AQA GCSE Biology | 8461

SPECIFICATION POINT 4.4.2.3

Metabolism

Past-paper questions

Tier	**Higher**
Question groups	**8**
Available paper years	**2010–2022**

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.

4.4.2.3 Metabolism

Question 01

January 2010 | BLY2H | Original Q3 | Legacy

3 (a) (i) Which organ in the body monitors the concentration of glucose (sugar) in the blood?

.....

(1 mark)

3 (a) (ii) In a healthy person, insulin prevents high levels of glucose in the blood.

How does it do this?

.....

.....

(1 mark)

3 (b) There are two forms of diabetes.

In type 1 diabetes, the body produces little or no insulin.
In type 2 diabetes, the body cells do not respond to insulin.

There are two ways in which diabetes can be treated.

Draw lines to join the type of diabetes to the way or ways in which it can be treated.

Type of diabetes	**Treatment**
	Careful attention to diet only
Type 1	
	Careful attention to diet **and** injection of insulin
Type 2	
	Injection of insulin only

(2 marks)

4.4.2.3 Metabolism

Question 01 · continued

for mark

3 (c) To make insulin, cells in the pancreas need amino acids.
A *small section of DNA* in the pancreas cells is involved in making insulin from the amino acids.

3 (c) (i) Insulin is a hormone.

What type of substance is insulin?

Draw a ring around **one** answer.

carbohydrate **lipid** **protein**

(1 mark)

3 (c) (ii) What term is used to describe the *small section of DNA* which controls the production of insulin?

.....

(1 mark)

3 (c) (iii) Amino acids cannot be stored in the body.

Describe, as fully as you can, what happens to the excess amino acids.

You may wish to use the following words in your explanation:

liver **kidneys** **bladder**

.....

.....

.....

.....

.....

.....

.....

.....

(3 marks)

9

4.4.2.3 Metabolism

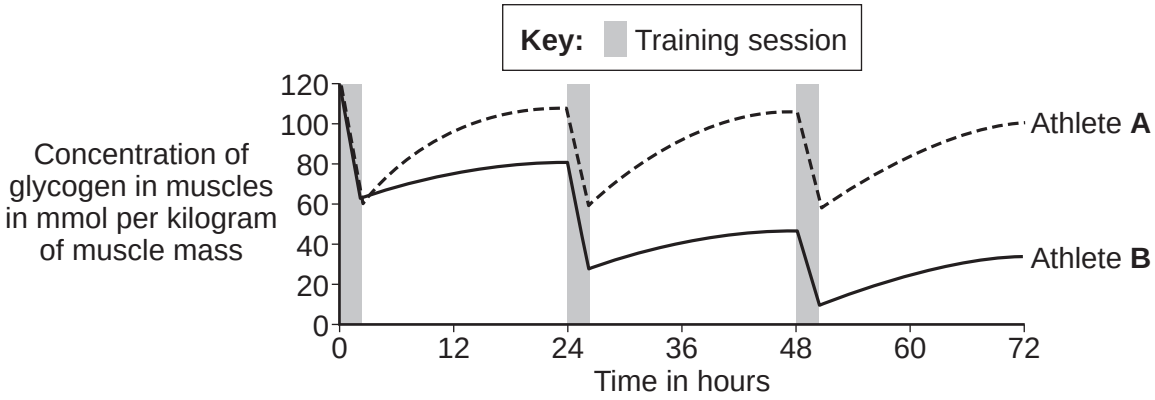
Question 02

1 Glycogen is stored in the muscles.

Scientists investigated changes in the amount of glycogen stored in the muscles of two 20 year-old male athletes, **A** and **B**.
Athlete **A** ate a high-carbohydrate diet. Athlete **B** ate a low-carbohydrate diet.

Each athlete did one 2-hour training session each day.

The graph shows the results for the first 3 days.



1 (a) (i) Give **three** variables that the scientists controlled in this investigation.

.....

.....

.....

.....

.....

.....

(3 marks)

4.4.2.3 Metabolism

Question 02 · continued

1 (a) (ii) Suggest **two** variables that would be difficult to control in this investigation.

.....

.....

.....

.....

(2 marks)

1 (a) (iii) Describe **one** way in which the results of Athlete **B** were different from the results of Athlete **A**.

.....

.....

(1 mark)

1 (b) Both athletes were training to run a marathon.

Which athlete, **A** or **B**, would be more likely to complete the marathon?

Use information from the graph to explain your answer.

.....

.....

.....

.....

.....

.....

.....

.....

(4 marks)

10

4.4.2.3 Metabolism

Question 03

June 2015 | BL2HP | Original Q1 | Legacy

1 Lipase is an enzyme that digests fat.

1 (a) (i) Complete the equation to show the digestion of fat.

Use the correct answer from the box.

[1 mark]

glucose	**glycerol**	**glycogen**

fat $\xrightarrow{\text{lipase}}$ fatty acids + ...

1 (a) (ii) Name **one** organ that makes lipase.

[1 mark]

.....

1 (b) Some students investigated the effect of bile on the digestion of fat by lipase.

The students:
1 mixed milk and bile in a beaker
2 put the pH sensor of a pH meter into the beaker
3 added lipase solution
4 recorded the pH at 2-minute intervals
5 repeated steps 1 to 4, but used water instead of bile.

Suggest **two** variables that the students should have controlled in this investigation.

[2 marks]

1 .....

.....

2 .....

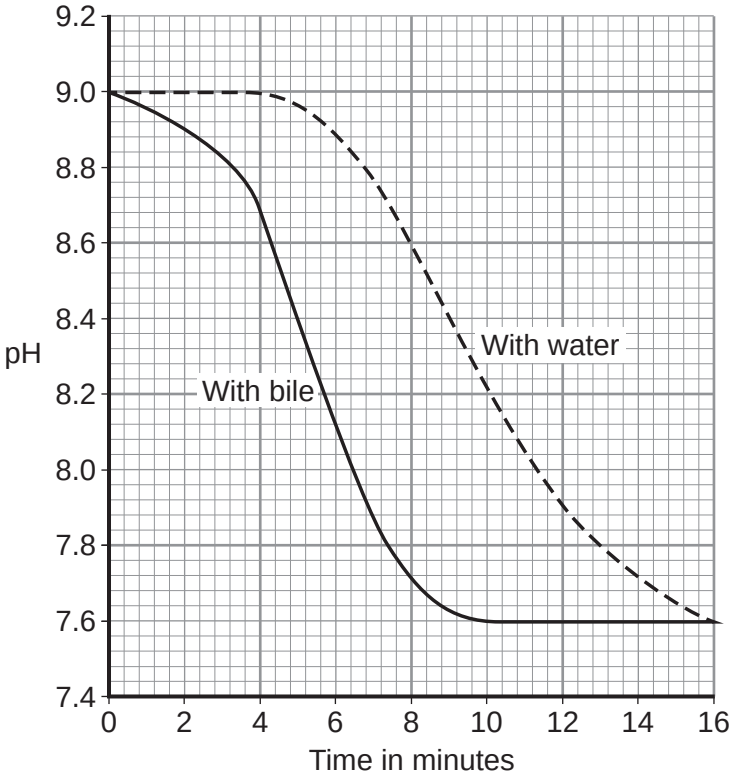
.....

4.4.2.3 Metabolism

Question 03 · continued

1 (c) **Figure 1** shows the students' results.

Figure 1



1 (c) (i) Why did the pH decrease in both investigations?

[1 mark]

.....

.....

1 (c) (ii) Bile helps lipase to digest fat.

What evidence is there in **Figure 1** to support this conclusion?

[1 mark]

.....

.....

1 (c) (iii) Suggest **one** reason why the contents of both beakers had the same pH at the end of the investigations.

[1 mark]

.....

.....

7

4.4.2.3 Metabolism

Question 04

June 2017 | BL3HP | Original Q9 | Legacy

9 (a) In a healthy person, blood sugar levels are kept within a narrow range.

Describe what happens in a healthy person when the pancreas detects a rise in blood sugar level.

[2 marks]

9 (b) Glycogen storage disorder is an inherited condition affecting a small number of people.

In some people with the disorder, glycogen does not form properly.

After exercise, a person with this type of glycogen storage disorder can feel very tired and can become unconscious.

Explain why the person has these symptoms after exercise.

[4 marks]

6

4.4.2.3 Metabolism

Question 05

0 2 Metabolism is the sum of all the chemical reactions in the cells of the body.

One metabolic reaction is the formation of lipids.

0 2 . 1 Give **one** other metabolic reaction in cells.

[1 mark]

Table 2 shows the mean metabolic rate of humans of different ages.

Table 2

Age in years	Mean metabolic rate in kJ/m^2/hour	
	Males	Females
5	53	53
15	45	42
25	39	35
35	37	35
45	36	35

0 2 . 2 What **two** conclusions can be made from the data in **Table 2**?

[2 marks]

Tick **two** boxes.

- As age increases, mean metabolic rate of males and females increases. ☐
- Males have a higher metabolic rate than females after five years of age. ☐
- The mean metabolic rate of females decreases faster than males up to 25 years of age. ☐
- The mean metabolic rate of males and females decreases more quickly after the age of 35. ☐
- There is no relationship between age and mean metabolic rate. ☐

4.4.2.3 Metabolism

Question 05 · continued

0 2 . 3 Calculate the percentage decrease in the mean metabolic rate of males between 5 years and 45 years of age.

Use the equation:

$$\text{percentage decrease} = \frac{\text{decrease in metabolic rate}}{\text{original metabolic rate}} \times 100$$

Give your answer to 3 significant figures.

[3 marks]

Percentage decrease = _____

Question 2 continues on the next page

4.4.2.3 Metabolism

Question 05 · continued

Regular exercise can increase metabolic rate.

Two people did five minutes of gentle exercise from rest.

Table 3 shows the effect of the exercise on their heart rates.

Table 3

Time in minutes	Heart rate in beats per minute	
	Person R	Person S
0 (at rest)	60	78
1	76	100
2	85	110
3	91	119
4	99	129
5	99	132

0 2 . 4 Describe **two** differences in the response of person **R** and person **S** to the exercise.

Use information from **Table 3**.

[2 marks]

1 _____

_____

2 _____

_____

0 2 . 5 Complete the line graph in **Figure 3** for person **S**.

You should:

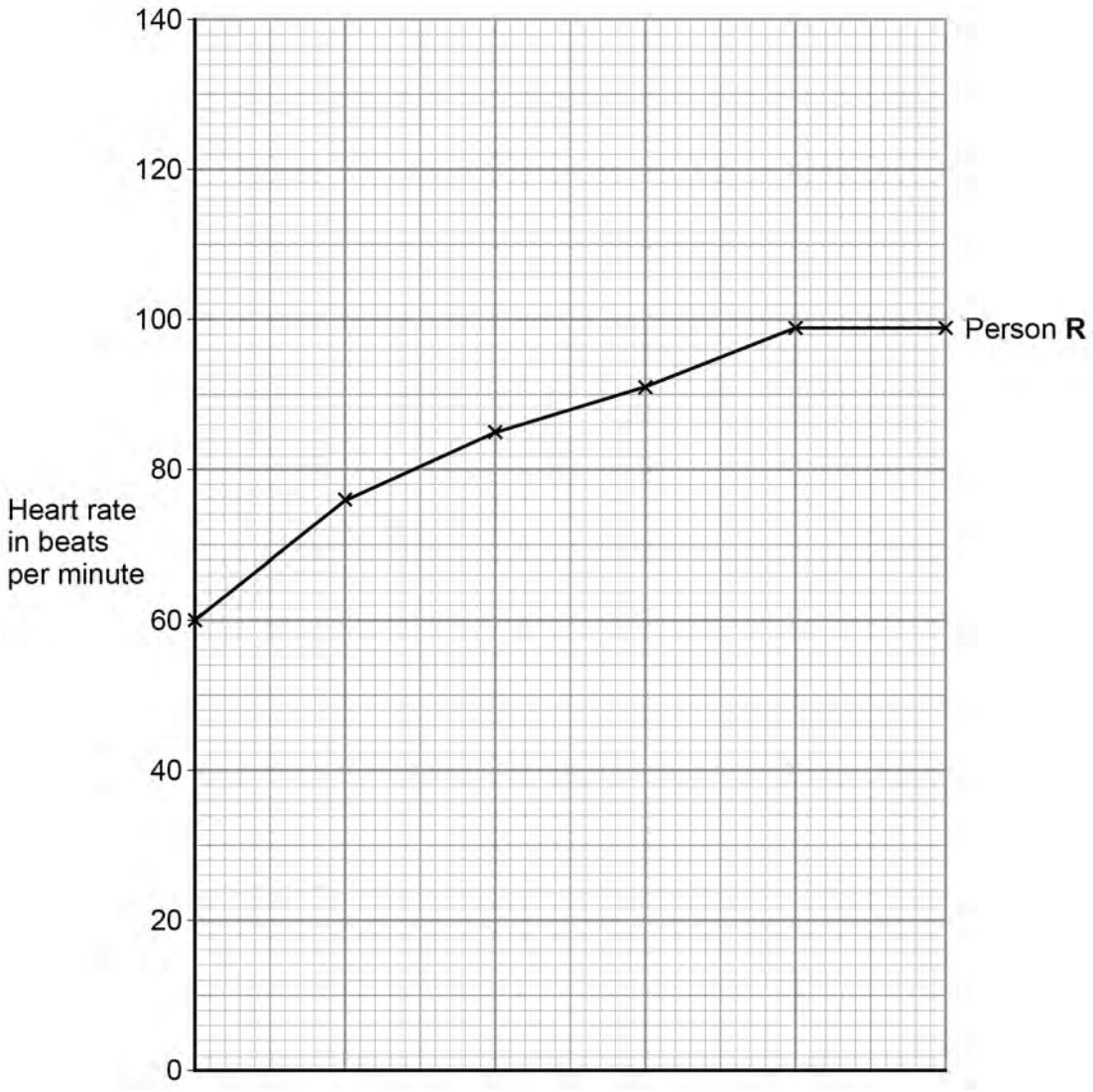
- add the scale to the x axis
- label the x axis.

[4 marks]

4.4.2.3 Metabolism

Question 05 · continued

Figure 3



0 2 . 6 After five minutes of exercise, the heart rate of person **S** was 132 beats per minute. When person **S** rested, his heart rate decreased steadily at a rate of 12 beats every minute.

Calculate how much time it would take the heart rate of person **S** to return to its resting rate.

[2 marks]

Time = _____ minutes

4.4.2.3 Metabolism

Question 05 · continued

0 2 . 7 A student made the following hypothesis about the heart rate of smokers and non-smokers during exercise.

"During exercise, the heart rate of smokers increases more than the heart rate of non-smokers."

Design an investigation that would allow you to test this hypothesis.

[6 marks]

20

4.4.2.3 Metabolism

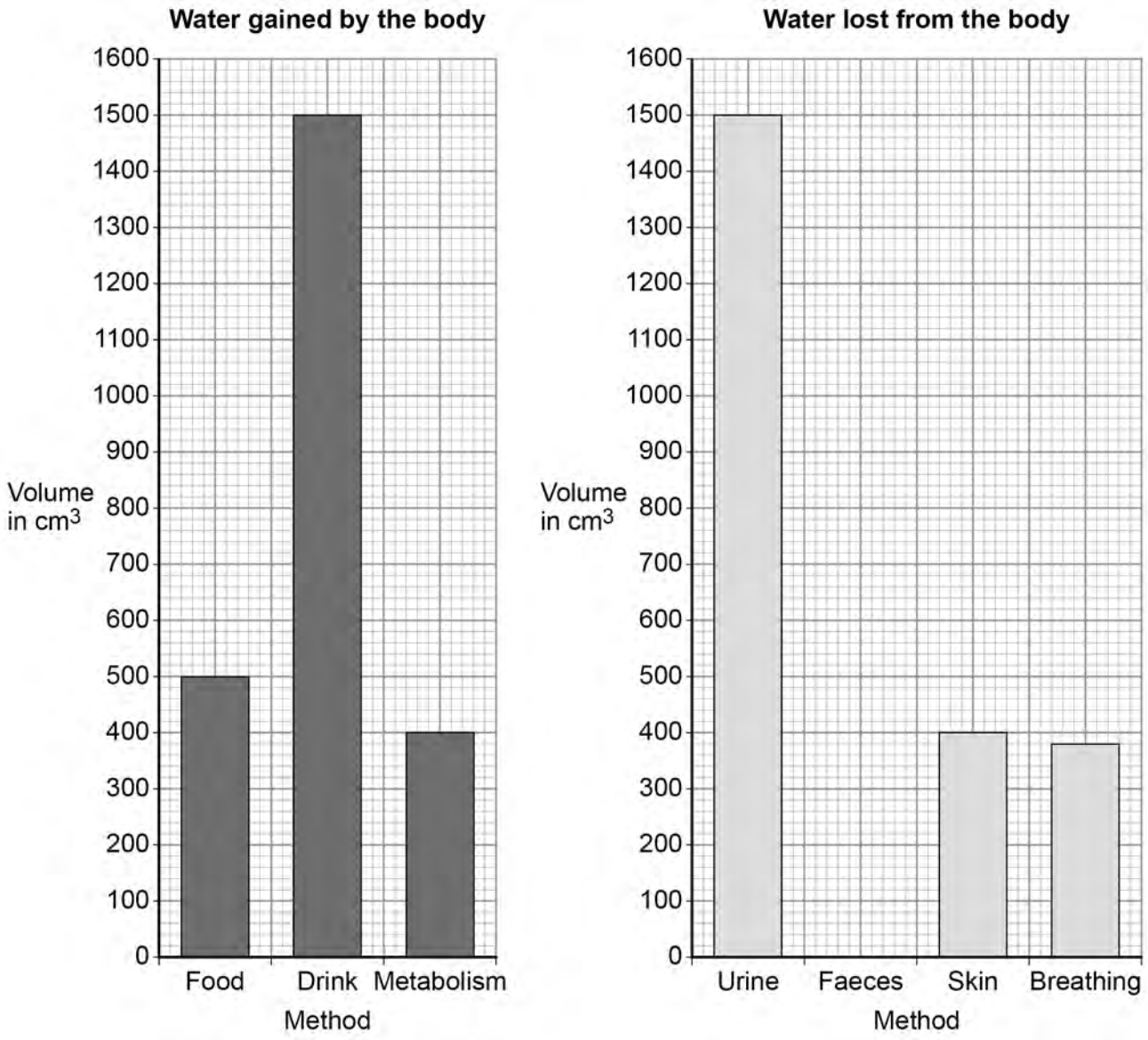
Question 06

June 2018 | 8461/2H | Original Q3

0 3 It is important to maintain water balance in the body.

Figure 4 shows how much water a person gained and lost by different methods in one day.

Figure 4



4.4.2.3 Metabolism

Question 06 · continued

When water is balanced, the volume of water taken in by the body is equal to the volume of water lost from the body.

0 3 . 1 Calculate the volume of water the person lost in one day in faeces.

Use information from **Figure 4**.

[2 marks]

Volume lost in faeces = _____ cm^3

0 3 . 2 **Figure 4** shows that one method of gaining water is by metabolism.

Which metabolic process produces water?

[1 mark]

Tick **one** box.

- Breakdown of protein to amino acids ☐
- Changing glycogen into glucose ☐
- Digestion of fat ☐
- Respiration of glucose ☐

Question 3 continues on the next page

4.4.2.3 Metabolism

Question 06 · continued

The next day, the person ran a 10-kilometre race.

The volume of water lost from the body through the skin and by breathing increased.

0 3 . 3 Explain why more water was lost through the skin during the race.

[2 marks]

0 3 . 4 Explain why more water was lost by breathing during the race.

[3 marks]

8

4.4.2.3 Metabolism

Question 07

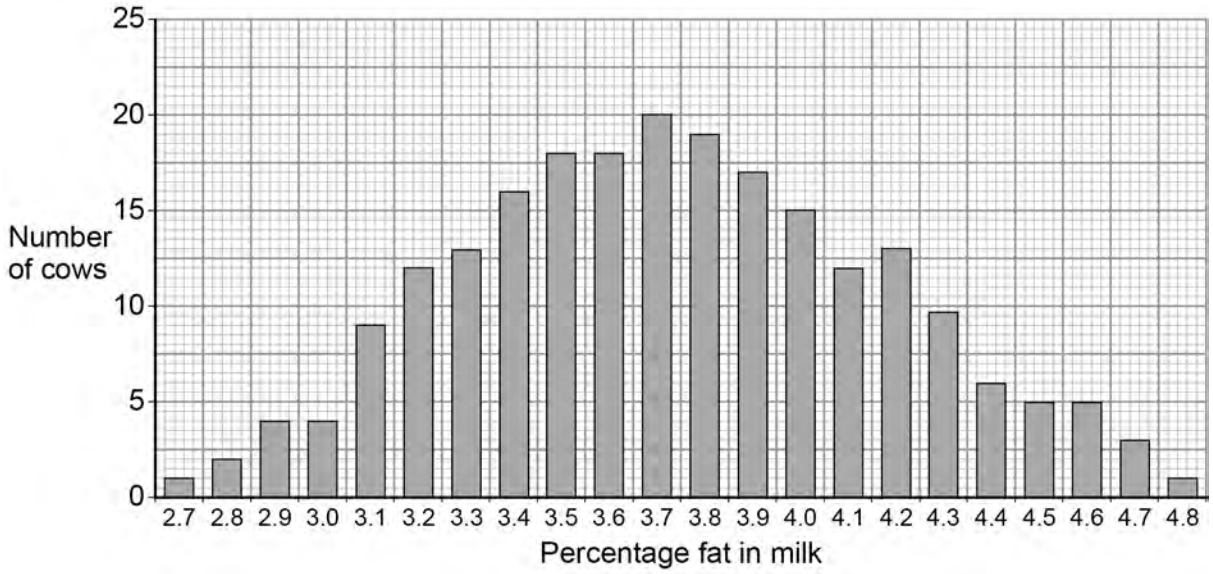
June 2018 | 8461/2H | Original Q8

0 8 Scientists want to breed cows that produce milk with a low concentration of fat.

Figure 10 shows information about the milk in one group of cows.

The cows were all the same type.

Figure 10



0 8 . 1 In **Figure 10** the mean percentage of fat in the milk is equal to the modal value.

Give the mean percentage of fat in the milk of these cows.

[1 mark]

Mean percentage = _____

0 8 . 2 A student suggested:

'The percentage of fat in milk is controlled by one dominant allele and one recessive allele.'

How many different phenotypes would this produce?

[1 mark]

Tick **one** box.

2		3		22		46	

4.4.2.3 Metabolism

Question 07 · continued

0 8 . 3 Give the evidence from **Figure 10** which shows the percentage of fat in the milk is controlled by several genes.

[1 mark]

0 8 . 4 One of the genes codes for an enzyme used in fat metabolism.

A mutation in this gene causes a reduction in milk fat.

The mutation changes one amino acid in the enzyme molecule.

Explain how a change in one amino acid in an enzyme molecule could stop the enzyme working.

[3 marks]

Question 8 continues on the next page

4.4.2.3 Metabolism

Question 07 · continued

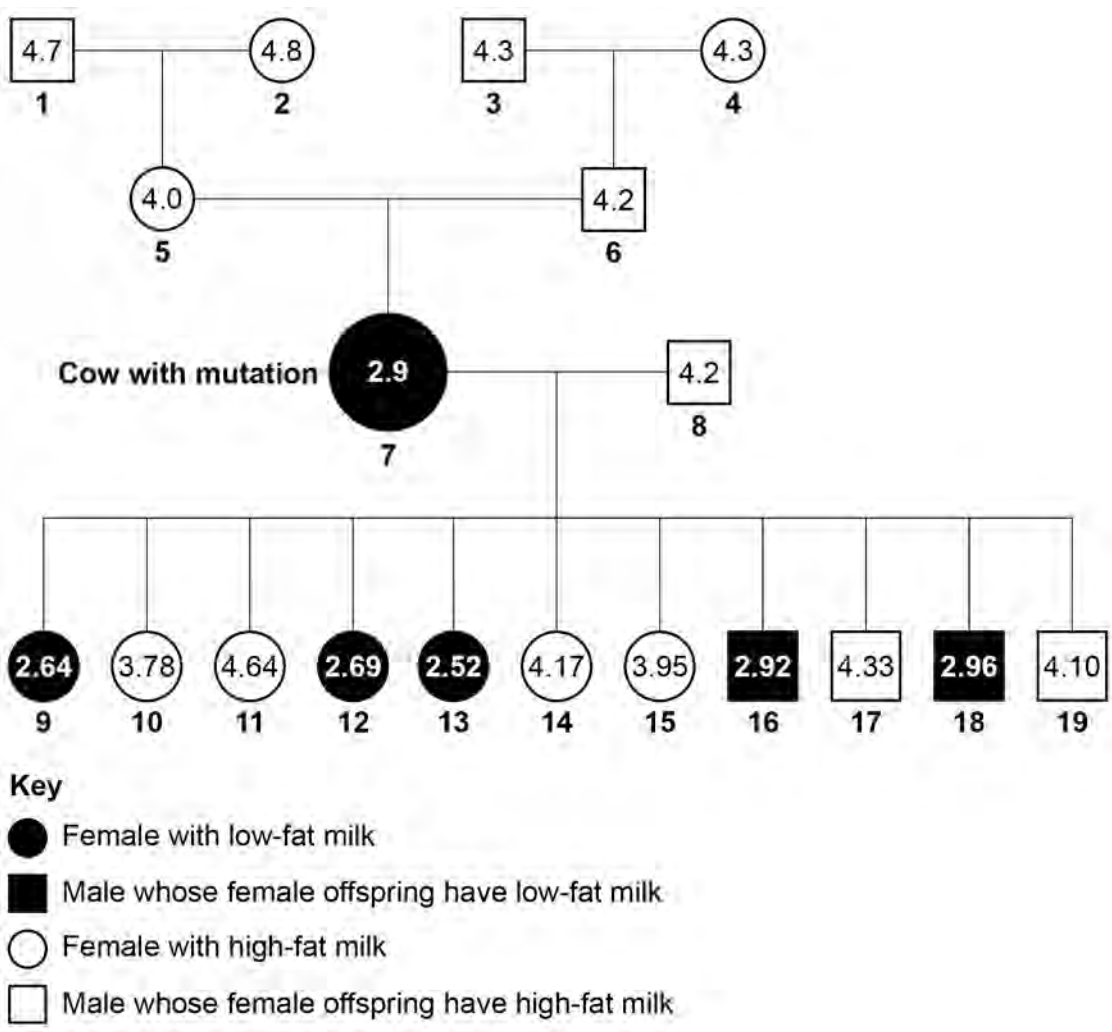
The scientists found one cow with a mutation.

The cow's milk contained only 2.9% fat.

Figure 11 shows the percentage of fat in the milk of cattle related to the cow with the mutation.

The values for male cattle are the mean values of their female offspring.

Figure 11



4.4.2.3 Metabolism

Question 07 · continued

0 8 . 5 Animal **8** is homozygous.

The mutation in animal **7** produced a dominant allele for making low-fat milk.

Give evidence from **Figure 11** that animal **7** is heterozygous.

[1 mark]

0 8 . 6 Animals **7** and **8** produced 11 offspring. These offspring were produced by in vitro fertilisation (IVF).

The embryos from IVF were transferred into 11 other cows.

Suggest why IVF and embryo transfer were used rather than allowing animals **7** and **8** to mate naturally.

[1 mark]

0 8 . 7 Draw a Punnett square diagram to show a cross between animals **7** and **8**.

Identify which offspring produce low-fat milk and which offspring produce high-fat milk.

[4 marks]

Use the following symbols:

D = dominant allele for making low-fat milk

d = recessive allele for making high-fat milk

4.4.2.3 Metabolism

Question 07 · continued

0 8 . 8 The scientists want to produce a type of cattle that makes large volumes of low-fat milk.

The scientists will selectively breed some of the animals shown in **Figure 11**.

Describe how the scientists would do this.

[4 marks]

16

4.4.2.3 Metabolism

Question 08

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

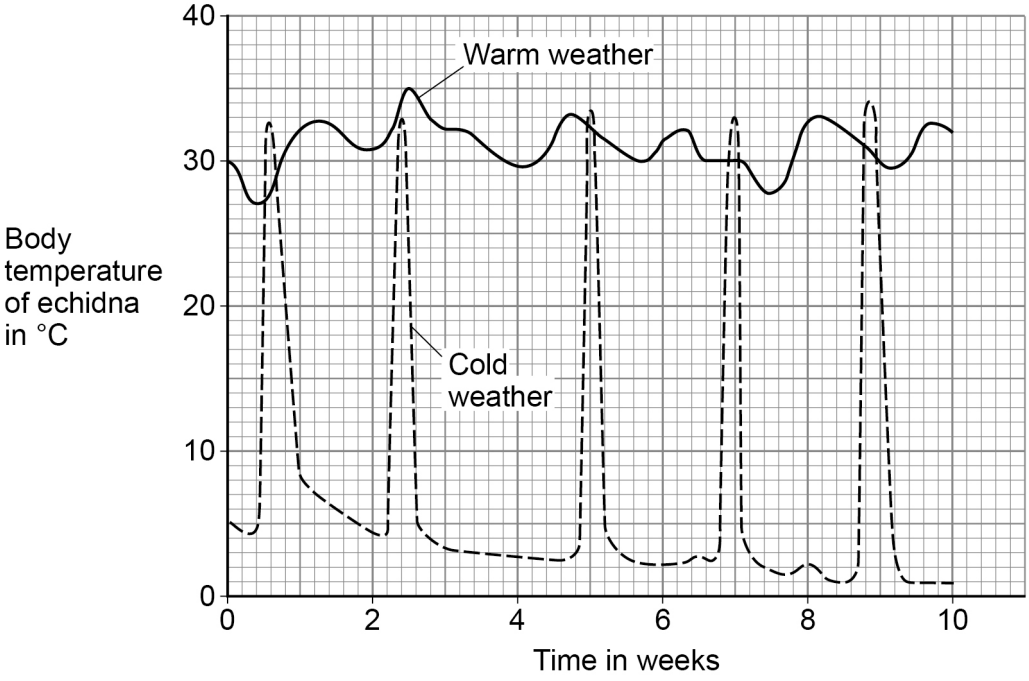
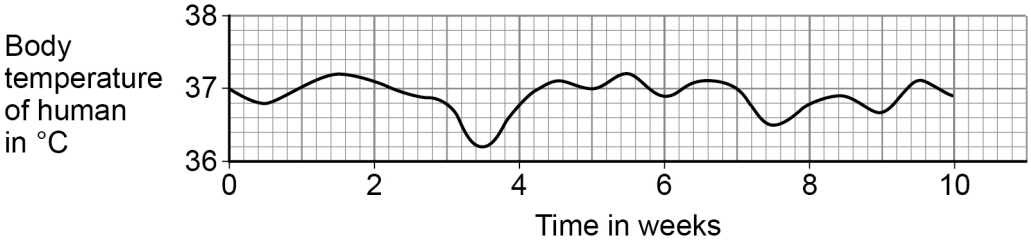


Figure 12 shows how human body temperature varies.

Figure 12



4.4.2.3 Metabolism

Question 08 · continued

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

4.4.2.3 Metabolism

Question 08 · 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]

4.4.2.3 Metabolism

Question 08 · 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