GradeMax

Pearson Edexcel International GCSE (9–1)

Time 1 hour 45 minutes

Paper reference **4HB1/02R**

Human Biology

UNIT: 4HB1
PAPER: 02R

You must have:
Ruler
Calculator

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name,
  centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
  – *there may be more space than you need*.
- Show all the steps in any calculations and state the units.

Information

- The total mark for this paper is 90.
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question*.

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

P 7 0 9 5 0 A 0 1 2 4

Pearson

Answer ALL questions.

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

1 A student investigates whether there is more carbon dioxide in expired air than in inspired air.

This is the apparatus the student uses.

conical flasks

rubber tubing

glass T piece

bungs with glass tubing

beaker containing indicator
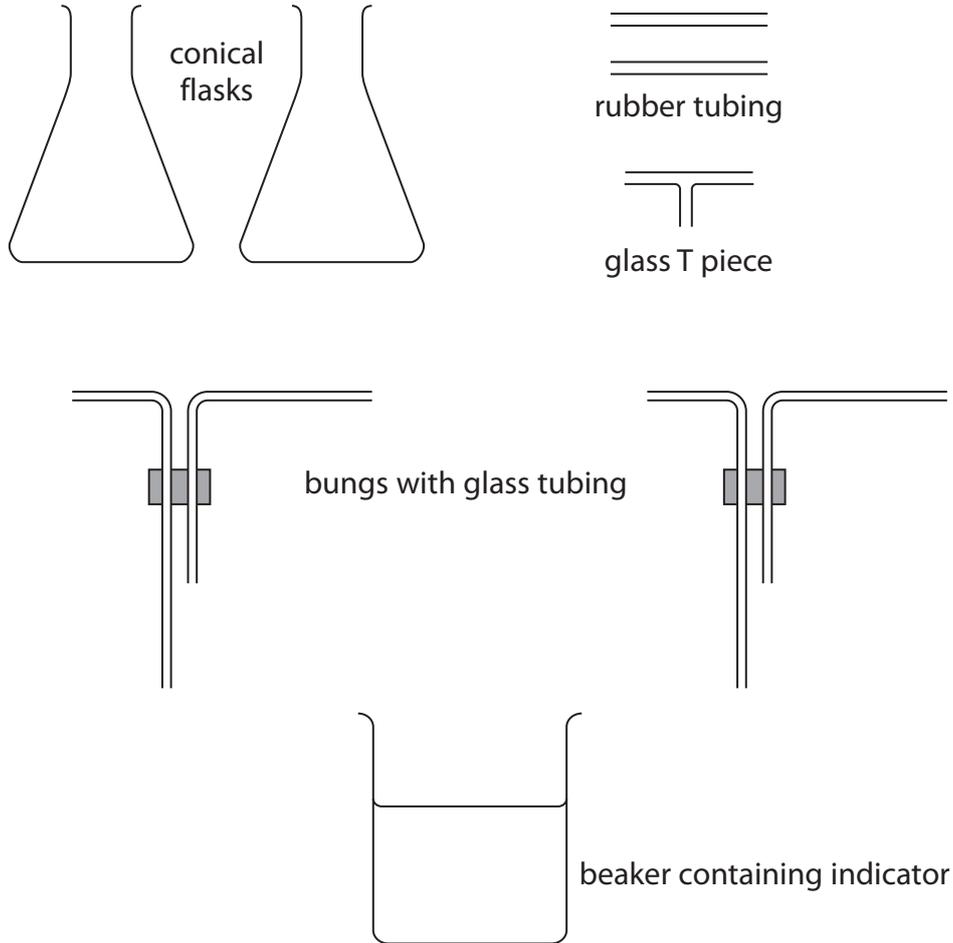
The apparatus is not drawn to scale.

(a) Draw a diagram to show how the apparatus should be put together for the investigation.

(3)

(b) Name an indicator that could be used in the investigation.

(1)

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(c) Describe how the apparatus would be used to determine whether there is more carbon dioxide in expired air than in inspired air.

(4)

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(d) State one safety precaution.

(1)

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(e) State one variable that should be controlled.

(1)

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(Total for Question 1 = 10 marks)

2 A student investigates the effect of a competitive inhibitor on the action of the enzyme phosphatase.

This is the reaction catalysed by the enzyme.

phenolphthalein phosphate $\longrightarrow$ phenolphthalein + phosphate
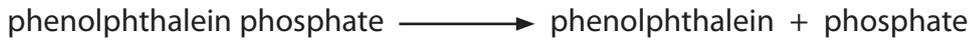
Phenolphthalein turns pink when an alkali is added.

This colour can be measured using a colorimeter. The more intense the colour, the higher the reading on the colorimeter.

This is the student's method.

- prepare six different concentrations of phenolphthalein phosphate solution

- place $5.0\,cm^3$ of each solution into a different test tube

- add $1.0\,cm^3$ of a competitive inhibitor and $1.0\,cm^3$ of the enzyme phosphatase into each test tube

- wait 30 minutes, then add $1.0\,cm^3$ of an alkali to each tube

- measure the intensity of the pink colour using a colorimeter

(a) (i) Give a suitable control for this investigation.

(2)

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(ii) State three variables that should be kept constant in this investigation.

(3)

1 ....

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2 ....

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3 ....

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(b) The table shows the student's results.

Concentration of phenolphthalein phosphate solution in arbitrary units	Intensity of pink colour in arbitrary units
0.05	0.20
0.10	0.30
0.20	0.47
0.40	0.65
0.60	0.79
0.80	0.91

(i) Plot the results of the investigation.

(3)

(ii) Draw a curve of best fit.

(1)
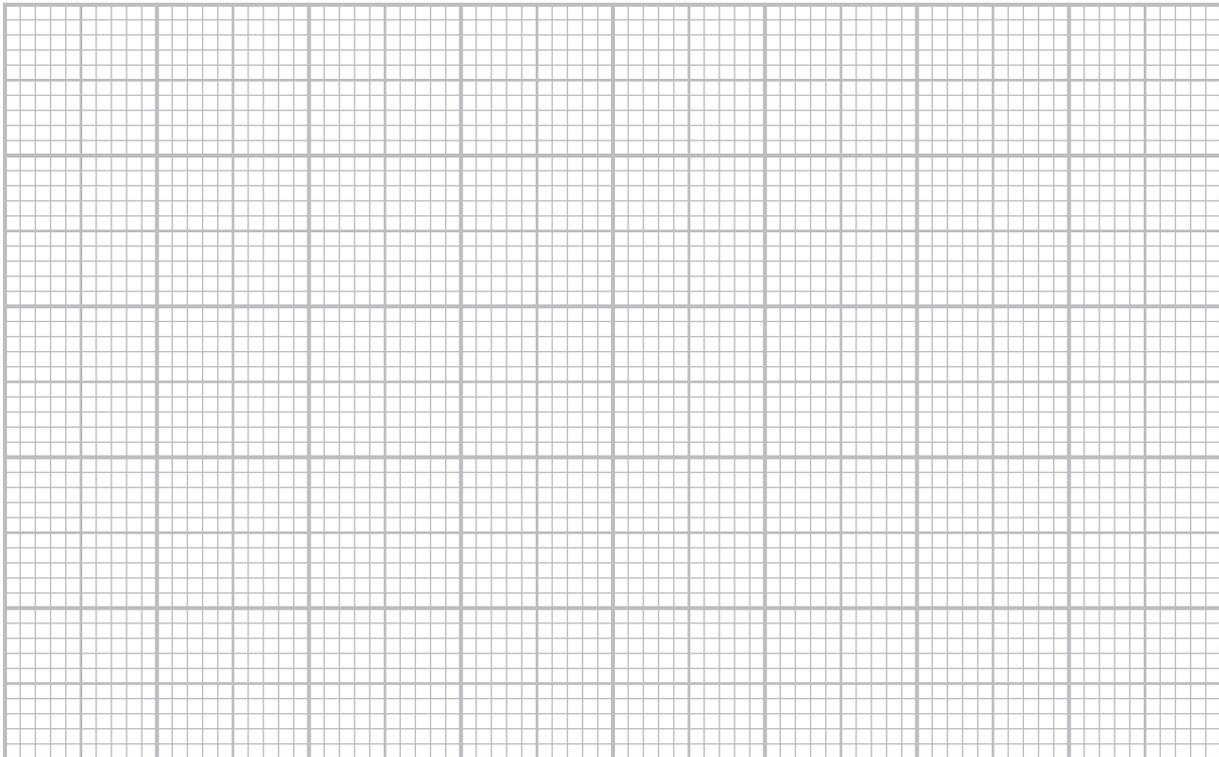
(iii) Add a second curve to show the results that would be obtained if the competitive inhibitor had not been added.

(2)

(c) Describe how the results of the investigation would be different if a non-competitive inhibitor had been used instead of a competitive inhibitor.

(2)

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(Total for Question 2 = 13 marks)

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3 (a) The diagram shows two types of blood vessel, A and B.
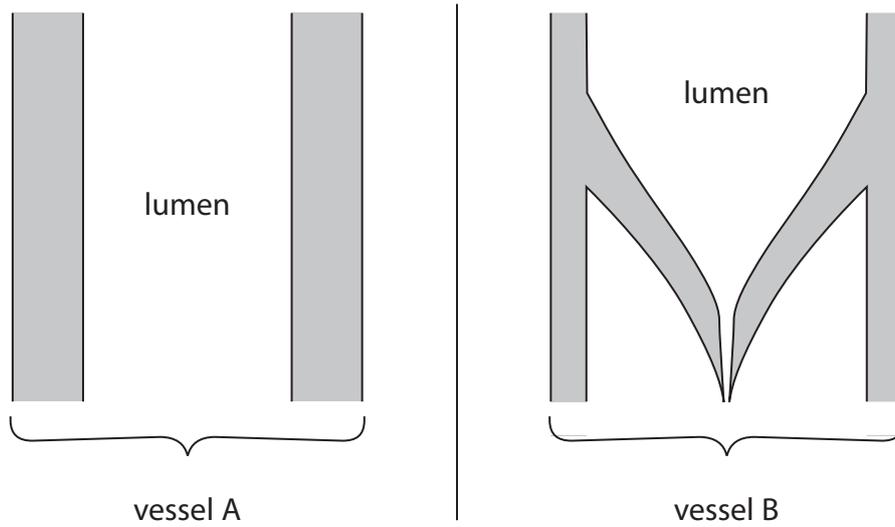
vessel A   vessel B

(i) Draw an arrow on the diagram to show the direction of blood flow in vessel B.

(1)

(ii) Identify each type of blood vessel, giving explanations for why there are differences in their structures.

(4)

Vessel A

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Vessel B

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(iii) State the name of one other type of blood vessel.

(1)

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(b) Coronary heart disease kills many people each year. The graph shows the number of deaths per 100 000 of the whole population in a part of the world.

Deaths from coronary heart disease per 100 000 population

Year

Key

◆——— Males

---■--- Females
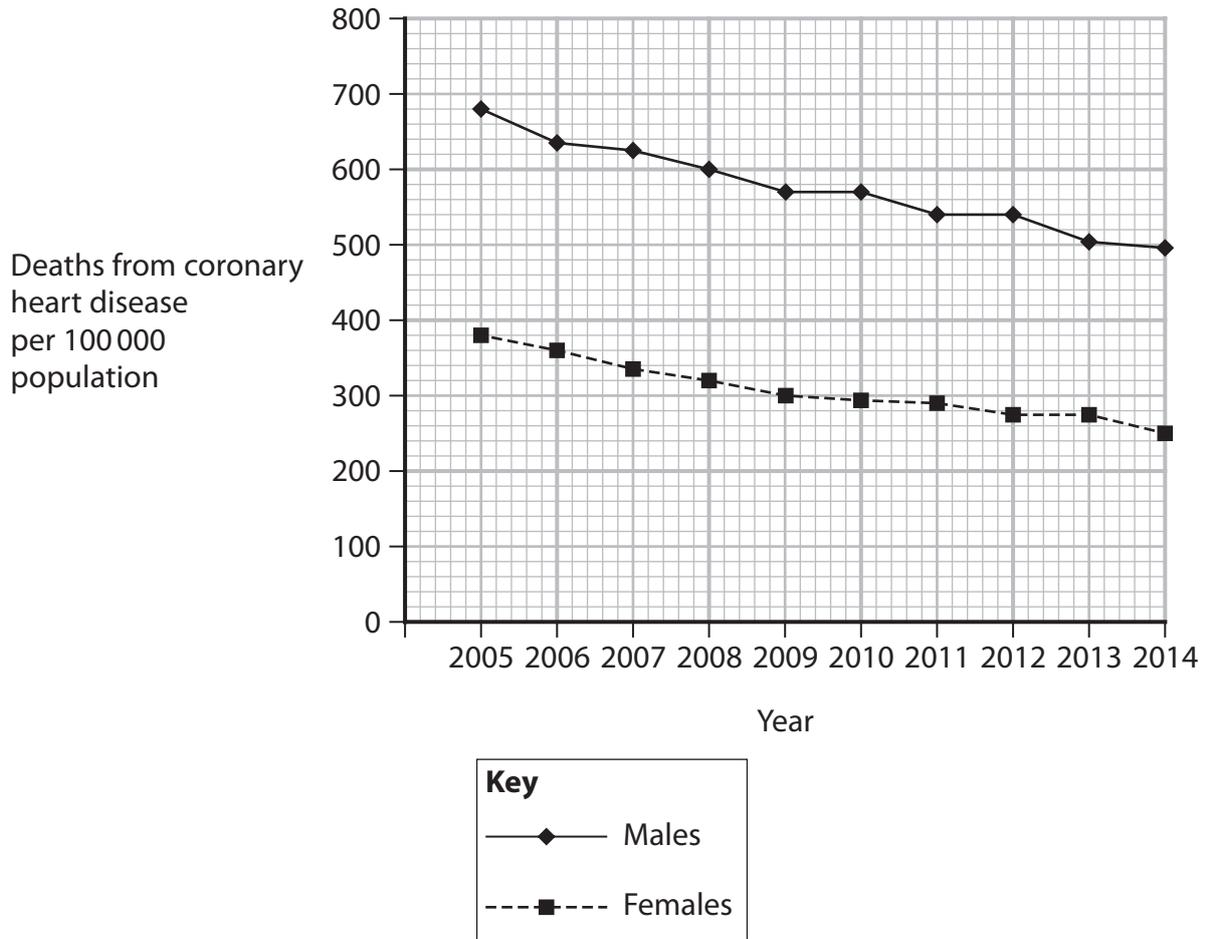
(i) Describe the trends shown by the graph.

(3)

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(ii) The part of the world for which the data was collected had a population of 60 million people in 2006.

Calculate the number of men who died from coronary heart disease in 2006.

(3)

number of men who died = ...

(Total for Question 3 = 12 marks)

4 (a) State three methods of birth control.

(3)

1 ....

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2 ....

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3 ....

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(b) The graph shows the changes in the width of the uterus lining and in the concentration of oestrogen in the blood during one menstrual cycle.

Key

- - ×- - - oestrogen concentration
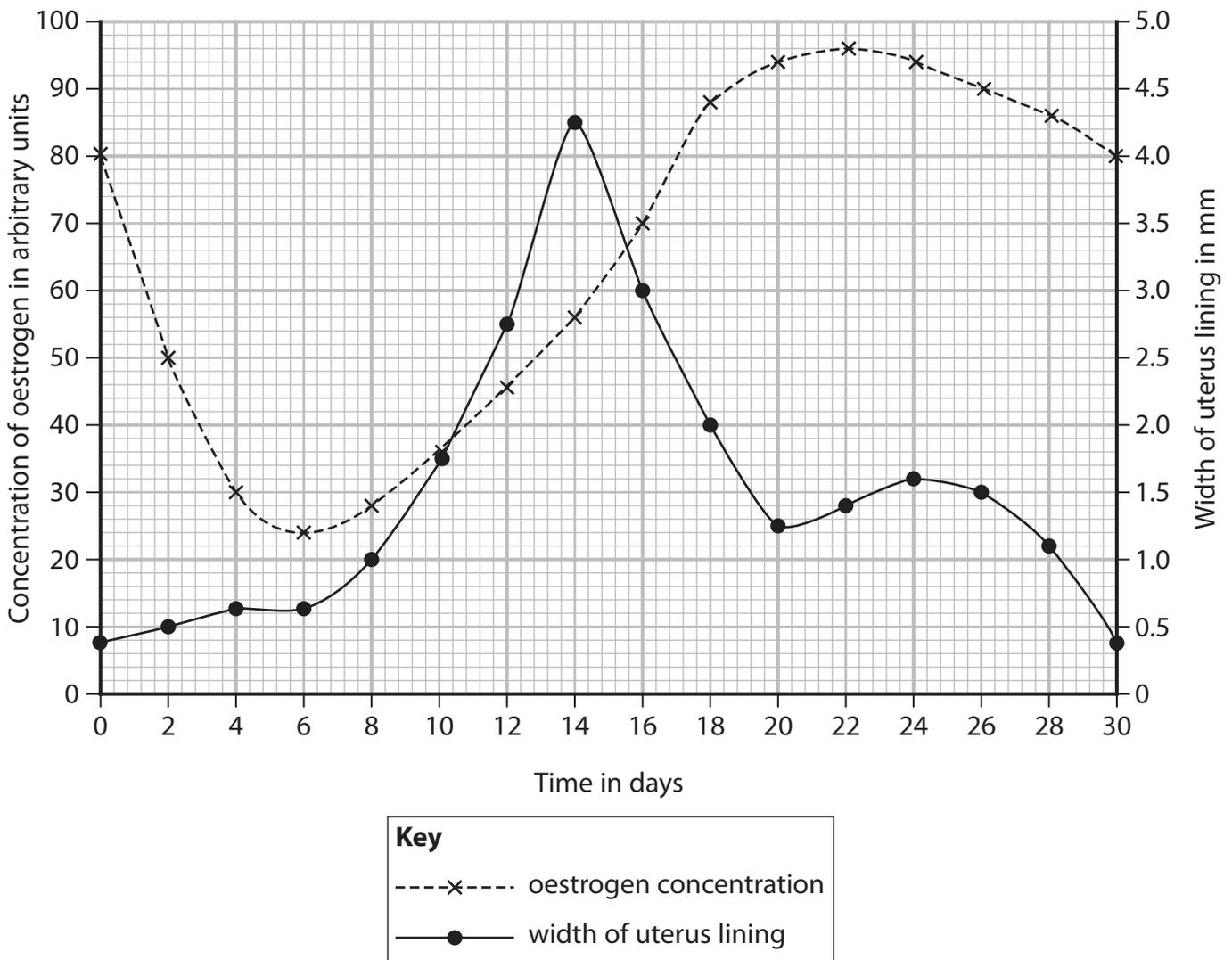
———•——— width of uterus lining

(i) Determine the change in width of the uterus lining between day 6 and day 14.

(2)

change in width = ... mm

(ii) Explain the importance of this change in width.

(3)

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(iii) Determine during which days menstruation occurred.

(1)

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(iv) Ovulation takes place on day 15.

Describe how the two lines on the graph would be different if the ovum had been fertilised.

(3)

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(Total for Question 4 = 12 marks)

5 Read the passage below. Use the information in the passage and your own knowledge to answer the questions that follow.

Milk contains a carbohydrate called lactose. Lactose is not absorbed by the epithelium of the ileum or duodenum.

Lactose is a disaccharide which is broken down into glucose and galactose by the enzyme lactase. Babies produce large amounts of lactase but in some people
5   the gene for producing lactase is switched off as they get older. When this gene is switched off people then become lactose-intolerant which means they cannot digest any lactose that is taken into the gut.

The number of people with lactose intolerance differs across the world. People in some countries are often tolerant because their ancestors have evolved tolerance
10   because of their diet.

In a lactose intolerant person, any lactose taken into the gut will collect and ferment, forming methane and carbon dioxide plus other soluble products. These other soluble products lower the water potential in the gut.

Symptoms of lactose intolerance include diarrhoea, calcium deficiency and
15   vitamin D deficiency.

(a) Suggest what is meant by the term disaccharide. (lines 3 to 4)

(2)

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(b) Give a reason why lactose is not absorbed by the epithelium. (lines 1 to 2)

(1)

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(c) (i) Explain what is meant by a gene being switched off. (lines 5 to 6)

(3)

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(ii) Describe the effects on a person when the gene for producing lactase is switched off. (lines 3 to 7)

(2)

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(d) Suggest how people in some parts of the world have evolved tolerance because of their diet. (lines 8 to 10)

(2)

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(e) Explain how the symptoms of lactose intolerance are caused. (lines 11 to 15)

(4)

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(Total for Question 5 = 14 marks)

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6 Blood will clot when there is damage to the skin, such as a cut.

(a) (i) State two reasons why it is important for the blood to clot.

(2)

1 ....

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2 ....

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(ii) The diagram shows some of the stages in the process of blood clotting.

component **V** in the blood

↓

substance **W**

↓

prothrombin ⟶ thrombin

↓

substance **Y** ⟶ substance **Z**

↓

forms clot
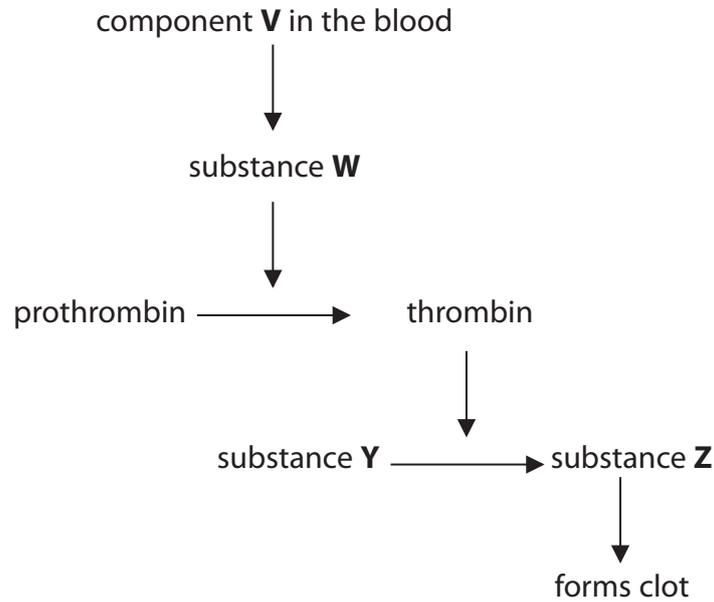
Use words from the box to identify V, W, Y and Z.

thrombokinase enzyme	white blood cells	platelets
haemoglobin fibrinogen	fibrin antigens	antibody

(4)

V ....

W..

Y ....

Z ....

(b) Haemophilia is an inherited condition where the blood of a person does not clot.

The diagram shows a family pedigree. Some members of the family have the condition.

Key

○ non-haemophiliac female

□ non-haemophiliac male

● haemophiliac female

■ haemophiliac male

(i) Deduce the genotypes of family members 1 and 2 showing how you obtained your answer.

(5)

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(ii) Male 3 and female 4 have a second child.

Deduce the probability that this child will be a boy with haemophilia showing how you obtained your answer.

(4)

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(Total for Question 6 = 15 marks)

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7 The diagram shows a kidney.

M
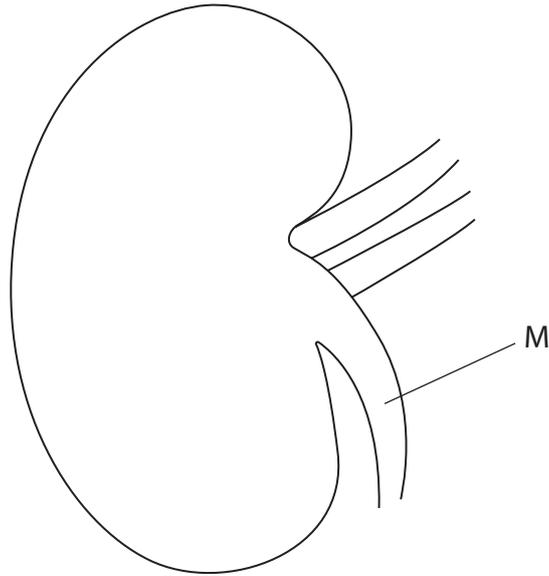
(a) (i) Which of these is the name of structure M?

(1)

- ☒ **A** renal artery

- ☒ **B** renal vein

- ☒ **C** ureter

- ☒ **D** urethra

(ii) Which of these structures is connected to structure M?

(1)

- ☒ **A** bladder

- ☒ **B** prostate gland

- ☒ **C** seminal vesicle

- ☒ **D** urethra

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(b) State three differences between the blood entering the kidney and the blood leaving the kidney.

(3)

1 ....

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2 ....

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3 ....

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(c) The table compares the nitrogen content of urine during 24 hours for a person on a high protein diet with a person on a low protein diet.

Substance excreted during 24 hours	High protein diet Mass in g	Low protein diet Mass in g
total nitrogen compounds	16.8	3.6
urea	14.7	2.2
uric acid	0.18	0.09
ammonia	0.49	0.04
creatinine	0.58	0.60

(i) Calculate the percentage difference in the mass of nitrogen compounds excreted during 24 hours for the person on a high protein diet compared with the low protein diet.

(3)

percentage difference = ... %

(ii) Which is the main nitrogen containing excretory product produced from the breakdown of protein in the diet?

Use the information in the table to explain your answer.

(2)

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(iii) The breakdown of muscle tissue continues at a constant rate and is not affected by diet.

Discuss whether the information in the table supports this statement.

(4)

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(Total for Question 7 = 14 marks)

TOTAL FOR PAPER = 90 MARKS

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