AQA GCSE Biology | 8461

SPECIFICATION POINT 4.2.2.3

Blood

Past-paper questions

Tier	**Higher**
Question groups	**25**
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.

4.2.2.3 Blood

Question 01

June 2008 | BLY1AP | Original Q1 | Legacy

QUESTION ONE

Our bodies defend themselves naturally against infections. We also use other methods to protect ourselves against infections and to relieve the symptoms of disease.

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

A antibiotics

B painkillers

C antibodies

D vaccines

1	given to people to provide immunity
2	medicines that kill bacteria
3	produced by white blood cells
4	relieve symptoms of disease

4.2.2.3 Blood

Question 02

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)

4.2.2.3 Blood

Question 02 · 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

4.2.2.3 Blood

Question 03

January 2009 | BLY1H | Original Q2 | Legacy

2 The MMR vaccine is used to protect children against measles, mumps and rubella.

2 (a) Complete the sentences about vaccination.

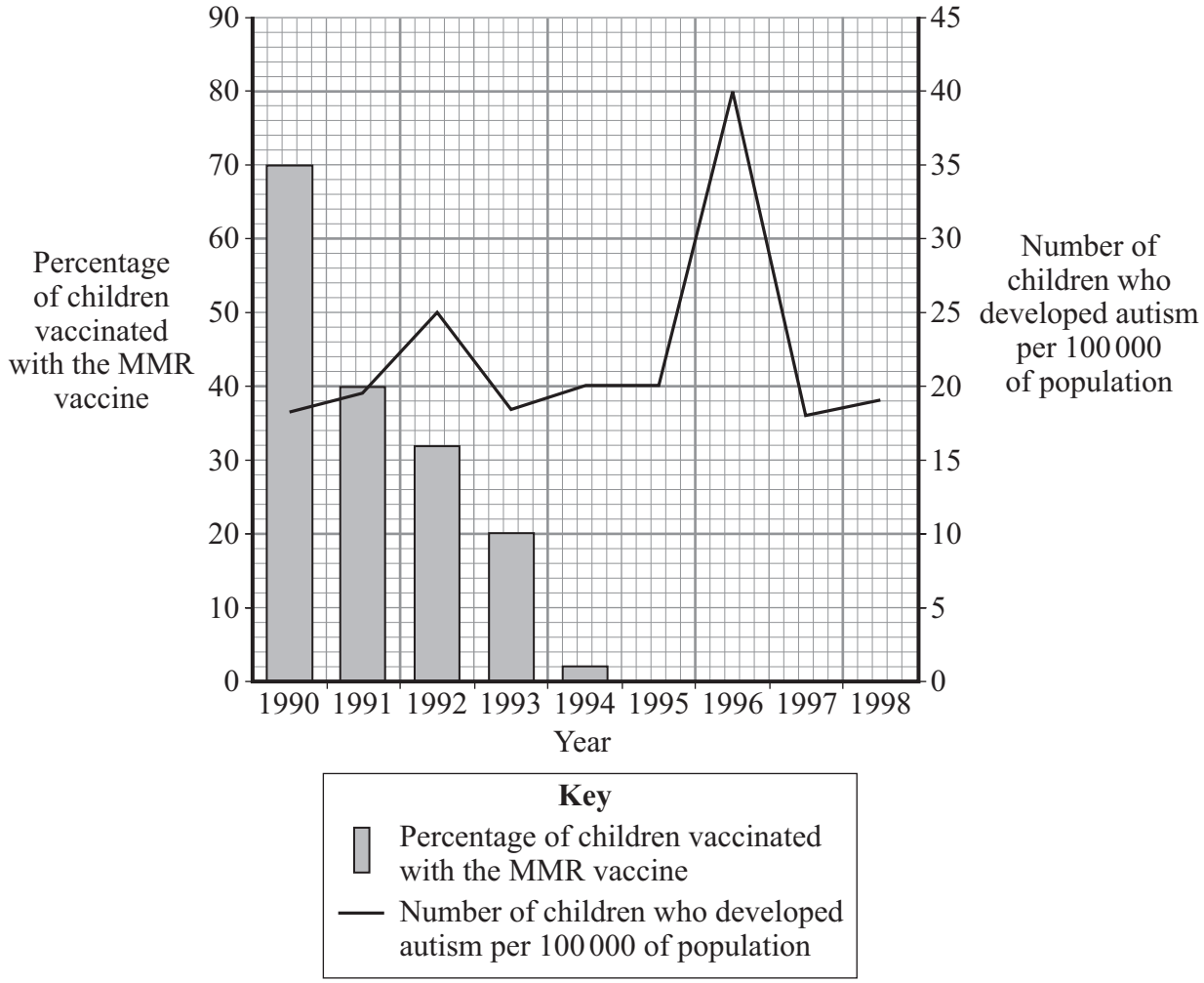
Vaccines stimulate white blood cells to produce ..... .

This makes children ..... to the pathogen.

(2 marks)

2 (b) In the 1990s, many people thought that the MMR vaccine caused autism in some children. As a result, the Japanese government stopped using the MMR vaccine.

The graph gives information about the percentage of children in Japan vaccinated with the MMR vaccine and the number of children who developed autism during the 1990s.



4.2.2.3 Blood

Question 03 · continued

for mark

2 (b) (i) Describe how the percentage of children vaccinated with the MMR vaccine changed between 1990 and 1995.

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(2 marks)

2 (b) (ii) Does the data in the graph support a link between MMR vaccination and autism?

Draw a ring around your answer. **Yes / No**

Explain the reason for your answer.

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(2 marks)

6

4.2.2.3 Blood

Question 04

January 2009 | BLY2H | Original Q2 | Legacy

2 Diabetes is a disease in which a person's blood glucose concentration rises to higher levels than normal.
Diabetes is caused by insufficient insulin being produced.

2 (a) (i) Which organ monitors blood glucose concentration?

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(1 mark)

2 (a) (ii) Insulin reduces the concentration of glucose in the blood.

Describe how insulin does this.

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.....

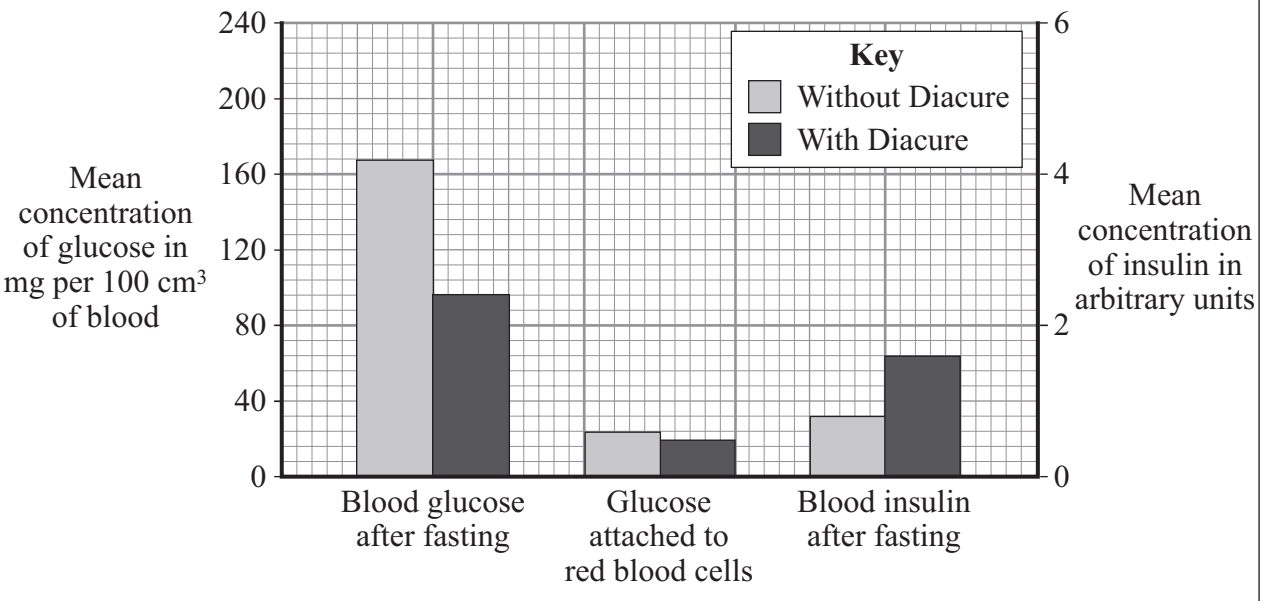
(1 mark)

2 (b) A person with diabetes can be monitored in three ways:

- measuring the blood glucose concentration after fasting (going without food for 12 hours)
- measuring the amount of glucose attached to red blood cells: this is a measure of the average blood glucose concentration over the previous three months
- measuring the concentration of insulin in the blood after fasting

The manufacturer of a new treatment for diabetes, called Diacure, publishes the following two claims.

1. **98.6% of all people who used Diacure reported an improvement in their condition.**
2. **An independent study of 30 diabetic patients showed a significant reduction in blood glucose concentrations and a significant increase in insulin production, as shown by the graph.**



4.2.2.3 Blood

Question 04 · continued

for mark

2 (b) (i) Which of the manufacturer's claims is **not** based on scientific evidence?

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(1 mark)

2 (b) (ii) Why might the data in this study be unreliable?

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(1 mark)

2 (b) (iii) The manufacturer did **not** draw attention to the data for the amount of glucose attached to red blood cells.

Suggest an explanation for this.

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(2 marks)

2 (b) (iv) The study of diabetic patients was carried out by an independent company.

Why is it important that the study should be independent?

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(1 mark)

7

4.2.2.3 Blood

Question 05

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)

4.2.2.3 Blood

Question 05 · 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)

8

4.2.2.3 Blood

Question 06

November 2009 | BLY1AP | Original Q2 | Legacy

QUESTION TWO

The human body defends itself against diseases caused by microorganisms.

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

A antibodies

B antitoxins

C pathogens

D vaccines

Microorganisms that can cause diseases are called . . . **1** . . . .

To kill invading organisms, white blood cells produce . . . **2** . . . .

Poisons produced by microorganisms are neutralised by . . . **3** . . . .

Immunity to a disease can be achieved by using . . . **4** . . . .

4.2.2.3 Blood

Question 07

November 2009 | BLY1AP | Original Q8 | Legacy

QUESTION EIGHT

Some pathogens cause epidemics and pandemics.

8A What is the difference between a pandemic and an epidemic?

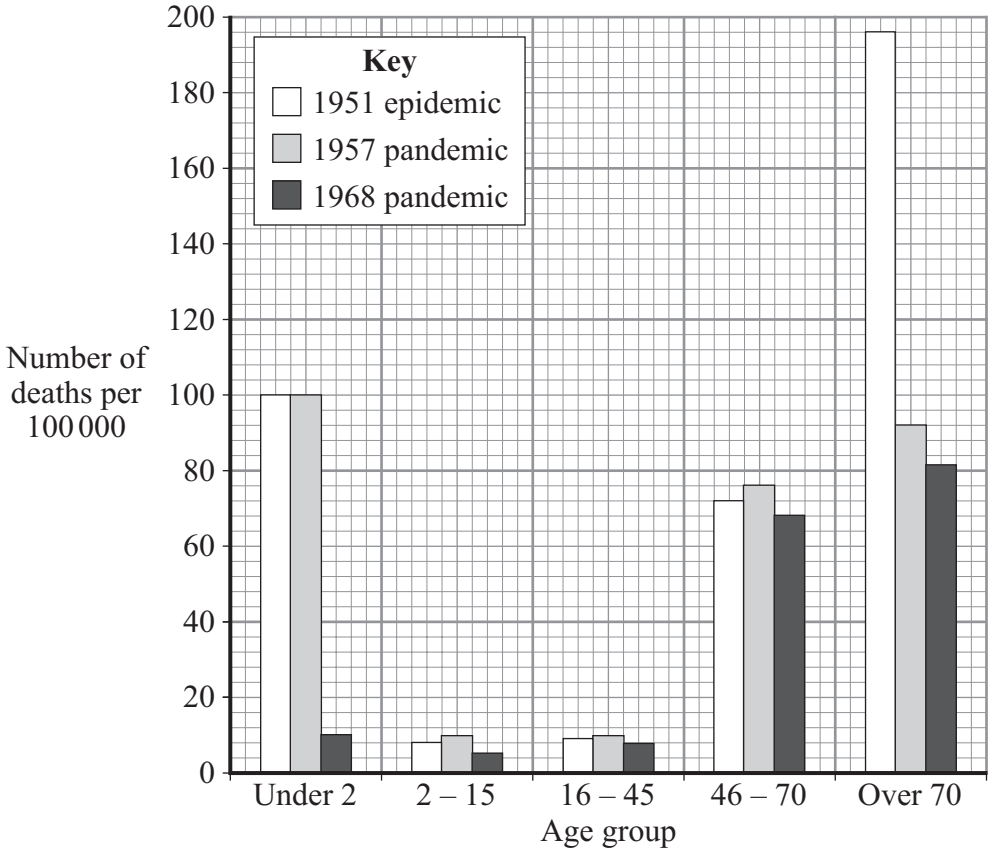
1 An epidemic results in more deaths.

2 A pandemic is caused by viruses and an epidemic is caused by bacteria.

3 Pandemics cause deaths over a wider area.

4 Only an epidemic is caused by a mutation in viruses or bacteria.

The bar chart shows the number of deaths per 100 000 people, due to influenza, in three different years.



4.2.2.3 Blood

8B How many deaths per 100 000 due to influenza in the 46 to 70 age group occurred in the 1951 epidemic?

1 68

2 70

3 72

4 76

8C What conclusion can be drawn from this data?

1 There is no link between age and the number of deaths due to influenza.

2 There were fewer deaths in the 1968 pandemic than in the 1957 pandemic and the 1951 epidemic.

3 In each of the three outbreaks, people over 70 have the highest death rate.

4 During the three outbreaks there were similar death rates for each age group.

8D If a person gets influenza, the body tries to defend itself.

Which of the following statements describes the body's response?

White blood cells . . .

1 produce antitoxins which destroy the pathogen.

2 produce antibiotics which destroy the pathogen.

3 ingest the pathogens.

4 produce antibodies which counteract the toxins.

4.2.2.3 Blood

Question 08

March 2010 | BLY1AP | Original Q3 | Legacy

QUESTION THREE

Measles is a dangerous viral disease which kills about one person in every 1000 people infected. It gives long-term complications for many others. Worldwide, almost 350 000 people, mainly of school age, are killed by measles every year.

After a UK health scare, some parents refused to have their children vaccinated.

In England and Wales:

- in 2006 there were 756 cases of measles
- in 2007 there were 971 cases of measles
- in 2008 there were more than 1300 cases of measles.

3A Approximately how many people are **infected** by measles across the world each year?

1 971

2 350 000

3 350 000 000

4 It is impossible to tell from the data.

3B The rise in the number of people suffering from measles in the UK in recent years . . .

1 can be described as a pandemic.

2 is due to measles viruses mutating.

3 is due to antibiotic resistance.

4 can be described as an epidemic.

4.2.2.3 Blood

Question 08 · continued

3C White blood cells can protect us from pathogens.

Which row in the table shows the way(s) in which this protection can occur?

	Ingesting pathogens	Producing antitoxins	Producing antibodies
1	✓	✓	✗
2	✓	✗	✓
3	✗	✓	✓
4	✓	✓	✓

3D School-age children are more likely to catch measles than adults.

This is because . . .

1 large numbers of children are often close together.

2 children have a poorly developed immune system.

3 the virus multiplies in the soil in playing fields.

4 new vaccines are less effective than older ones in protecting against measles.

4.2.2.3 Blood

Question 09

March 2010 | BLY1AP | Original Q9 | Legacy

QUESTION NINE

Some diseases are caused by viruses. Each type of virus only infects and causes the disease in one species of organism. One of the reasons for this is that a protein on the virus surface only matches with the cells of one particular species of organism.

9A Why does the flu virus make us feel ill?

1 The virus itself produces a toxin.

2 The virus damages the cells in which it reproduces.

3 The large number of viruses increases our temperature.

4 Viruses reproduce rapidly as soon as they are breathed in.

9B Bird flu is caused by a virus.

What might happen to the existing form of bird flu virus that would allow it to infect humans and cause flu in Britain?

1 an increase in the number of birds with the bird flu virus

2 a new strain of bird flu entering Britain

3 a change in the antibody which the bird flu virus carries

4 a change in the protein on the virus surface

4.2.2.3 Blood

Question 09 · continued

Humans produce antibodies against viruses.

A scientist investigated the effect of a virus infection on the antibody concentration in a person's blood.

The person was infected by day 3.

Time in days	1	4	7	10	13	16	19	22	25
Antibody concentration in mg per 100 cm^3 of blood	5.1	6.0	10.4	35.9	55.9	50.2	48.8	32.7	10.0

9C Which conclusion can be drawn from the data?

1 This virus did not reproduce until the 10th day.

2 Antibody production by the body continues to rise until the patient recovers.

3 The patient had recovered by the 25th day.

4 Antibody production by the body rises to a peak after an infection and then declines.

9D Another scientist repeated the investigation but could not measure the antibody concentration directly. Instead, he made measurements using a blood cell counter. He counted the white blood cells using a microscope with an automatic cell counter. A colleague said that he would not trust this data as much as measuring the antibody concentration with a machine.

Which of the reasons below best accounts for his colleague's attitude?

1 There is no relationship between the number of white cells and the concentration of antibodies.

2 Counting white cells is a less sensitive method than measuring antibody concentration with a machine.

3 The antibody measuring machine is more expensive to buy and run.

4 Reading the cell counter is less accurate than reading the scale on the antibody machine.

END OF TEST

4.2.2.3 Blood

Question 10

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.

.....

.....

(1 mark)

4.2.2.3 Blood

Question 10 · 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

4.2.2.3 Blood

Question 11

June 2011 | BLY1H | Original Q3 | Legacy

3 The body's immune system protects us from disease.

Describe the different ways in which white blood cells protect us from infectious diseases.

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(4 marks)

4

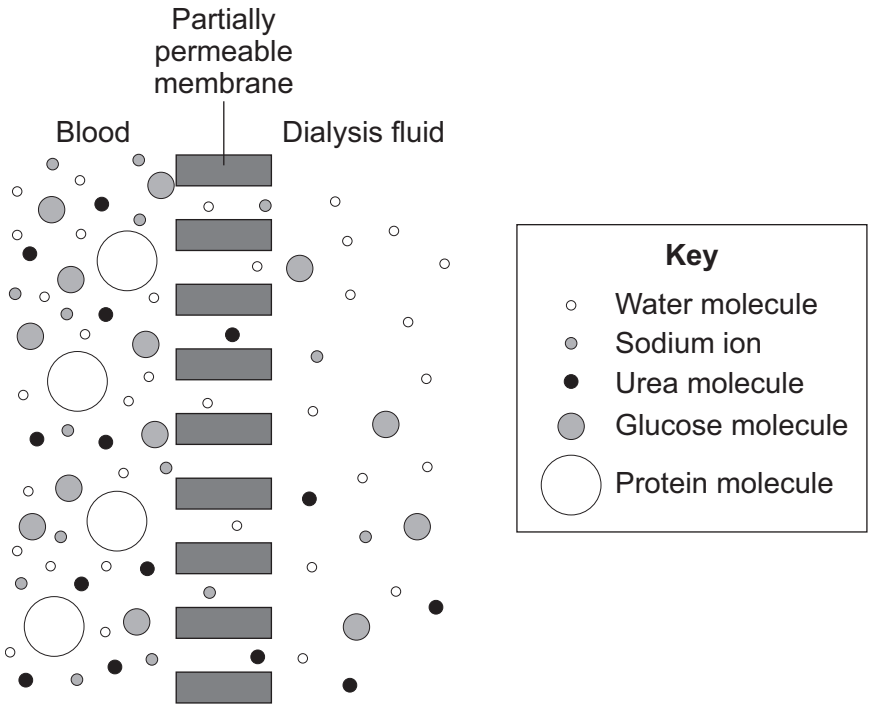
4.2.2.3 Blood

Question 12

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)

4.2.2.3 Blood

Question 12 · 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 .....

.....
(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

4.2.2.3 Blood

Question 13

6 White blood cells protect the body against pathogens such as bacteria and viruses.

6 (a) (i) Pathogens make us feel ill.

Give **one** reason why.

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.....

(1 mark)

6 (a) (ii) White blood cells produce antibodies. This is one way white blood cells protect us against pathogens.

Give **two** other ways that white blood cells protect us against pathogens.

1 .....

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2 .....

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(2 marks)

6 (b) Vaccination can protect us from the diseases pathogens cause.

6 (b) (i) One type of virus causes measles.

A doctor vaccinates a child against measles.

What does the doctor inject into the child to make the child immune to measles?

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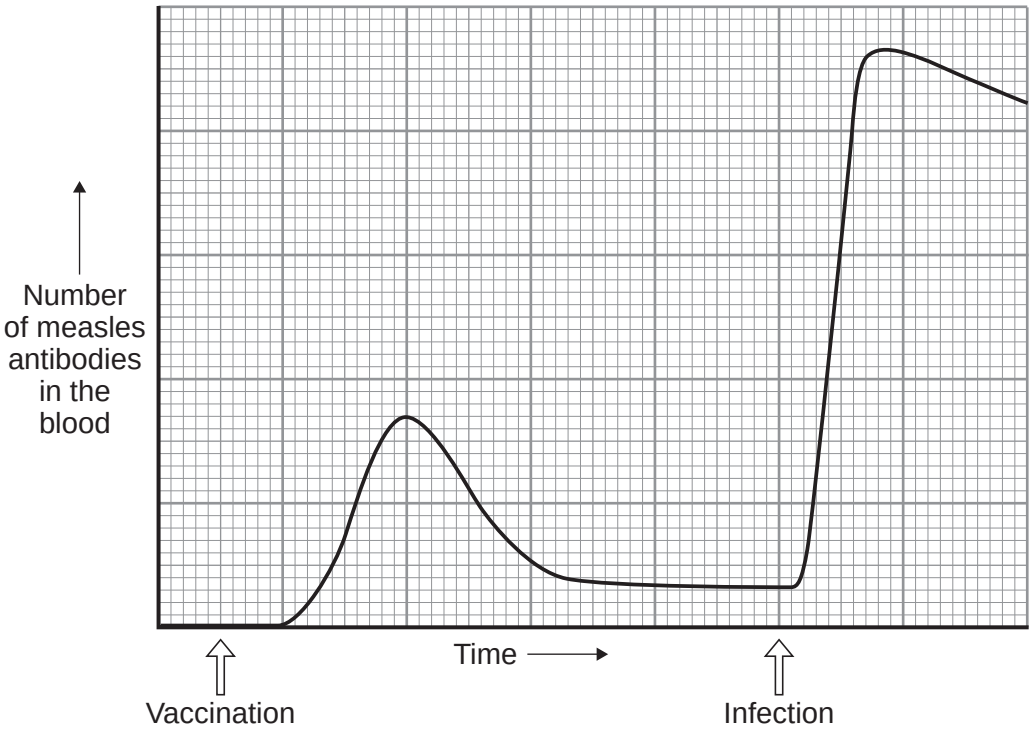
(2 marks)

6 (b) (ii) A few weeks after the vaccination, the child becomes infected with measles viruses from another person.

The graph shows the number of measles antibodies in the child's blood from before the vaccination until after the infection.

4.2.2.3 Blood

Question 13 · continued



More measles antibodies are produced after the infection than after the vaccination.

Describe other differences in antibody production after infection compared with after vaccination.

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(3 marks)

6 (b) (iii) Vaccination against the measles virus will **not** protect the child against the rubella virus.

Why?

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(1 mark)

6 (c) What is the advantage of vaccinating a large proportion of the population against measles?

.....

(1 mark)

10

4.2.2.3 Blood

Question 14

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]

.....

.....

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.

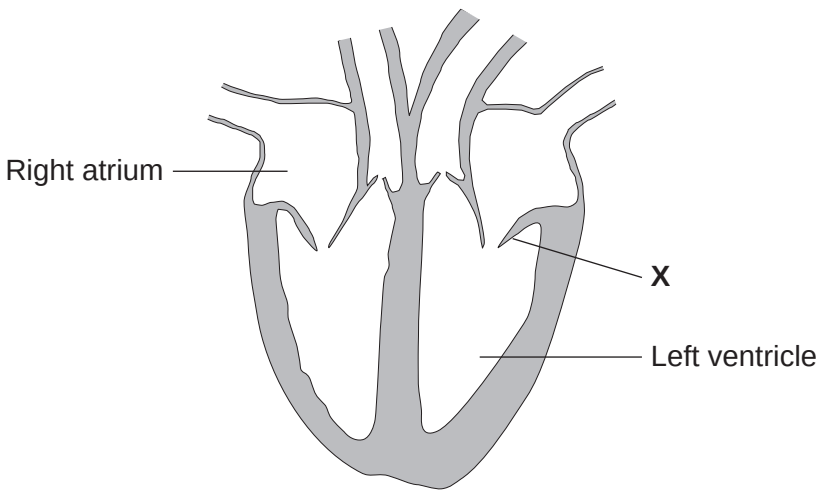
Question 4 continues on the next page

4.2.2.3 Blood

Question 14 · 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]

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6

4.2.2.3 Blood

Question 15

June 2015 | BL3HP | Original Q2 | Legacy

2 The circulatory system transports substances such as glucose and oxygen around the body.

2 (a) Name **two** other substances that the circulatory system transports around the body.

[2 marks]

1 .....

2 .....

2 (b) (i) Blood is a tissue. Blood contains red blood cells and white blood cells.

Name **two** other components of blood.

[2 marks]

1 .....

2 .....

2 (b) (ii) The heart is part of the circulatory system.

What type of tissue is the wall of the heart made of?

[1 mark]

.....

Question 2 continues on the next page

4.2.2.3 Blood

Question 15 · continued

2 (c) **In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.**

Every year, many patients need to have heart valve replacements.

Figure 2 gives information about two types of heart valve.

Figure 2

Living human heart valve	Cow tissue heart valve
• It has been used for transplants for more than 12 years. • It can take many years to find a suitable human donor. • It is transplanted during an operation after a donor has been found. • During the operation, the patient's chest is opened and the old valve is removed before the new valve is transplanted.	• It has been used since 2011. • It is made from the artery tissue of a cow. • It is attached to a stent and inserted inside the existing faulty valve. • A doctor inserts the stent into a blood vessel in the leg and pushes it through the blood vessel to the heart.

A patient needs a heart valve replacement. A doctor recommends the use of a cow tissue heart valve.

Give the advantages and disadvantages of using a cow tissue heart valve compared with using a living human heart valve.

Use information from **Figure 2** and your own knowledge in your answer.

[6 marks]

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4.2.2.3 Blood

Question 16

6 Many people drink sports drinks after exercise.

Table 4 shows some data about five different sports drinks, **P**, **Q**, **R**, **S** and **T**.

Table 4

Sports drink	Concentration of the drink in arbitrary units	Mass per 100 cm^3		
		Sodium ions in mg	Potassium ions in mg	Substance X in g
P	260	45	21	10
Q	170	48	24	9
R	270	112	38	2
S	280	25	6	10
T	493	6	3	13

6 (a) Substance **X** in **Table 4** is used during exercise.

Substance **X** releases energy during exercise.

What is substance **X**?

[1 mark]

_____

6 (b) A sports scientist investigated the effectiveness of sports drinks. She made the following statements:

- the best sports drinks have a slightly lower concentration than blood plasma
- the mean concentration of blood plasma is 280 arbitrary units
- the closer the ratio of sodium ions to potassium ions is to 2:1, the more effective the sports drink.

6 (b) (i) Calculate the ratio of sodium ions to potassium ions in drink **R**.

[1 mark]

_____

_____

Ratio = _____

4.2.2.3 Blood

Question 16 · continued

6 (b) (ii) The scientist stated:

'sports drink **P** is the most effective sports drink'

Use information from part **(b)** and **Table 4** to give reasons why the scientist made this statement.

[2 marks]

6 (b) (iii) Blood cells were placed in a sample of sports drink **T**.

The concentration inside the blood cells was 280 arbitrary units.

Explain what would happen to the blood cells.

[3 marks]

7

4.2.2.3 Blood

Question 17

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]

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

[2 marks]

Tick **two** boxes.

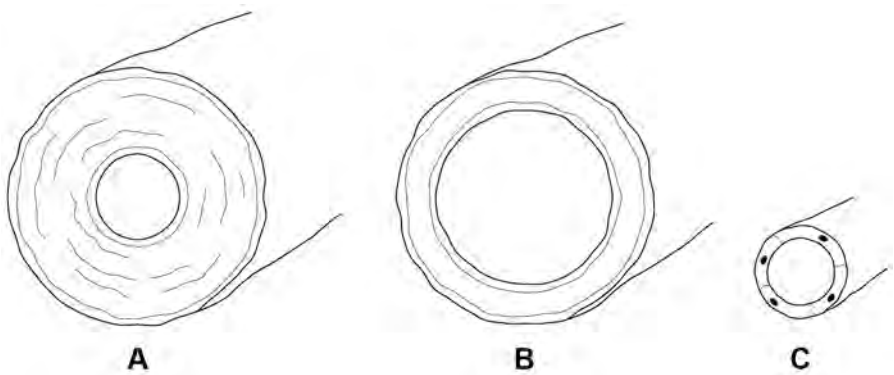
- Aorta ☐
- Coronary artery ☐
- Pulmonary artery ☐
- Pulmonary vein ☐
- Vena cava ☐

4.2.2.3 Blood

Question 17 · 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]

4.2.2.3 Blood

Question 17 · continued

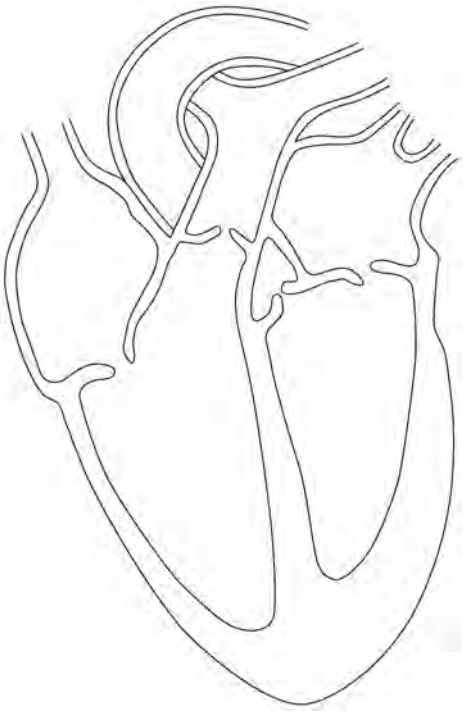
0 3 . 6 Heart rate is controlled by a group of cells. This group of cells act as a pacemaker.

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

4.2.2.3 Blood

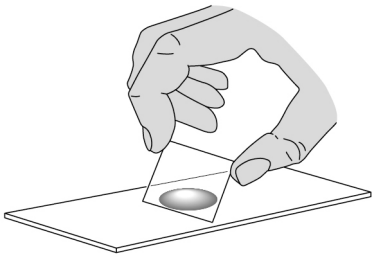
Question 18

November 2021 | 8461/1H | Original Q1

0 1 A student prepared some animal cells to view using a microscope.

Figure 1 shows the student preparing the cells.

Figure 1



0 1 . 1 Name **two** pieces of laboratory equipment the student could have used to **prepare** cells to view using a microscope.

[2 marks]

1 _____

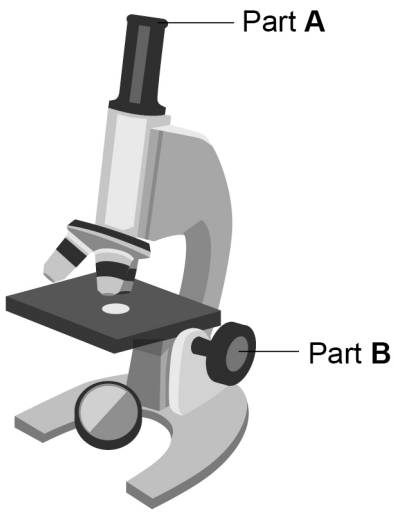
2 _____

4.2.2.3 Blood

Question 18 · continued

Figure 2 shows the student's light microscope.

Figure 2



0 1 . 2 Name part **A**.

[1 mark]

0 1 . 3 What is the function of part **B**?

[1 mark]

0 1 . 4 The student tried to look at the cells using the microscope.

Suggest **one** reason why the student could **not** see any cells when looking through part **A**.

[1 mark]

Question 1 continues on the next page

4.2.2.3 Blood

Question 18 · continued

0 1 . 5 Red blood cells are specialised animal cells.

Compare the structure of a red blood cell with the structure of a plant cell.

[6 marks]

0 1 . 6 When placed into a beaker of water:

- a red blood cell bursts
- a plant cell does **not** burst.

Explain why the red blood cell bursts but the plant cell does **not** burst.

[2 marks]

13

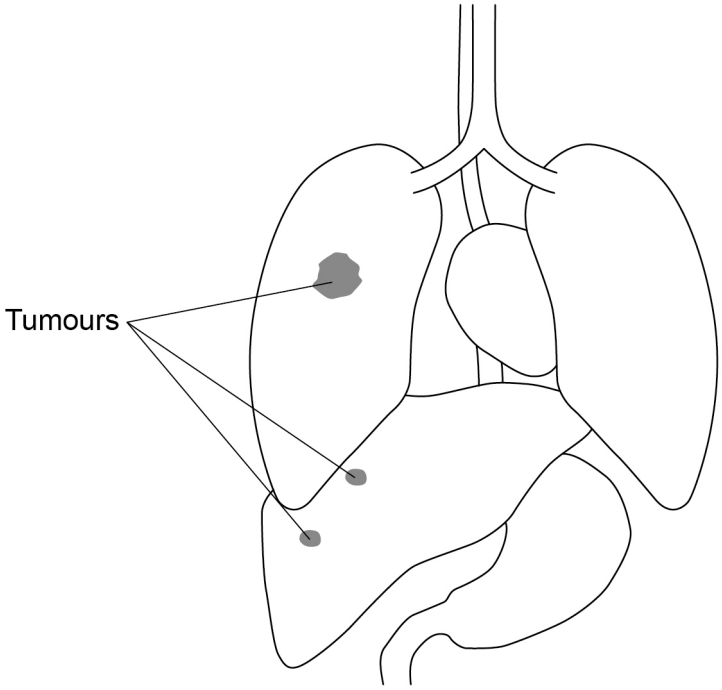
4.2.2.3 Blood

Question 19

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]

4.2.2.3 Blood

Question 19 · 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 19 · continued

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

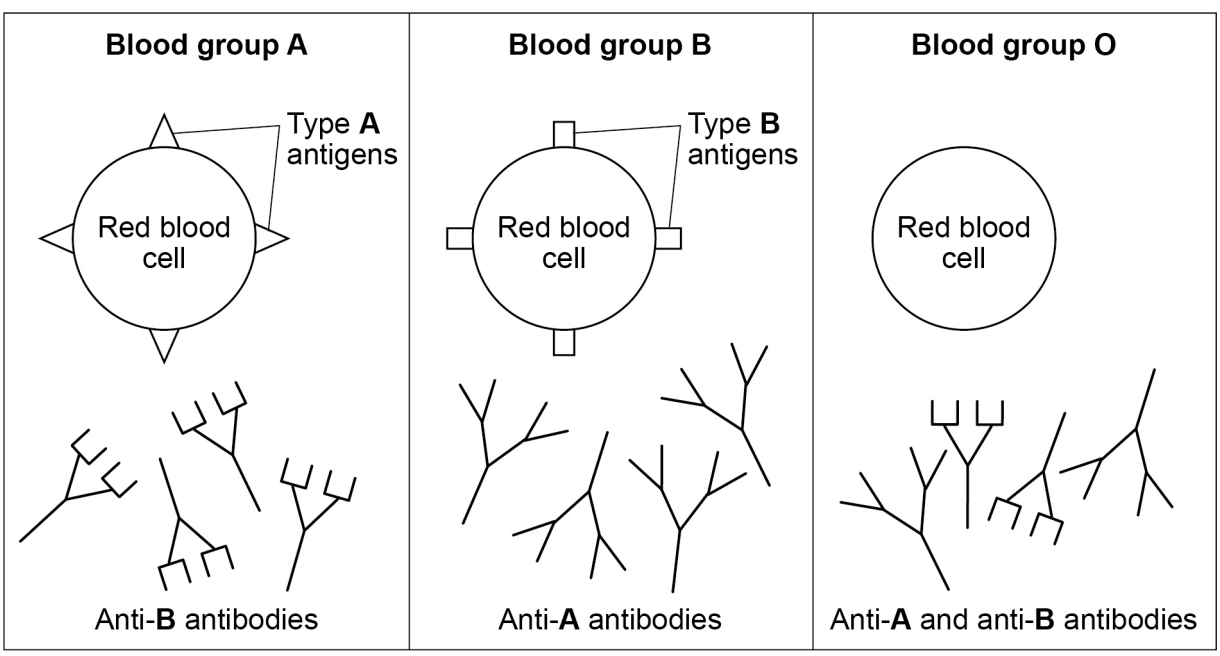
A blood transfusion is where a patient receives blood from a donor.

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.

4.2.2.3 Blood

Question 19 · 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

4.2.2.3 Blood

Question 19 · 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 ☐

4.2.2.3 Blood

Question 19 · 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

4.2.2.3 Blood

Question 20

November 2021 | 8461/2H | Original Q8

0 8 Sickle cell anaemia is an inherited condition that affects red blood cells.

Sickle cell anaemia is caused by a mutation in the gene for haemoglobin. Haemoglobin is the red pigment found in red blood cells.

A person who is homozygous for the normal haemoglobin allele (H^A) produces normal red blood cells.

A person who is homozygous for the mutated allele (H^S):

- produces red blood cells with abnormal haemoglobin
- has red blood cells that can form an altered shape
- has sickle cell anaemia and becomes ill.

A person who is heterozygous:

- has both normal and abnormal haemoglobin in the red blood cells
- has sickle cell trait
- is generally healthy but can become ill in certain circumstances.

0 8 . 1 Give the reason why a mutation in the gene coding for haemoglobin could be harmful.

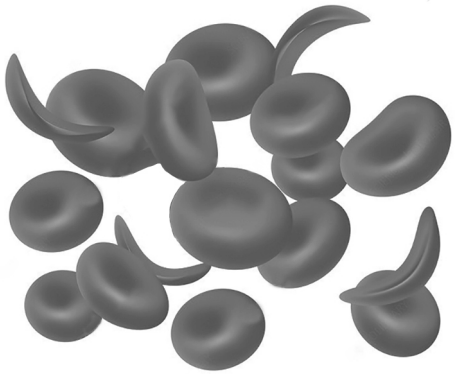
[1 mark]

4.2.2.3 Blood

Question 20 · continued

0 8 . 2 **Figure 13** shows some red blood cells from the blood of a person with sickle cell trait.

Figure 13



Calculate the proportion of cells in **Figure 13** that have an altered shape.

[2 marks]

Proportion = _____

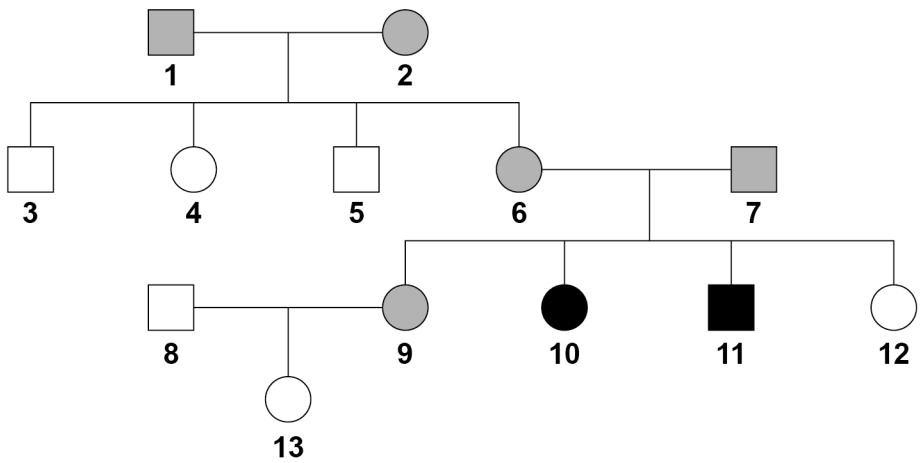
Question 8 continues on the next page

4.2.2.3 Blood

Question 20 · continued

Figure 14 shows the inheritance of sickle cell anaemia in one family.

Figure 14



Key

- Unaffected male
- Unaffected female
- Male with sickle cell anaemia
- Female with sickle cell anaemia
- Male with sickle cell trait
- Female with sickle cell trait

4.2.2.3 Blood

Question 20 · continued

0 8 . 3 Persons **8** and **9** in **Figure 14** are expecting a second child.

Determine the probability that the child will be a girl with sickle cell trait.

You should:

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

  H^A = normal haemoglobin allele

  H^S = mutated haemoglobin allele.

[5 marks]

Probability of a girl with sickle cell trait = _____

Question 8 continues on the next page

4.2.2.3 Blood

Question 20 · continued

0 8 . 4 Without medical treatment, people with sickle cell anaemia are frequently ill and have a reduced life expectancy.

The malarial parasite cannot live in the red blood cells of a person who has the $\mathbf{H^S}$ allele.

A scientist stated:

'It is an advantage for people to have the $\mathbf{H^S}$ allele in countries where malaria occurs.'

Evaluate the scientist's statement.

[3 marks]

11

4.2.2.3 Blood

Question 21

June 2023 | 8461/1H | Original Q5

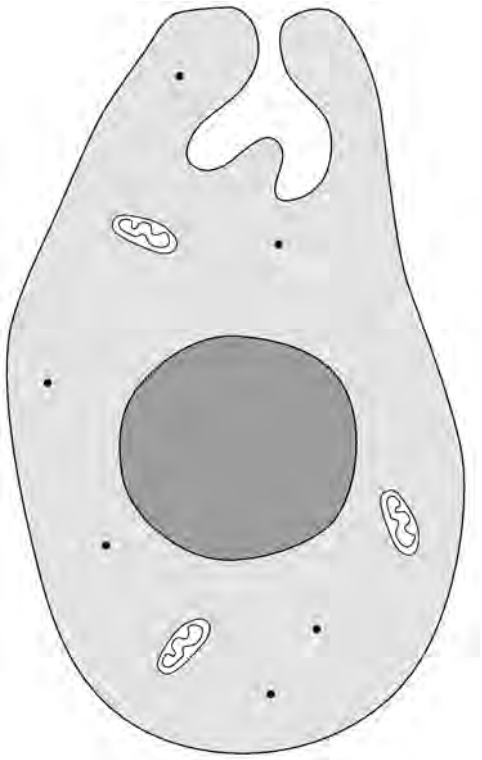
0 5 The protist that causes malaria is passed from one person to another person by mosquitos.

0 5 . 1 What term describes an organism that passes a pathogen from one person to another person?

[1 mark]

0 5 . 2 **Figure 7** shows the malarial protist.

Figure 7



4.2.2.3 Blood

Question 21 · continued

The malarial protist is a eukaryotic cell.

Describe **three** ways the structure of the malarial protist is different from the structure of a prokaryotic cell.

Do **not** refer to size in your answer.

[3 marks]

1 _____

2 _____

3 _____

0 5 . 3 During one stage of malaria infection, the malarial protists enter red blood cells and cause them to burst.

Explain why the bursting of red blood cells causes tiredness.

[2 marks]

_____

_____

_____

_____

Question 5 continues on the next page

4.2.2.3 Blood

Question 21 · continued

0 5 . 4 The malarial protist reproduces sexually and asexually during a life cycle.

Complete **Table 3** to give **three** differences between sexual reproduction and asexual reproduction.

[3 marks]

One difference has been completed for you.

Table 3

	Sexual reproduction	Asexual reproduction
	Involves two parents	Involves one parent
1		
2		
3		

0 5 . 5 One drug for treating malaria prevents mitosis occurring in the malarial protist.

The drug stops the synthesis of new DNA bases in the cell.

Suggest how the drug prevents mitosis occurring.

[1 mark]

4.2.2.3 Blood

Question 21 · continued

0 5 . 6 Describe the process of cell division by mitosis.

[3 marks]

Question 5 continues on the next page

Question 21 · continued

0 5 . 7 Different types of disease may interact.

Scientists studied the incidence of malaria infections in children:

- with disorder **S**
- without disorder **S**.

The incidence of malaria in children with disorder **S** was calculated as a percentage of the incidence in children without disorder **S**.

Table 4 shows the results.

Table 4

Age in years	Calculated percentage (%) incidence of malaria in children with disorder S
2 to < 4	69
4 to < 6	63
6 to < 8	50
8 to 10	45
> 10	73

Describe what the results in **Table 4** show about the interaction between disorder **S** and malaria.

[2 marks]

15

4.2.2.3 Blood

Question 22

0 6 This question is about pathogens.

A scientist investigated antibiotic resistance in bacteria.

0 6 . 1 Name **one** antibiotic.

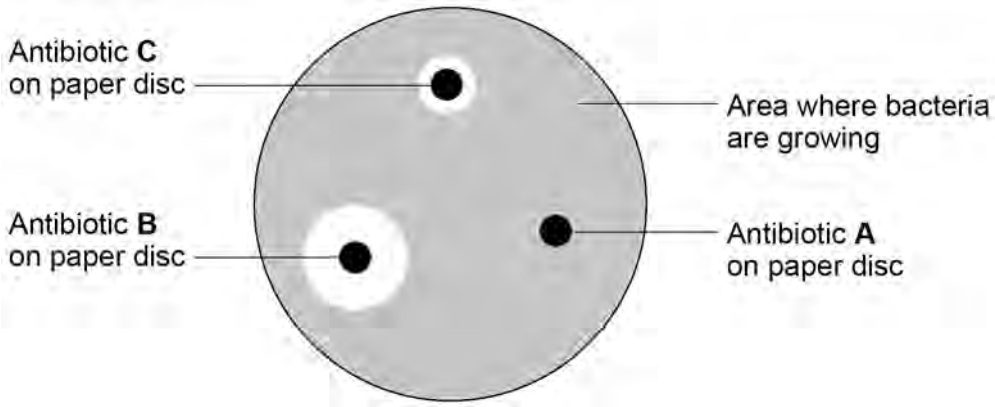
[1 mark]

The scientist grew one type of bacterium on agar in a Petri dish.

The scientist placed paper discs each containing a different antibiotic on the agar.

Figure 5 shows the appearance of the Petri dish after 2 days.

Figure 5



4.2.2.3 Blood

Question 22 · continued

0 6 . 2 A student said:

‘The bacterium is resistant to antibiotic **C**.’

Explain how the results in **Figure 5** show that the student is **not** correct.

[2 marks]

0 6 . 3 Suggest why doctors are concerned about antibiotic resistance.

[2 marks]

Question 6 continues on the next page

4.2.2.3 Blood

Question 22 · continued

Diseases caused by viruses **cannot** be treated using antibiotics.

0 6 . 4 Suggest why viruses **cannot** be grown on agar.

[1 mark]

0 6 . 5 Why is it difficult for scientists to develop drugs to destroy viruses?

[1 mark]

0 6 . 6 Which disease is caused by a virus that damages white blood cells?

[1 mark]

Tick (✓) **one** box.

- AIDS ☐
- Gonorrhoea ☐
- Measles ☐
- Salmonella ☐

8

4.2.2.3 Blood

Question 23

June 2025 | 8461/1H | Original Q5

0 5 This question is about the human circulatory system.

0 5 . 1 Blood plasma transports blood cells around the body.

Give **one** other function of blood plasma.

Do **not** refer to oxygen in your answer.

[1 mark]

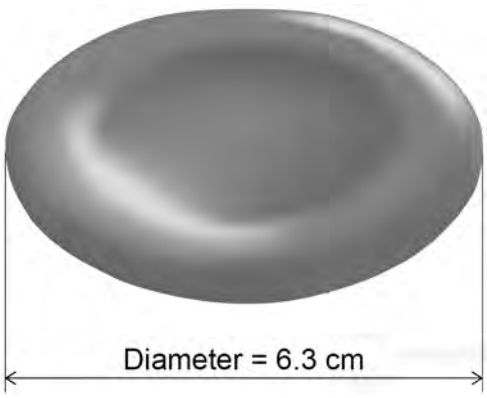
Question 5 continues on the next page

4.2.2.3 Blood

Question 23 · continued

0 5 . 2 **Figure 5** shows a red blood cell.

Figure 5



The image of the red blood cell in **Figure 5** is magnified 7200 times.

Calculate the real diameter of the red blood cell.

Give your answer in micrometres (µm).

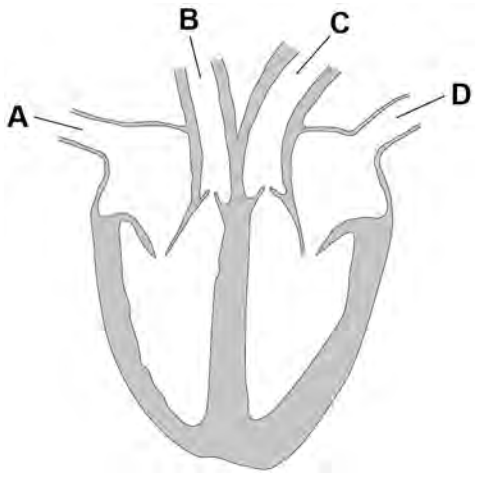
[5 marks]

Real diameter = _____ µm

Question 23 · continued

Figure 6 shows the heart.

Figure 6



0 5 . 3 Blood pressure is a measure of the force of the blood against the walls of the blood vessels.

Table 5 shows information about the different types of blood vessel shown in **Figure 6**.

[2 marks]

Table 5

Pressure of blood travelling through blood vessel in arbitrary units	Blood vessel in Figure 6
4	**D**
5	
18	
120	

Complete **Table 5** using the correct letters from **Figure 6**.

One row has been completed for you.

0 5 . 4 Name blood vessel **D** in **Figure 6**.

[1 mark]

Question 5 continues on the next page

4.2.2.3 Blood

Question 23 · continued

0 5 . 5 Describe the structure of the walls of an artery.

[1 mark]

An athlete ran on a running machine.

The athlete:

- reached their maximum intensity of exercise and then stopped exercising
- had their use of oxygen recorded
- had the lactic acid concentration in their blood recorded.

0 5 . 6 During the exercise the athlete respired aerobically **and** anaerobically.

Explain why anaerobic respiration is less efficient than aerobic respiration.

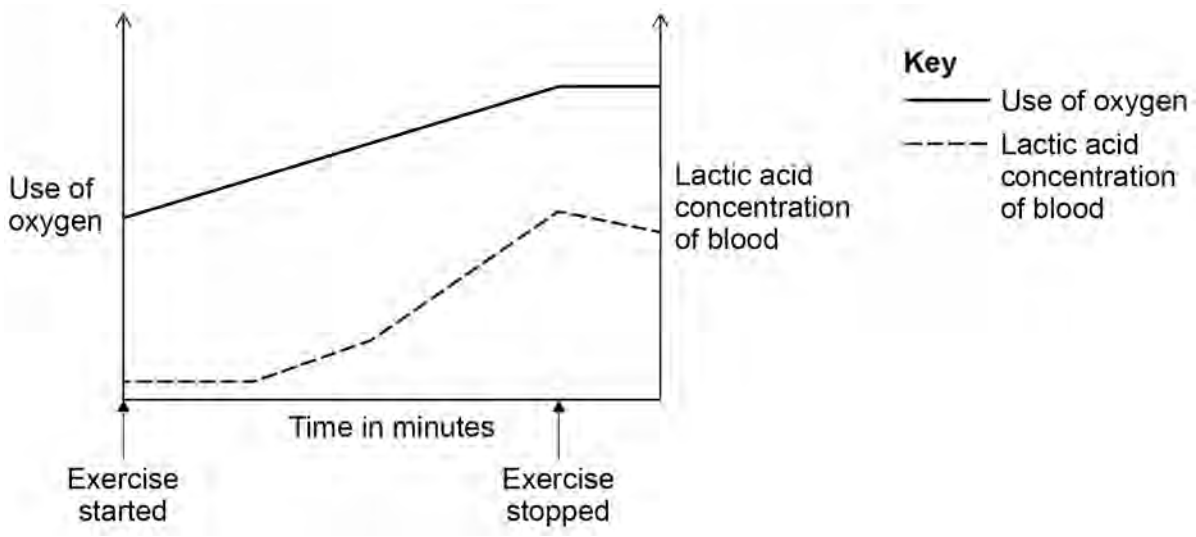
[2 marks]

4.2.2.3 Blood

Question 23 · continued

Figure 7 shows the athlete's use of oxygen and the lactic acid concentration of blood during exercise and after exercise.

Figure 7



0 5 . 7 Explain why the use of oxygen remained high **after** the athlete stopped exercising.

[2 marks]

Question 5 continues on the next page

4.2.2.3 Blood

Question 23 · continued

0 5 . 8 Some athletes regularly exercise in conditions that increase the number of red blood cells.

Explain why having an increased number of red blood cells is an advantage to an athlete.

[2 marks]

16

4.2.2.3 Blood

Question 24

June 2025 | 8461/1H | Original Q7

0 7 In people with severe liver disease the liver stops working correctly.

A person with severe liver disease can be treated with:

- an injection of embryonic stem cells
  or
- a liver transplant from a donor.

The person's body can reject embryonic stem cells and can reject a liver transplanted from a donor.

0 7 . 1 What property of embryonic stem cells makes them suitable to treat liver disease?

[1 mark]

0 7 . 2 Suggest **one ethical** reason why a person may **not** want an injection of embryonic stem cells.

[1 mark]

Question 24 · continued

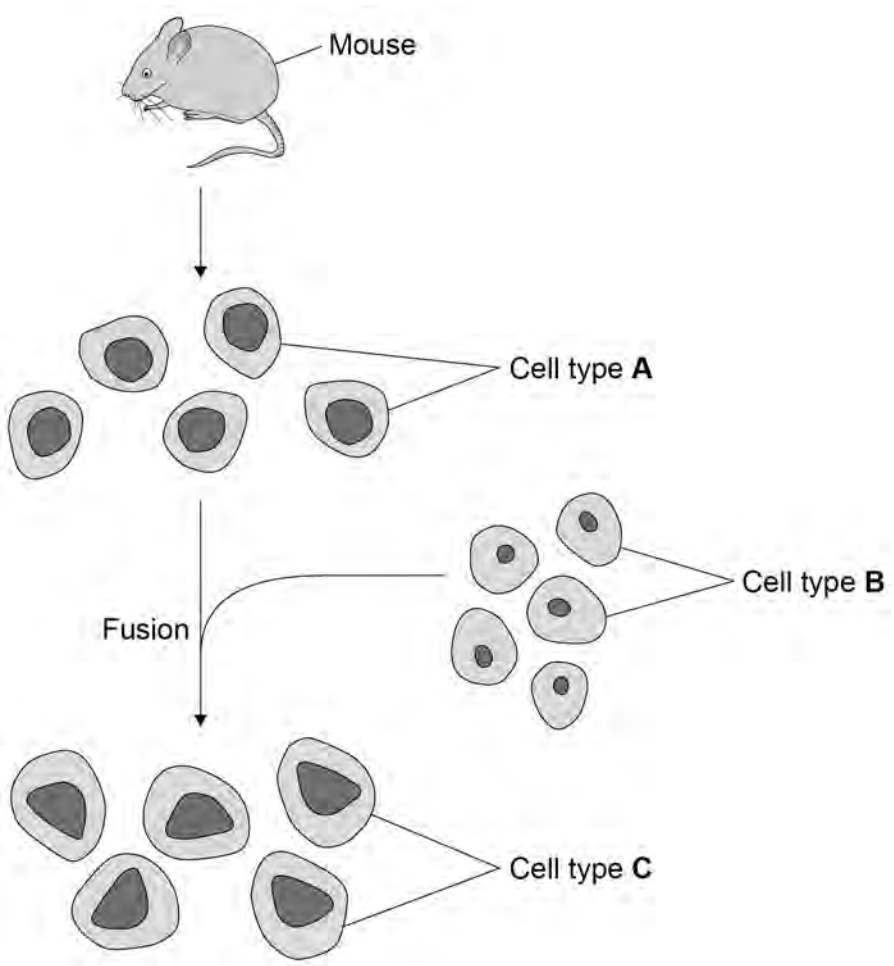
Drugs can be used to reduce the risk of liver rejection after a transplant.

One drug contains monoclonal antibodies.

The monoclonal antibodies are specific to an antigen on the surface of liver cells.

Figure 9 shows part of the process used to create the monoclonal antibodies.

Figure 9



0 7 . 3 Name the **three** types of cell in **Figure 9**.

[3 marks]

A _____

B _____

C _____

4.2.2.3 Blood

Question 24 · continued

0 7 . 4 How is the mouse stimulated to produce cell type **A**?

[1 mark]

0 7 . 5 A patient with severe liver disease was given a liver transplant.

The drug containing the monoclonal antibody is given to the patient.

Explain how the monoclonal antibody stops the patient's white blood cells from attacking the cells of the donor liver.

[3 marks]

0 7 . 6 Give **one** other use of monoclonal antibodies.

Do **not** refer to pregnancy tests.

[1 mark]

Question 7 continues on the next page

4.2.2.3 Blood

Question 24 · continued

The liver produces bile.

Bile is needed for efficient digestion.

0 7 . 7 Where is bile stored in the human body?

[1 mark]

Tick (✓) **one** box.

- Gall bladder ☐
- Kidney ☐
- Pancreas ☐
- Small intestine ☐

0 7 . 8 Explain why a person with severe liver disease has difficulty digesting fats.

[6 marks]

17

4.2.2.3 Blood

Question 25

June 2025 | 8461/2H | Original Q9

0 9 Type 2 diabetes is a condition that has become more common in recent years.

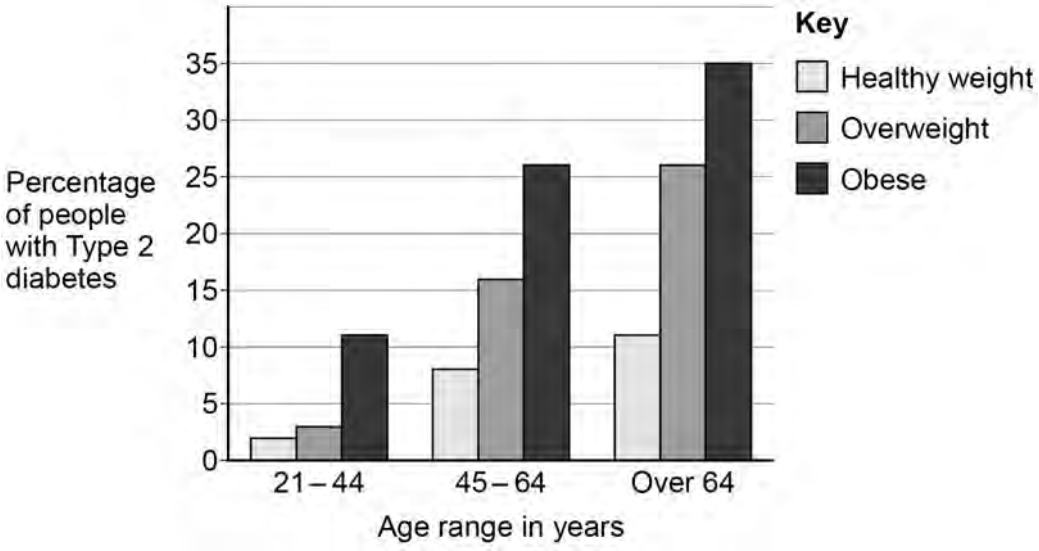
0 9 . 1 Scientists recorded the percentage of people of different ages who had Type 2 diabetes.

The people were in different weight categories:

- healthy weight
- overweight
- obese.

Figure 10 shows the results.

Figure 10



Give **two** conclusions from the results in **Figure 10**.

[2 marks]

1 _____

_____

2 _____

_____

Question 9 continues on the next page

Two groups of scientists investigated the use of different drugs to treat Type 2 diabetes.

In both investigations, the scientists measured the percentage of haemoglobin with glucose attached (Hb-G).
This showed the long-term concentration of glucose in the blood.

Investigation 1:

The scientists injected drug **A** into 175 patients with Type 2 diabetes once each day for 12 weeks.

Table 4 shows the results.

Table 4

	Mean value	
	At start	**At 12 weeks**
Percentage (%) of haemoglobin with glucose attached (Hb-G)	9.2	7.6

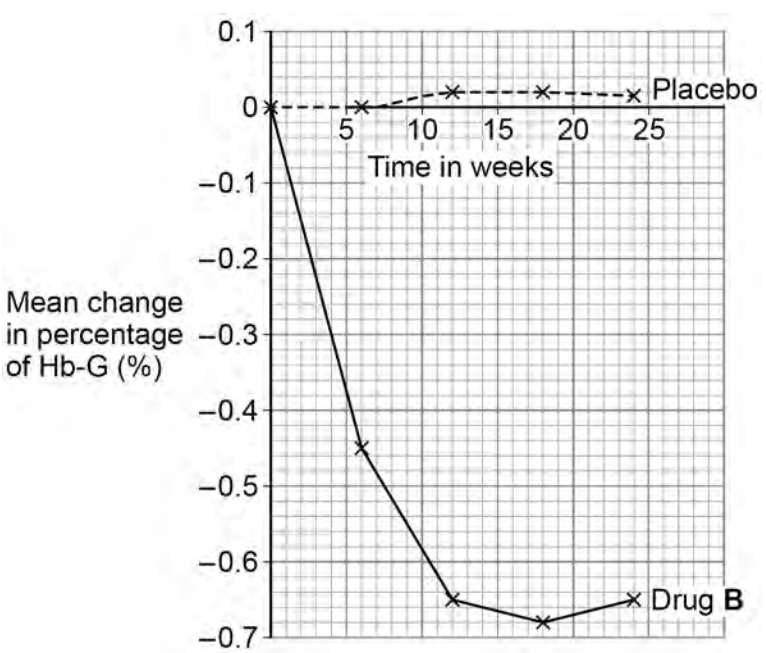
Investigation 2:

631 patients with Type 2 diabetes took one tablet containing drug **B** each day.
A control group of 630 patients took a placebo tablet each day.

The scientists measured the Hb-G in each patient's blood at the start of the investigation and at 6-week intervals up to 24 weeks.

Figure 11 shows the results.

Figure 11



4.2.2.3 Blood

Question 25 · continued

0 9 . 2 For the patients treated with drug **B** the mean percentage of Hb-G at the start was 8.3%.

What was the mean percentage of Hb-G after 12 weeks for the patients treated with drug **B**?

[1 mark]

Tick (✓) **one** box.

0.65% ☐ 0.75% ☐ 7.65% ☐ 8.95% ☐

0 9 . 3 In a person **without** diabetes, the Hb-G value is between 4.5% and 6%.

When treating patients with Type 2 diabetes, doctors think that an Hb-G value <7% is acceptable.

Evaluate:

- the methods used in the investigations
- the usefulness of drug **A** and drug **B** for controlling Type 2 diabetes.

[6 marks]

Extra space

9