AQA GCSE Biology | 8461

SPECIFICATION POINT 4.5.3.3

Maintaining water and nitrogen balance in the body (biology only)

Past-paper questions

Tier	**Higher**
Question groups	**31**
Available paper years	**2007–2025**

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.

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Question 01

March 2007 | BLY1A | Original Q9 | Legacy

QUESTION NINE

Cardiovascular disease is a major cause of death. Two drugs which can be used to treat this disease are statins and aspirin.

Read the article.

Statins	Aspirin
Statins are produced by drug companies after carrying out extensive studies on their effectiveness. In these studies, 30 000 patients were monitored over several years. Statins were found to reduce the rate of non-fatal heart attacks by about 30 %. Approximately 0.1 % of the patients suffered serious muscle damage and 0.01 % suffered kidney failure. The cost of treating patients with statins can vary between £150 and £500 per year, depending on the type of heart condition being treated.	Aspirin has been freely available on the market for many years. It was extracted from the bark of willow trees hundreds of years ago and used to treat fever. It is now made artificially. Treatment with aspirin can cost as little as £10 per year. In a study of 1000 patients, aspirin was found to cause bleeding of the stomach in around 0.5 % of patients and there was a slightly increased risk of poor blood clotting. Aspirin was found to reduce the risk of non-fatal heart attacks by 31 %.

9A In the study on statins, how many patients suffered from serious muscle damage?

1 3

2 30

3 300

4 3000

9B It is possible that the information about statins is biased.

This is because . . .

1 a balanced account of the advantages and disadvantages of statins is not given.

2 scientists working for the drug companies have a vested interest in promoting the company.

3 there were insufficient patients in the study to come to a firm conclusion.

4 the status of the scientists may not be sufficiently high for the results to be accepted.

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

9C Some health experts suggest that aspirin is a better treatment than statins because . . .

1 aspirin has been used for much longer than statins.

2 aspirin has similar effectiveness to statins but is much cheaper.

3 aspirin is more effective than statins in reducing the risk of non-fatal heart attacks.

4 aspirin is less likely to cause side-effects.

9D The risk of suffering from cardiovascular disease can be increased by . . .

1 increasing the amount of exercise taken.

2 increasing the amount of LDL-cholesterol in the diet.

3 increasing the amount of polyunsaturated fats in the diet.

4 increasing the amount of non-processed food in the diet.

END OF TEST

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Question 02

January 2008 | BLY3H | Original Q5 | Legacy

5 (a) Why is glucose found in the blood but not in the urine?
Use your knowledge of how the kidney works to explain your answer as fully as you can.

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(3 marks)

(b) The table shows the concentrations of dissolved substances in the urine of a healthy person and the urine of a person with one type of kidney disease.

Substance	Concentration in grams per dm^3	
	Urine of healthy person	Urine of person with kidney disease
Protein	0	6
Glucose	0	0
Amino acids	0	0
Urea	21	21
Mineral ions	19	19

(i) Suggest an explanation for the difference in composition of the urine between the healthy person and the person with the kidney disease.

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(2 marks)

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Question 02 · continued

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(ii) The person with the kidney disease could be treated either by using a dialysis machine or by having a kidney transplant operation.

What are the advantages and disadvantages of having a kidney transplant operation rather than dialysis?

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(4 marks)

9

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Question 03

June 2008 | BLY3H | Original Q5 | Legacy

5 The table shows the concentrations of some substances in one person's blood plasma, kidney filtrate and urine.

Substance	Concentration in grams per dm^3		
	Plasma	Filtrate	Urine
Water	900.0	900.0	950.0
Protein	78.0	0.0	0.0
Glucose	0.8	0.8	0.0
Amino acids	0.4	0.4	0.0
Urea	0.3	0.3	20.0
Sodium ions	2.8	2.8	3.5

5 (a) (i) Protein is **not** present in the filtrate.

Explain why.

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(1 mark)

5 (a) (ii) Glucose is filtered out of the blood by the kidney and is then completely reabsorbed back into the blood.

What is the evidence for this in the table?

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(2 marks)

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Question 03 · continued

for mark

5 (a) (iii) Glucose is reabsorbed into the blood by active transport.

Give **two** ways in which active transport differs from diffusion.

1 .....

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2 .....

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(2 marks)

5 (b) The concentration of urea is much higher in the urine than in the filtrate.

Explain what causes this.

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(1 mark)

6

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Question 04

January 2009 | BLY3H | Original Q7 | Legacy

7 Urine consists of water, ions and other substances such as urea.
Urine is formed in the kidney by filtering the blood.
The diameter of the pores in the filter is about 6 nanometres.

The table shows the diameters of the molecules of some of the substances in the blood.

Substance	Diameter of molecule in nanometres
A	10 to 20
B	1.0
C	0.6
D	0.5
E	0.2

Use information from the table and your own knowledge to answer the questions.

7 (a) (i) Which substance, **A**, **B**, **C**, **D** or **E**, is protein? ☐

(1 mark)

7 (a) (ii) Explain why protein is **not** found in the urine of a healthy person.

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(2 marks)

7 (b) Substance **B** is **not** found in the urine of a healthy person.

Suggest an explanation for this.

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(2 marks)

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Question 04 · continued

for mark

7 (c) Haemolytic anaemia is a disease in which some of the red blood cells burst open.

Small amounts of haemoglobin may be found in the urine of a person suffering from haemolytic anaemia.
The diameter of a haemoglobin molecule is 5.5 nanometres.

Haemoglobin is **not** found in the urine of a healthy person, but can be found in the urine of a person with haemolytic anaemia.

Explain why.

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(3 marks)

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4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Question 05

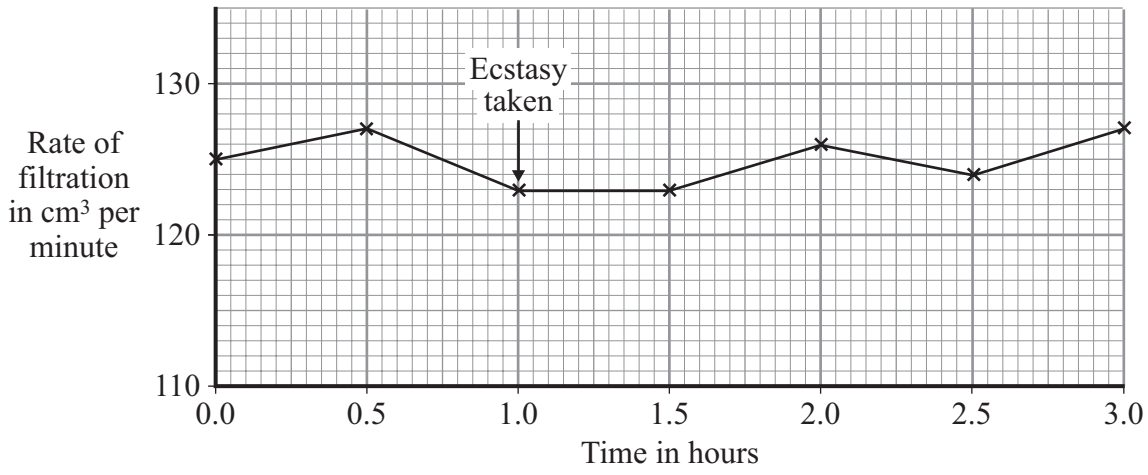
June 2009 | BLY3H | Original Q7 | Legacy

7 Taking the drug ecstasy affects the rate of urine flow from the kidneys.

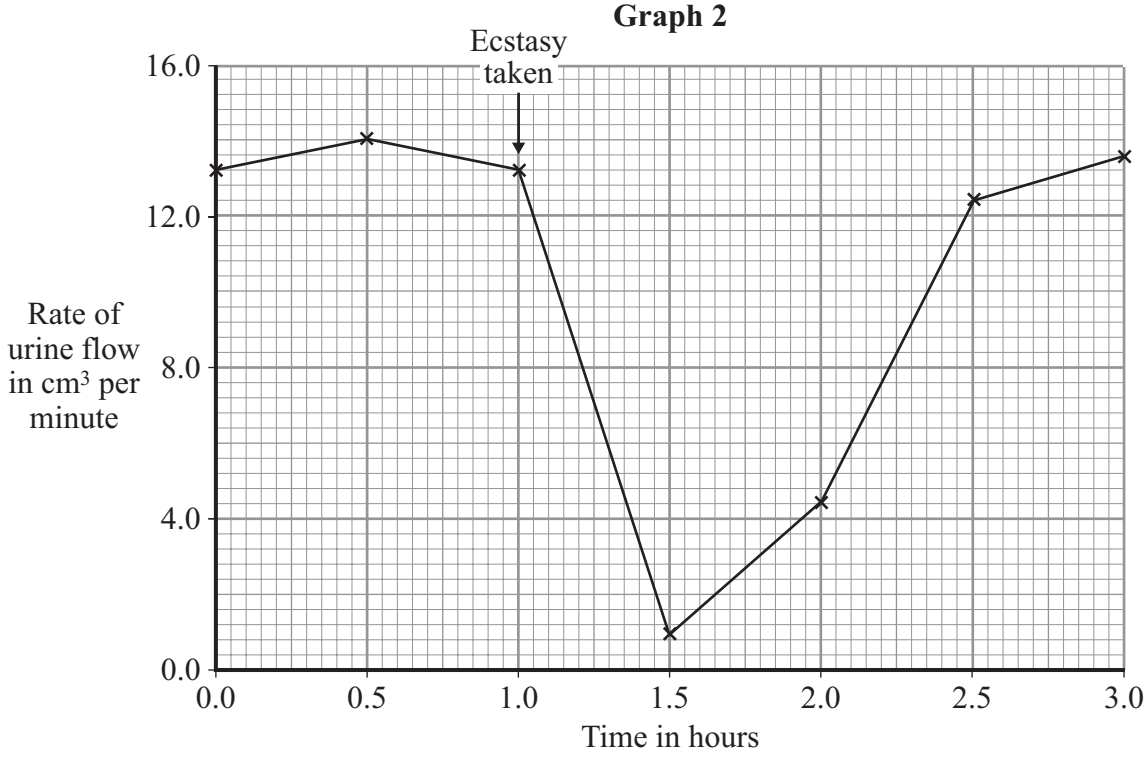
Graph 1 shows the rate of filtration by the kidneys of a healthy person.
Graph 2 shows the rate of urine flow from the kidneys of the same person.

One hour after the first measurement, the person took ecstasy.

Graph 1



Graph 2



4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Question 05 · continued

for mark

7 (a) Describe the effect of taking ecstasy on

7 (a) (i) the rate of filtration

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(1 mark)

7 (a) (ii) the rate of urine flow.

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(1 mark)

7 (b) Use information from the graphs and your understanding of how the kidney works to answer the following questions.

7 (b) (i) Suggest an explanation for the change in the rate of urine flow after the person took ecstasy.

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(2 marks)

(Extra space) .....

7 (b) (ii) After a person has taken ecstasy, the concentration of ions in the blood changes.

Suggest an explanation for this.

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(2 marks)

(Extra space) .....

6

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Question 06

November 2009 | BLY1AP | Original Q7 | Legacy

QUESTION SEVEN

Statins are drugs that affect how the liver works.

7A Statins reduce . . .

1 the amount of sugar in the blood.

2 the amount of salt in the blood.

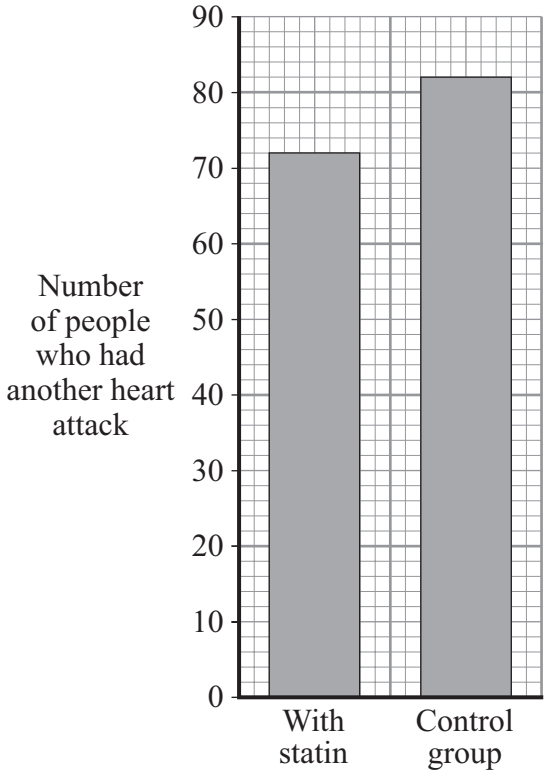
3 the amount of cholesterol in the blood.

4 the amount of nicotine in the blood.

A new statin was trialled on patients who had previously had a heart attack.

- 300 volunteers were involved in the trial, which continued for five years.
- They were split into two equal sized groups.
- Only one group was given the drug; the other volunteers formed the control group.

The number of volunteers who had another heart attack during the five years of the trial is shown in the graph.



4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Question 06 · continued

7B In a well-designed trial, what would the volunteers in the control group have been given instead of the test drug?

1 nothing

2 water

3 a different drug

4 a placebo

7C What conclusion can be drawn from this data?

1 Statins prevent heart attacks.

2 Statins reduce the risk of heart attacks in all people.

3 Statins reduce the risk of a second heart attack.

4 Statins have no effect on the incidence of heart attacks.

7D People who take statins should not drink grapefruit juice. A chemical in grapefruit juice inhibits the action of the liver enzyme that breaks down statins. The effect of this can be breakdown of muscle fibres and, in extreme cases, kidney failure.

What does this information suggest might happen to people who take statins and drink grapefruit juice?

1 The concentration of liver enzymes in the blood will increase.

2 The concentration of statins in the blood will increase.

3 The concentration of statins in the blood will decrease.

4 The concentration of statin breakdown products in the blood will increase.

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Question 07

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

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(1 mark)

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

How does it do this?

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

(2 marks)

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Question 07 · 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**

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(3 marks)

9

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Question 08

6 A person had diseased kidneys.

The table shows the concentrations of dissolved substances in this person's urine.

Substance	Concentration in grams per dm^3
Protein	6
Glucose	0
Amino acids	0
Urea	21
Mineral ions	19

6 (a) One of the substances found in this person's urine would **not** be found in the urine of a healthy person.

6 (a) (i) Name this substance. .....

(1 mark)

6 (a) (ii) Explain why this substance would **not** be found in the urine of a healthy person.

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(2 marks)

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Question 08 · continued

for mark

6 (b) A person with diseased kidneys may be treated by dialysis.

Explain how dialysis treatment restores the concentrations of dissolved substances in the blood to normal levels.

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(4 marks)

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4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Question 09

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.

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(1 mark)

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

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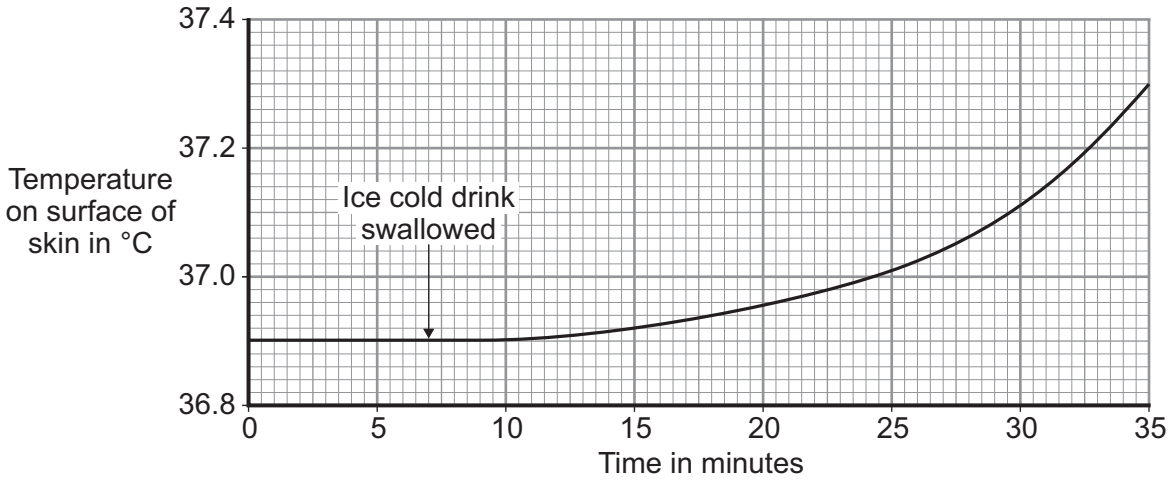
(1 mark)

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.



4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Question 09 · 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.

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(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?

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(1 mark)

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

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(1 mark)

7

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Question 10

June 2010 | BLY3H | Original Q6 | Legacy

6 Diffusion and active transport take place in healthy kidneys.

6 (a) Explain what is meant by:

6 (a) (i) diffusion.....

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(2 marks)

6 (a) (ii) active transport .....

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(2 marks)

6 (b) Describe, as fully as you can, how urine is produced by the kidneys.

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(5 marks)

9

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Question 11

1 The table shows the volume of blood flowing through different organs at three levels of exercise.

Organ(s)	Volume of blood flowing through organ(s) in cm^3 per minute		
	Light exercise	**Moderate exercise**	**Heavy exercise**
Gut	1 100	600	300
Kidneys	900	600	250
Brain	750	750	750
Heart muscles	350	750	1 000
Skeletal muscles	4 500	12 500	22 000
Skin	1 500	1 900	600
Other	400	500	100
Total	**9 500**	**17 600**	**25 000**

1 (a) (i) Which organ has a constant flow of blood through it?

.....

(1 mark)

1 (a) (ii) Which organ has the greatest reduction in the volume of blood supplied during heavy exercise compared with light exercise?

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(1 mark)

1 (a) (iii) What proportion of the blood flows through the heart muscle during heavy exercise?

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(1 mark)

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Question 11 · continued

1 (b) The volume of blood flowing through the skeletal muscles increases greatly during exercise.

Give **two** ways in which the body brings about this increase.

1 .....

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2 .....

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(2 marks)

1 (c) During exercise, the concentration of carbon dioxide in the blood increases.

Explain what causes this increase.

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(3 marks)

8

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Question 12

January 2011 | BLY3H | Original Q7 | Legacy

7 Urine consists of water, ions and other substances such as urea.
Urine is formed in the kidney by filtering the blood.
The diameter of the pores in the filter is about 6 nanometres.

The table shows the diameters of the molecules of some of the substances in the blood.

Substance	Diameter of molecule in nanometres
A	10 to 20
B	1.0
C	0.6
D	0.5
E	0.2

Use information from the table and your own knowledge to answer the questions.

7 (a) (i) Which substance, **A**, **B**, **C**, **D** or **E**, is protein? ☐

(1 mark)

7 (a) (ii) Explain why protein is **not** found in the urine of a healthy person.

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(1 mark)

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Question 12 · continued

7 (b) Haemolytic anaemia is a disease in which some of the red blood cells burst open.

Small amounts of haemoglobin may be found in the urine of a person suffering from haemolytic anaemia.
The diameter of a haemoglobin molecule is 5.5 nanometres.

Haemoglobin is **not** found in the urine of a healthy person, but can be found in the urine of a person with haemolytic anaemia.

Explain why.

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(3 marks)

5

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Question 13

March 2011 | BLY1AP | Original Q1 | Legacy

QUESTION ONE

We control conditions inside our bodies.

Match organs, **A**, **B**, **C** and **D**, with the statements **1**–**4** in the table.

A liver

B pituitary gland

C kidney

D skin

1	produces the hormone FSH
2	gets rid of excess heat
3	removes excess water from the blood
4	produces cholesterol

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

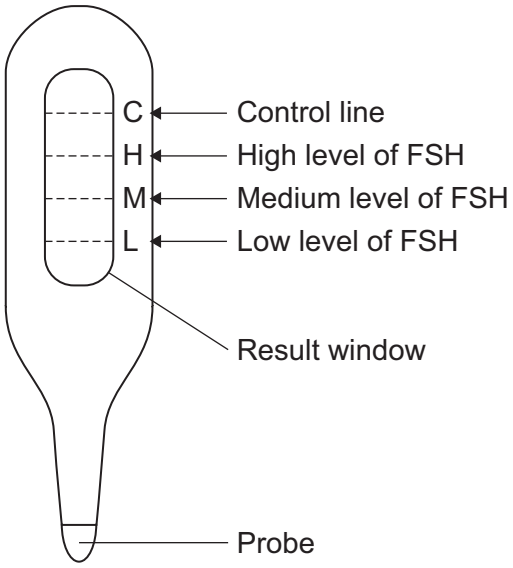
Question 14

March 2011 | BLY1AP | Original Q2 | Legacy

QUESTION TWO

Diagram 1 shows an instrument used to test FSH concentration in urine.

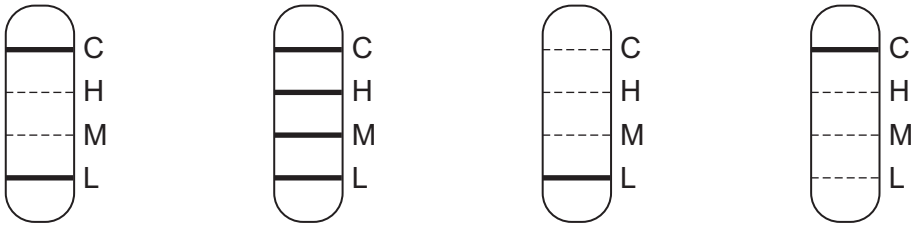
Diagram 1



The probe is put in a urine sample. After 30 minutes, dark lines may show in the result window. The control line shows when the test has been done correctly.

Diagram 2 shows the result windows of four tests, **A**, **B**, **C** and **D**.

Diagram 2



Match results, **A**, **B**, **C** and **D**, with the statements **1**–**4** in the table.

1	shows that the test was not done properly
2	shows the FSH level between the end of menstruation and egg release
3	shows a test on urine from a male
4	shows the FSH level at the end of the menstrual cycle

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Question 15

June 2011 | BLY1AP | Original Q1 | Legacy

QUESTION ONE

This question is about human organs.

Match organs, **A**, **B**, **C** and **D**, with the functions **1**–**4** in the table.

A kidney

B liver

C ovary

D pituitary gland

	Function
1	produces cholesterol
2	produces FSH
3	produces oestrogen
4	produces urine

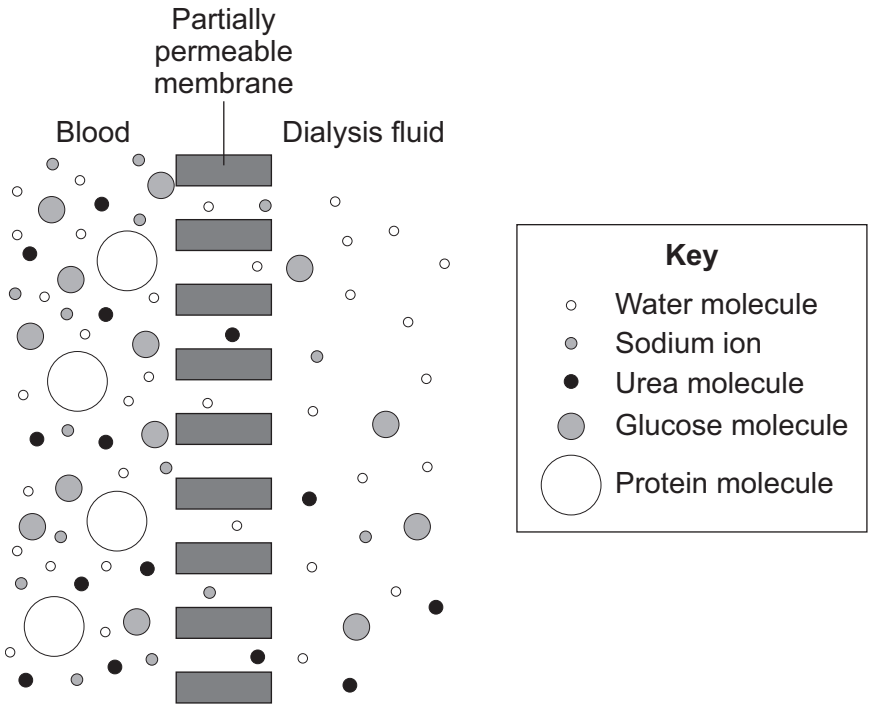
4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Question 16

June 2011 | BLY3H | Original Q2 | Legacy

2 Dialysis can be used to treat a person with kidney disease.

The diagram shows blood and dialysis fluid separated by a partially permeable membrane.



Blood plasma and dialysis fluid contain several substances dissolved in water.

The table shows the concentrations of some of these substances in dialysis fluid and in the blood plasma of a person with kidney disease immediately before dialysis.

Substance	Concentration of substance in grams per dm^3	
	Blood plasma of person with kidney disease	Dialysis fluid
Sodium ions	3.26	3.15
Urea	0.45	0.00
Glucose	0.90	0.99
Protein	60.00	0.00

2 (a) Protein molecules are **not** able to move from the blood to the dialysis fluid.
Use information from the diagram to explain why.

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(1 mark)

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Question 16 · continued

2 (b) Urea molecules move from the blood into the dialysis fluid.

2 (b) (i) Give the name of this type of movement. .....

(1 mark)

2 (b) (ii) Why do the urea molecules move in this direction?

Use information from the table to help you to answer this question.

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(1 mark)

2 (c) The concentration of sodium ions in the blood plasma will change during dialysis.

Suggest a value for the concentration of sodium ions in the plasma at the end of dialysis.

Use information from the table.

Concentration of sodium ions = ... grams per dm^3

(1 mark)

2 (d) For most patients a kidney transplant is better than continued treatment by dialysis.

2 (d) (i) Give **two** advantages of having a kidney transplant rather than treatment by dialysis.

1 .....

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2 .....

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(2 marks)

2 (d) (ii) Give **two** possible disadvantages of having a kidney transplant.

1 .....

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2 .....

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(2 marks)

8

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Question 17

January 2012 | BL1HP | Original Q6 | Legacy

6 Drugs must be trialled before the drugs can be used on patients.

6 (a) (i) Before the clinical trials, drugs are tested in the laboratory.
The laboratory trials are **not** trials on people.

What is the drug tested on in these laboratory trials?

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(1 mark)

6 (a) (ii) Drugs must be trialled before the drugs can be used on patients.

Give **three** reasons why.

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(3 marks)

6 (b) Read the information about cholesterol and ways of treating high cholesterol levels.

Diet and inherited factors affect the level of cholesterol in a person's blood.
Too much cholesterol may cause deposits of fat to build up in blood vessels and reduce the flow of blood. This may cause the person to have a heart attack.
Some drugs can lower the amount of cholesterol in the blood.

The body needs cholesterol. Cells use cholesterol to make new cell membranes and some hormones. The liver makes cholesterol for the body.

Some drugs can help people with high cholesterol levels.

Statins block the enzyme in the liver that is used to produce cholesterol.
People will normally have to take statins for the rest of their lives. Statins can lead to muscle damage and kidney problems. Using some statins for a long time has caused high numbers of deaths.

Cholesterol blockers reduce the absorption of cholesterol from the intestine into the blood.
Cholesterol blockers can sometimes cause problems if the person is using other drugs.

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Question 17 · continued

Evaluate the use of the two types of drug for a person with high cholesterol levels.

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(6 marks)

10

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Question 18

June 2013 | BL1HP | Original Q6 | Legacy

6 Drugs are used to treat cardiovascular diseases (diseases of the heart and blood vessels).

6 (a) What is a drug?

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(1 mark)

6 (b) People can be treated for cardiovascular diseases with statins or aspirin.

Information about these two drugs is given in the table.

STATINS	ASPIRIN
Statins are only available on prescription from doctors. In studies, 30 000 patients were monitored over several years. Statins were found to reduce the rate of non-fatal heart attacks by about 30%. Approximately 0.1% of the patients suffered serious muscle damage and 0.01% suffered kidney failure. Statins reduce blood cholesterol which builds up in the walls of blood vessels. The cost of treating patients with statins can vary between £150 and £500 per year, depending on the type of cardiovascular disease being treated.	Aspirin can be bought over the counter. Treatment with aspirin costs up to £15 per year. In a study of 1000 patients, aspirin was found to cause bleeding of the stomach in around 0.5% of patients and there was a slightly increased risk of poor blood clotting at cuts. There was a slightly increased risk of damage to the blood vessels in the brain in older patients. Aspirin was found to reduce the risk of non-fatal heart attacks by 31%.

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Question 18 · continued

Would you recommend statins or aspirin for the treatment of cardiovascular diseases?

In your answer you should:

- give your recommendation
- use information from the table to support your recommendation by making comparisons of the two drugs.

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(5 marks)

6

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Question 19

June 2014 | BL3HP | Original Q4 | Legacy

4 Blood is part of the circulatory system.

4 (a) (i) Give **one** function of white blood cells.

[1 mark]

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4 (a) (ii) Which of the following is a feature of platelets?

Tick (✓) **one** box.

[1 mark]

They have a nucleus. ☐

They contain haemoglobin. ☐

They are small fragments of cells. ☐

4 (b) Urea is transported by the blood plasma from where it is made to where the urea is excreted.

Complete the following sentence.

[2 marks]

Blood plasma carries urea from where it is made in the .....

to the ..... where the urea is removed from the blood.

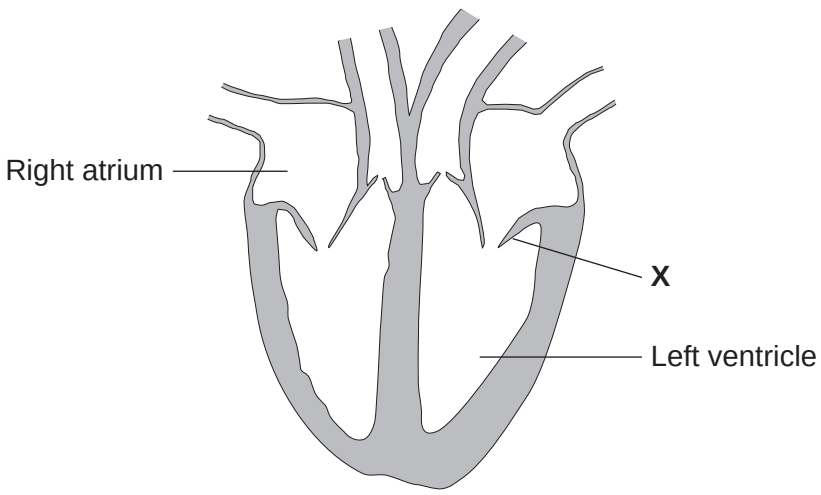
Question 4 continues on the next page

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Question 19 · continued

4 (c) **Figure 4** shows a section through the human heart.

Figure 4



Structure **X** is a valve. If valve **X** stops working, it may need to be replaced.

A scientist is designing a new heart valve. The scientist knows that the valve must be the correct size to fit in the heart.

Suggest **two** other factors the scientist needs to consider so that the newly designed valve works effectively in the heart.

[2 marks]

.....

.....

.....

.....

6

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Question 20

June 2015 | BL3HP | Original Q7 | Legacy

7 It is important to remove waste products from our bodies.

Healthy kidneys help to keep our internal environment constant.

7 (a) Describe how a healthy kidney produces urine.

[5 marks]

.....

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.....

7 (b) A child has kidney failure and is treated with dialysis.

Before the dialysis starts, the doctor measures the concentration of urea and glucose in the child's blood.

Table 3 shows the results.

Table 3

	Concentration in the blood before dialysis starts in mmol per dm^3
Urea	28
Glucose	6

The child has a normal blood glucose concentration.

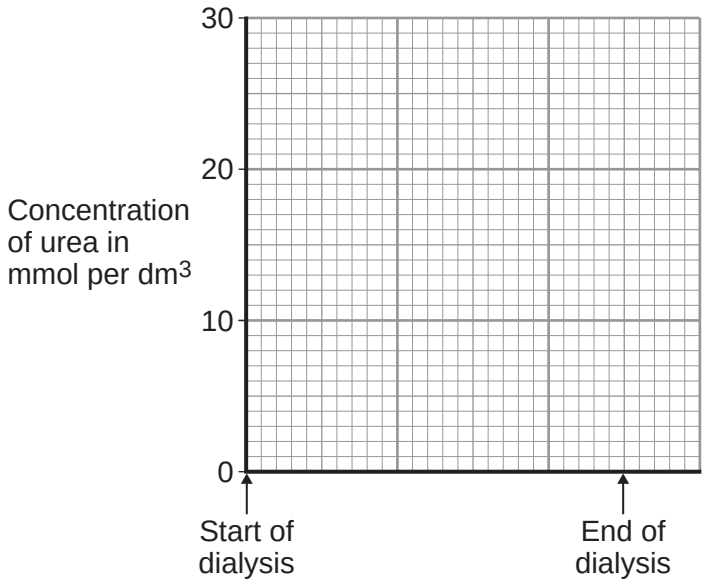
4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Question 20 · continued

7 (b) (i) Sketch a graph on **Figure 7** to suggest what will happen to the concentration of urea in the blood during dialysis.

[1 mark]

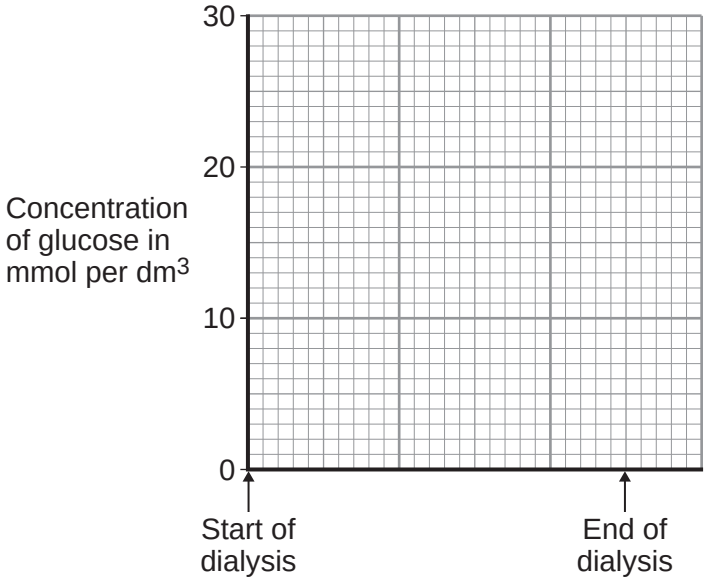
Figure 7



7 (b) (ii) Sketch a graph on **Figure 8** to suggest what will happen to the concentration of glucose in the blood during dialysis.

[1 mark]

Figure 8



Question 7 continues on the next page

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Question 20 · continued

June 2015 | BL3HP | Original Q7 | Legacy

7 (c) (i) Another way of treating kidney failure is with a kidney transplant.

A transplanted kidney can be rejected.

Explain why the new kidney may be rejected.

[3 marks]

.....

.....

.....

.....

.....

.....

7 (c) (ii) Describe **one** way in which doctors try to prevent kidney rejection.

[1 mark]

.....

.....

11

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Question 21

June 2017 | BL2HP | Original Q6 | Legacy

6 Alkaptonuria (AKU) is a rare, inherited condition. A person with AKU produces brownish-black urine. Further health problems develop later in life.

6 (a) The allele that causes AKU is on chromosome number 3.
The allele is recessive.

6 (a) (i) How many chromosomes are there in most human cells?

[1 mark]

_____

6 (a) (ii) What are alleles?

[1 mark]

_____

_____

6 (a) (iii) What does recessive mean?

[1 mark]

_____

_____

Question 6 continues on the next page

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Question 21 · continued

6 (b) Two parents, who do **not** have AKU, have a child with AKU.

These two parents are heterozygous.

6 (b) (i) What does heterozygous mean?

[1 mark]

_____

_____

6 (b) (ii) Draw a genetic diagram to find the probability that the parents' next child will have AKU.

[4 marks]

You should identify in your diagram any children with AKU.

Use the following symbols: **N** = allele for **not** having AKU (non-AKU)
n = allele for AKU

Probability of having a child with AKU = _____

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Question 21 · continued

6 (c) The parents do not want to have another child with AKU.

A genetic counsellor tells the parents that this would be possible if they use IVF followed by embryo screening.

The procedure is:

1. several eggs from the woman are fertilised in a glass dish using sperm cells from the man (IVF)
2. each fertilised egg divides to form an embryo
3. at the 16-cell stage, one cell is removed from each embryo and the cell's DNA is tested (embryo screening)
4. one embryo, which does not have the recessive allele for AKU, is placed in the woman's uterus to develop into a baby
5. some of the other embryos may be frozen and stored.

In **Steps 2** and **3**, a 16-cell embryo is produced by cell division of the original fertilised egg cell.

6 (c) (i) Name the type of cell division in **Step 2**.

[1 mark]

_____

6 (c) (ii) How many cell divisions are needed to make 16 cells from one cell?

[1 mark]

_____

6 (d) Some people have ethical objections to embryo screening.

6 (d) (i) Suggest **one** ethical objection to embryo screening.

[1 mark]

_____

_____

6 (d) (ii) Suggest **one** reason in favour of embryo screening.

[1 mark]

_____

_____

12

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Question 22

June 2018 | 8461/1H | Original Q3

0 3 The circulatory system is composed of the blood, blood vessels and the heart.

0 3 . 1 Urea is transported in the blood plasma.

Name **two** other substances transported in the blood plasma.

[2 marks]

1 _____

2 _____

0 3 . 2 Some athletes train at high altitude.

Training at high altitude increases the number of red blood cells per cm^3 of blood.

Explain why having more red blood cells per cm^3 of blood is an advantage to an athlete.

[3 marks]

_____

_____

_____

_____

_____

_____

0 3 . 3 Which **two** blood vessels carry deoxygenated blood?

[2 marks]

Tick **two** boxes.

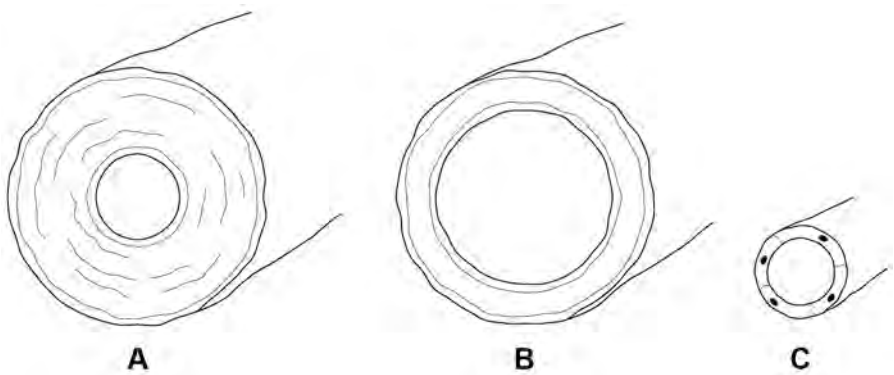
- Aorta ☐
- Coronary artery ☐
- Pulmonary artery ☐
- Pulmonary vein ☐
- Vena cava ☐

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Question 22 · continued

Figure 4 shows the three types of blood vessel.

Figure 4



0 3 . 4 Which type of blood vessel carries blood into the right atrium?

[1 mark]

Tick **one** box.

A		B		C	

0 3 . 5 Compare the structure of an artery with the structure of a vein.

[3 marks]

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Question 22 · continued

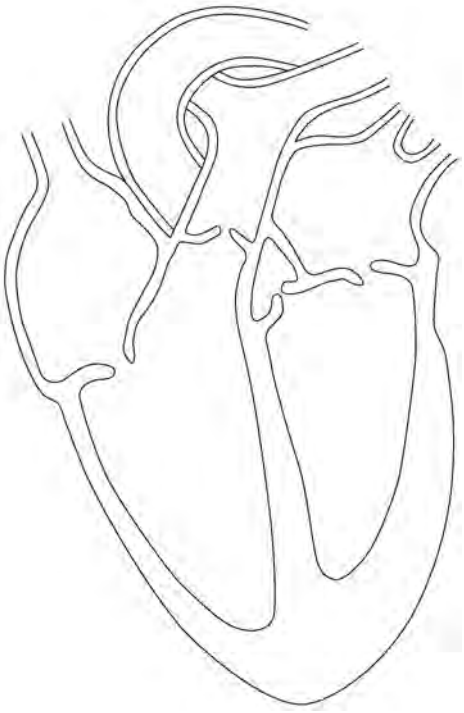
0 3 . 6 Heart rate is controlled by a group of cells. This group of cells act as a pacemaker.

Figure 5 shows a section through the heart.

Draw an **X** on **Figure 5** to show the position of the pacemaker.

[1 mark]

Figure 5



0 3 . 7 A patient may be fitted with an artificial pacemaker.

What condition may be treated using an artificial pacemaker?

[1 mark]

13

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Question 23

June 2019 | 8461/1H | Original Q6

0 6 People with diabetes have difficulty controlling their blood glucose concentration.

0 6 . 1 Which part of the blood transports glucose?

[1 mark]

Tick (✓) **one** box.

- Lymphocytes ☐
- Plasma ☐
- Platelets ☐
- Red blood cells ☐

Glucose is often found in the urine of people with diabetes.

0 6 . 2 Name a chemical used to test for glucose.

[1 mark]

_____

0 6 . 3 Describe a test that could be used to show that a person's urine contains glucose.

[2 marks]

Test _____

_____

Positive result _____

_____

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Question 23 · continued

0 6 . 4 The body cells of a person with untreated diabetes lose more water than the body cells of a person who does **not** have diabetes.

Explain how diabetes can cause the body cells to lose more water.

[3 marks]

0 6 . 5 Glucose is absorbed into the blood in the small intestine by both diffusion and active transport.

Describe how the small intestine is adapted for efficient absorption.

[5 marks]

12

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Question 24

June 2019 | 8461/2H | Original Q6

0 6 Water conservation is important to the human body.

0 6 . 1 Which gland releases the hormone that controls water loss from the body?

[1 mark]

Tick (✓) **one** box.

- Adrenal ☐
- Pancreas ☐
- Pituitary ☐
- Thyroid ☐

0 6 . 2 Which hormone helps the kidneys to control water loss from the body?

[1 mark]

Tick (✓) **one** box.

- ADH ☐
- Adrenaline ☐
- LH ☐
- Thyroxine ☐

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Question 24 · continued

June 2019 | 8461/2H | Original Q6

0 6 . 3 A man is walking across a desert.

The man has used up his supply of drinking water.

Explain how the gland you named in Question **06.1** and the kidneys reduce water loss.

[3 marks]

Question 6 continues on the next page

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Question 24 · continued

0 6 . 4 Some people have kidney failure.

Doctors may treat patients with kidney failure by either:

- dialysis
- a kidney transplant.

Explain **two** biological reasons why most doctors think that a kidney transplant is a better method of treatment than dialysis.

Do **not** refer to cost or convenience.

[4 marks]

Reason 1 _____

_____

_____

_____

Reason 2 _____

_____

_____

_____

9

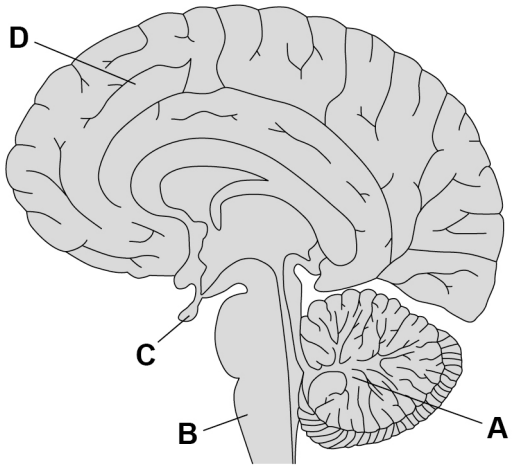
4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Question 25

November 2020 | 8461/2H | Original Q6

0 6 **Figure 7** shows the brain.

Figure 7



0 6 . 1 Which part of the brain becomes more active if a person balances on one leg instead of standing on two legs?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

0 6 . 2 Name the part of the brain that is responsible for making a decision.

[1 mark]

_____

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Question 25 · continued

0 6 . 3 In most MRI scanners the person being scanned needs to stay completely still.

A functional MRI (fMRI) scanner allows a person to move while the scanner makes images of the person's brain activity.

Suggest how the fMRI scanner could help to find out more about the brain damage a person has.

[3 marks]

0 6 . 4 Describe how the brain receives information about light entering the eye.

You should include the names of structures in your answer.

[3 marks]

Question 6 continues on the next page

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Question 25 · continued

0 6 . 5 The eyes of some birds contain cells that detect ultraviolet (UV) light.

UV light is reflected by some fruits and the urine of small mammals.

Explain how birds that detect UV light have evolved from birds that could not detect UV light.

[6 marks]

14

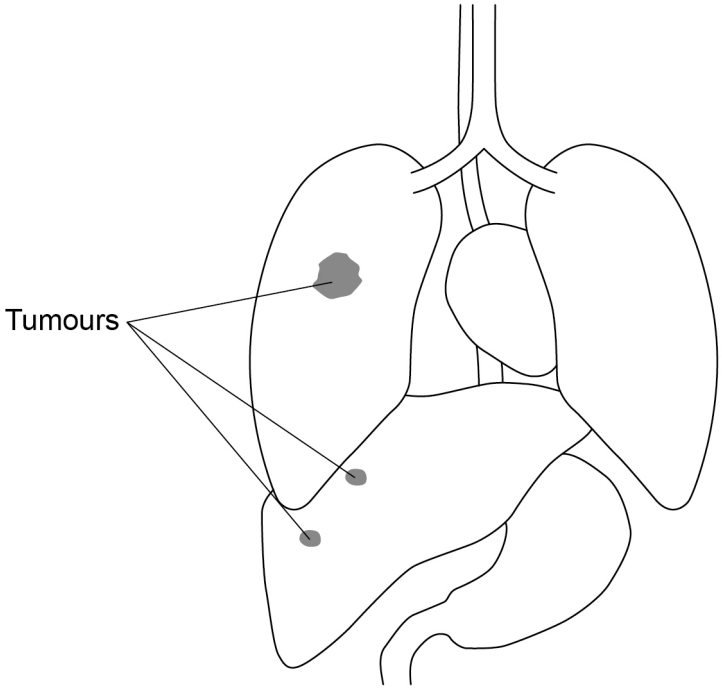
4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Question 26

November 2021 | 8461/1H | Original Q7

0 7 **Figure 11** shows where three of the same type of tumour were found in a patient.

Figure 11



Malignant tumours are cancers.

0 7 . 1 Describe what happens to cells when a tumour forms.

[1 mark]

0 7 . 2 What evidence is there in **Figure 11** to suggest that the tumour in the lung is malignant?

[1 mark]

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Question 26 · continued

0 7 . 3 Some types of cancer can cause the numbers of blood components in a person's body to fall to a dangerously low level.

A person with one of these types of cancer may experience symptoms such as:

- tiredness
- frequent infections
- bleeding that will not stop after the skin is cut.

Explain how a very low number of blood components in the body can cause these symptoms.

[6 marks]

Question 7 continues on the next page

Question 26 · continued

Some patients with a very low number of blood cells may be given a blood transfusion.

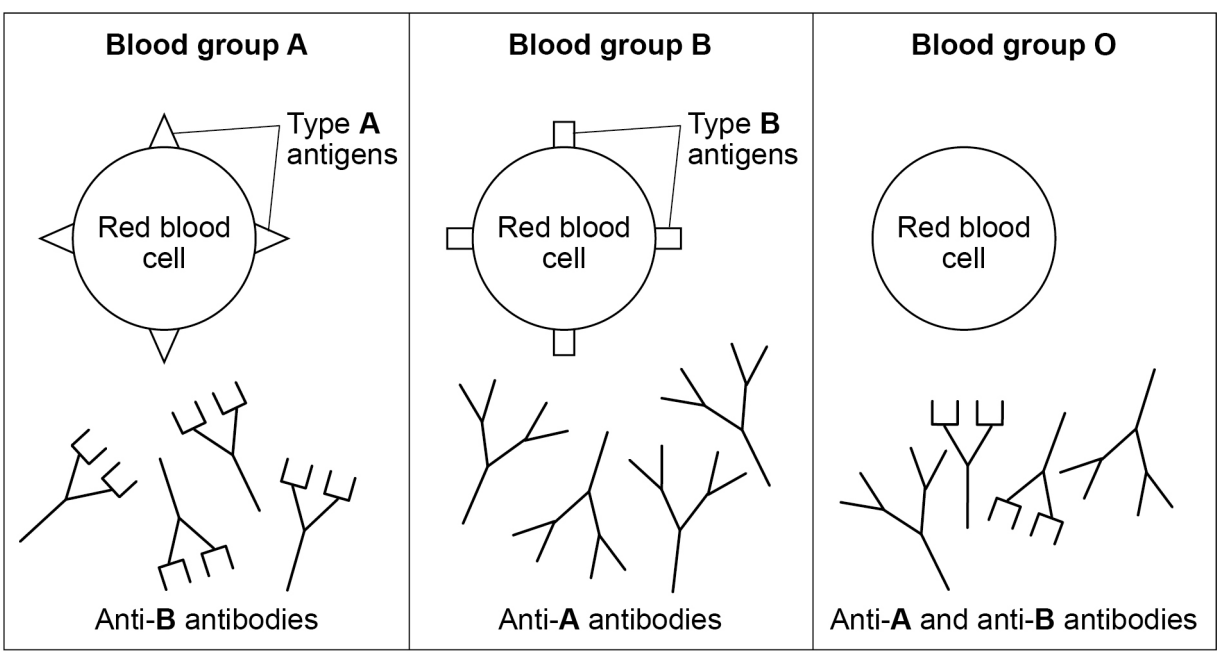
A blood transfusion is where a patient receives blood from a donor.

Different people have different blood groups.

Figure 12 shows:

- the red blood cells found in people with different blood groups
- the antibodies that can be made by people with different blood groups.

Figure 12



Antibodies can bind to antigens that have complementary shapes.

When antibodies bind to the antigens on red blood cells, many red blood cells begin to clump together.

Each red blood cell is about 8 μm in diameter.

Many capillaries have an internal diameter of about 10 μm.

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Question 26 · continued

In one type of blood transfusion, **only** red blood cells from a donor are transferred to the patient.

0 7 . 4 It is dangerous for a patient with blood group **A** to receive red blood cells from a donor with blood group **B**.

Explain why.

[3 marks]

0 7 . 5 Explain why blood group **O** red blood cells can be given to patients with any blood group.

[2 marks]

Question 7 continues on the next page

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Question 26 · continued

0 7 . 6 **Table 4** shows some of the risks associated with blood transfusions.

Table 4

Risk	Probability of risk occurring
Allergic reaction	0.9 %
Hepatitis B infection	1 in (3×10^5)
Hepatitis C infection	6.7×10^{-7}
Kidney damage	1 in 70 000

Which risk has the **lowest** probability of occurring?

[1 mark]

Tick (✓) **one** box.

- Allergic reaction ☐
- Hepatitis B infection ☐
- Hepatitis C infection ☐
- Kidney damage ☐

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Question 26 · continued

0 7 . 7 A person has a tumour blocking the tube leading from the gall bladder to the small intestine.

Explain why this person would have difficulty digesting fat.

[5 marks]

19

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Question 27

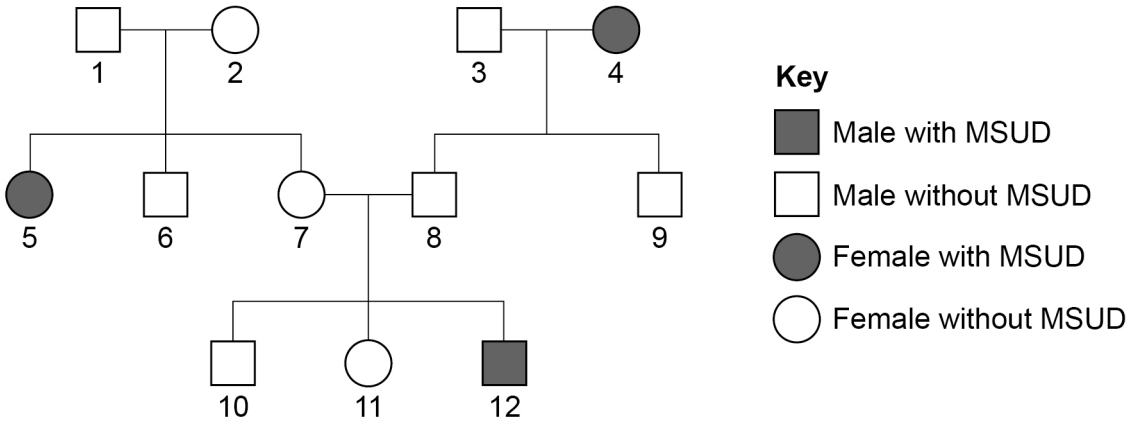
June 2022 | 8461/2H | Original Q5

0 5 Maple syrup urine disease (MSUD) is a rare inherited human condition.

MSUD is usually diagnosed early in childhood and can be controlled by having a low-protein diet.

Figure 4 shows the inheritance of MSUD in one family.

Figure 4



The allele for MSUD is recessive.

0 5 . 1 Give **one** piece of evidence from **Figure 4** which shows that MSUD is a recessive condition.

[1 mark]

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Question 27 · continued

0 5 . 2 Persons **7** and **8** in **Figure 4** are expecting a fourth child.

Determine the probability that the child will have MSUD.

You should:

- draw a Punnett square diagram
- identify the phenotype of each offspring genotype
- use the symbols:

N = allele for **not** having MSUD
n = allele for MSUD.

[4 marks]

Probability = _____

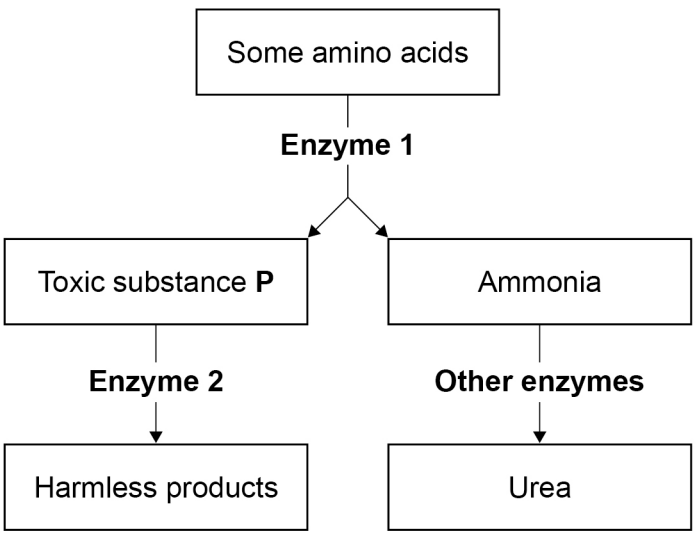
Question 5 continues on the next page

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Question 27 · continued

Figure 5 shows chemical reactions involved in the normal breakdown of some types of amino acid inside body cells.

Figure 5



A person with MSUD **cannot** make **Enzyme 2**.

0 5 . 3 One of the final products shown in **Figure 5** is urea.

Where in the human body are the reactions shown in **Figure 5** most likely to occur?

[1 mark]

Tick (✓) **one** box.

- Kidney ☐
- Liver ☐
- Pancreas ☐
- Small intestine ☐

Question 27 · continued

Scientists can analyse blood samples or urine samples to see if a person has MSUD.

The test identifies high concentrations of toxic substance **P**, shown in **Figure 5**.

0 5 . 4 Explain why the **blood** of a person with MSUD will have a high concentration of toxic substance **P**.

Use information from **Figure 5**.

[3 marks]

0 5 . 5 Explain why the **urine** of a person with MSUD will have a high concentration of toxic substance **P**.

[2 marks]

Question 5 continues on the next page

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Question 27 · continued

0 5 . 6 Explain why a person with MSUD must have a low-protein diet.

[3 marks]

14

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Question 28

June 2023 | 8461/1H | Original Q4

0 4 This question is about exercise.

0 4 . 1 During vigorous exercise, anaerobic respiration occurs in a person's body.

Explain **two** effects of anaerobic respiration on the person's body.

[4 marks]

1 _____

2 _____

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Question 28 · continued

0 4 . 2 Design an investigation to show the effect of different types of exercise on the heart rate of athletes.

[6 marks]

Question 4 continues on the next page

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Question 28 · continued

Anabolic steroids are drugs.

Anabolic steroids:

- increase muscle mass in humans
- are banned in most competitive sports.

Some athletes take anabolic steroids to improve their performance in sport.

0 4 . 3 Explain how taking anabolic steroids could improve an athlete's performance.

[2 marks]

Scientists use monoclonal antibodies to test for the presence of anabolic steroids in an athlete's urine.

To produce monoclonal antibodies, a mouse lymphocyte is combined with a tumour cell.

0 4 . 4 What type of cell is created when a mouse lymphocyte and a tumour cell combine?

[1 mark]

Tick (✓) **one** box.

- Embryo ☐
- Hybridoma ☐
- Phagocyte ☐
- Stem cell ☐

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Question 28 · continued

0 4 . 5 Describe how scientists make monoclonal antibodies using the cell created when a mouse lymphocyte and a tumour cell combine.

[3 marks]

0 4 . 6 What property makes a monoclonal antibody useful in detecting the presence of an anabolic steroid in urine?

[1 mark]

Tick (✓) **one** box.

- A monoclonal antibody is quick and easy to produce. ☐
- A monoclonal antibody is specific to only one person's urine. ☐
- A monoclonal antibody only binds to the anabolic steroid. ☐
- A monoclonal antibody can identify many different drugs at the same time. ☐

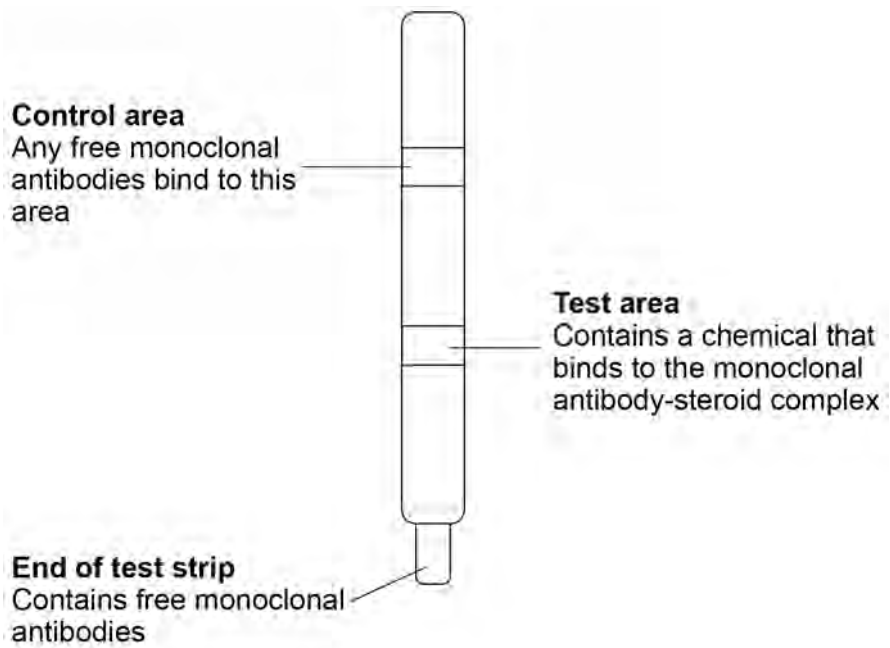
Question 4 continues on the next page

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Question 28 · continued

Figure 5 shows a test strip that can detect the presence of an anabolic steroid in an athlete's urine.

Figure 5



The end of the test strip is dipped in urine.

The urine moves up through the test strip.

The test area and the control area contain a dye.
The dye turns blue when monoclonal antibodies bind to it.

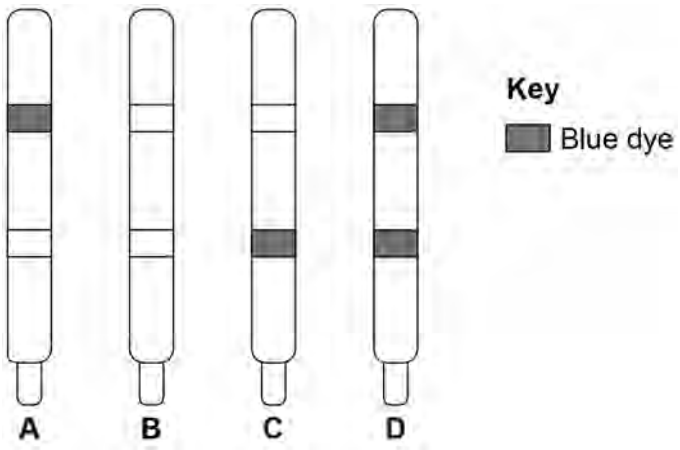
0 4 . 7 Suggest the purpose of the control area in the test strip.

[1 mark]

Question 28 · continued

Figure 6 shows the urine test results of four athletes.

Figure 6



0 4 . 8 Describe the evidence in **Figure 6** that shows the test for athlete **B** has **not** worked.

Suggest **one** reason why the test did **not** work.

[2 marks]

Evidence _____

_____

Reason _____

_____

0 4 . 9 Which athlete has tested positive for anabolic steroids in their urine?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

21

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Question 29

June 2023 | 8461/2H | Original Q5

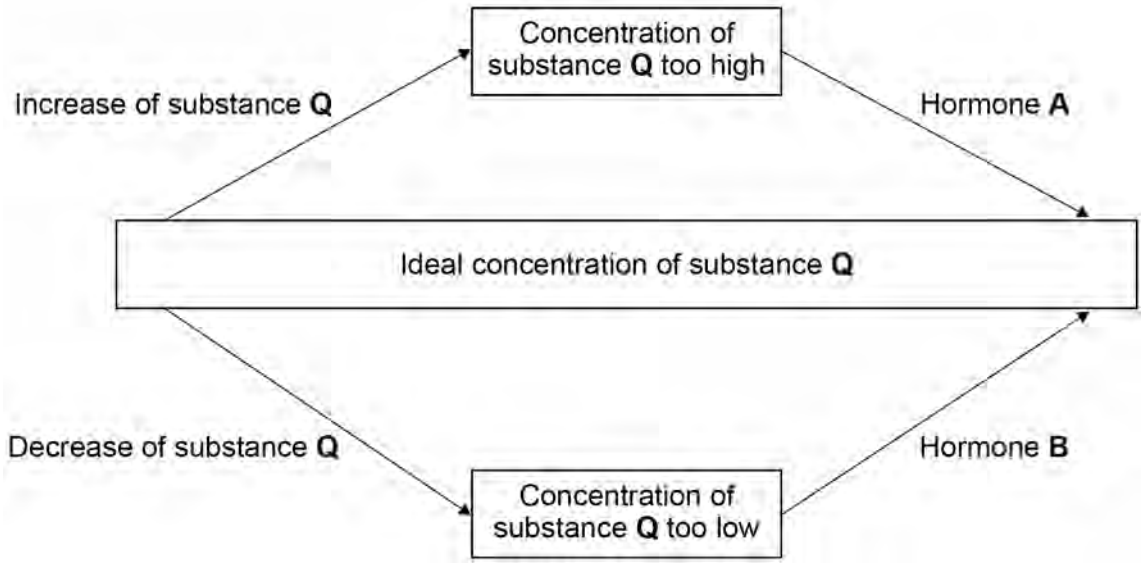
0 5 Homeostasis is the regulation of the body's internal conditions.

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]

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Question 29 · continued

June 2023 | 8461/2H | Original Q5

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

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Question 29 · 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

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Question 30

June 2024 | 8461/2H | Original Q8

0 8 Conditions inside and outside of the human body often change.

Homeostasis helps the human body to survive changing conditions.

0 8 . 1 Explain what is meant by the term 'homeostasis'.

[2 marks]

The kidneys have an important role in homeostasis.

0 8 . 2 Describe what happens to **glucose**, **protein** and **urea** in the kidneys.

[4 marks]

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Question 30 · continued

0 8 . 3 Explain how ADH affects the production and concentration of urine by the kidneys.

[4 marks]

10

Turn over for the next question

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Question 31

June 2025 | 8461/2H | Original Q4

0 4 Human growth hormone (hGH) is made by the pituitary gland.

0 4 . 1 Name **one other** hormone made by the pituitary gland.

[1 mark]

_____

0 4 . 2 hGH is a protein.

A child with a deficiency of hGH can be given injections of hGH.

What would happen to the hGH if it was given as a tablet that was swallowed?

[1 mark]

_____

_____

Question 4 continues on the next page

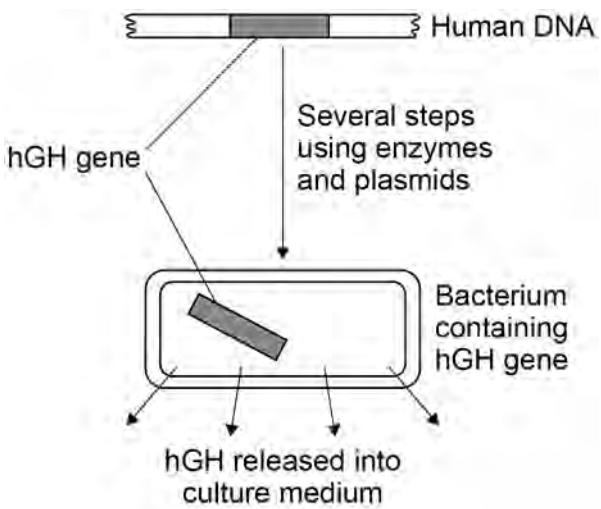
4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Question 31 · continued

Scientists can use genetic engineering to make hGH.

Figure 4 shows a summary of the process.

Figure 4



0 4 . 3 Describe how scientists can transfer the gene for hGH from human cells to bacterial cells.

Use information from **Figure 4**.

[4 marks]

Extra space

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Question 31 · continued

0 4 . 4 Growth hormone (GH) can be extracted from the urine of farm animals.

It is better to use hGH made by genetic engineering than to use GH from the urine of farm animals.

Suggest **two** reasons why.

Do **not** refer to ethical reasons or religious beliefs in your answer

[2 marks]

1 _____

_____

2 _____

_____

8

Turn over for the next question