms/dm$^3$.

Explain how the decrease in the concentration of ADH would cause the changes to the urine shown in **Table 2**.

**[4 marks]**

9

4.5.2.4 Control of body temperature (biology only)

Question 23



**0 8** Some people keep rabbits as pets.

**Figure 8** shows two types of rabbit.

**Figure 8**



**Himalayan rabbit**
has black patches



**White rabbit**
has no black patches

The Himalayan fur pattern is controlled by a dominant allele.

A heterozygous male Himalayan rabbit was crossed many times with each of two female Himalayan rabbits, **A** and **B**.

The results of the two types of cross were different.

- Crosses with female **A**: **all** of the 210 offspring were Himalayan rabbits.
- Crosses with female **B**: **some** of the 240 offspring were Himalayan rabbits and **some** were white rabbits.

In Questions **08.1** and **08.2**, use the following symbols to represent alleles:

**H** = dominant allele for Himalayan fur

**h** = recessive allele for white fur.

**0 8 . 1** What is the genotype of female Himalayan rabbit **A**?

Give the reason for your answer.

**[2 marks]**

Genotype _____

Reason _____

_____

4.5.2.4 Control of body temperature (biology only)

Question 23 · continued



**0 8 . 2** Determine the probability that one of the offspring from a cross with female Himalayan rabbit **B** will be white.

You should:

- draw a Punnett square diagram
- use the symbols **H** and **h**
- identify the phenotype of each offspring genotype.

**[4 marks]**

Probability of offspring being white = _____

**Question 8 continues on the next page**

4.5.2.4 Control of body temperature (biology only)

Question 23 · continued



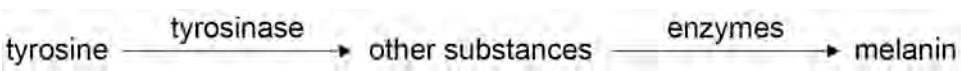
Adult Himalayan rabbits have:

- white fur over most of the body
- black fur on the nose, ears and feet.

The black colour is caused by production of a substance called melanin.

**Figure 9** shows how melanin is made from another substance called tyrosine.

**Figure 9**




**0 8 . 3** White rabbits have one base change in the gene that codes for the enzyme tyrosinase.

Explain how a change of one base in the DNA of the gene coding for tyrosinase could stop the tyrosinase working.

**[4 marks]**

4.5.2.4 Control of body temperature (biology only)

Question 23 · continued



For the first four weeks of life, Himalayan rabbits produce white fur over the whole body.

The black areas of fur start to develop after four weeks.

In the first four weeks, young rabbits stay in the nest with their mother.

A rabbit's body temperature is 39 °C.

The tyrosinase in Himalayan rabbits is:

- most active between 15 °C and 25 °C
- **not** active above 35 °C.

**0 8 . 4** The fur on the nose, ears and feet of Himalayan rabbits is white for the first four weeks of life.

Explain what causes the fur to be white in the first four weeks of life.

**[2 marks]**

**0 8 . 5** From the age of four weeks, young rabbits move from the nest to the outside environment.

Explain why a Himalayan rabbit develops black nose, ears and feet from the age of four weeks.

**[3 marks]**

4.5.2.4 Control of body temperature (biology only)

Question 23 · continued



**0 8 . 6** Melanin is also produced in human skin.

Melanin absorbs ultraviolet (UV) radiation from sunlight and prevents the radiation reaching deep into the skin.

UV radiation is a type of ionising radiation.

Explain the advantage of producing melanin in human skin when exposed to bright sunlight.

**[2 marks]**

17