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Answer **all** questions in the spaces provided.

1 (a) (i) What is atheroma?

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(2 marks)

(Extra space) ....

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1 (a) (ii) Atheroma makes it more likely that a blood clot will form. Describe how a blood clot may lead to a myocardial infarction.
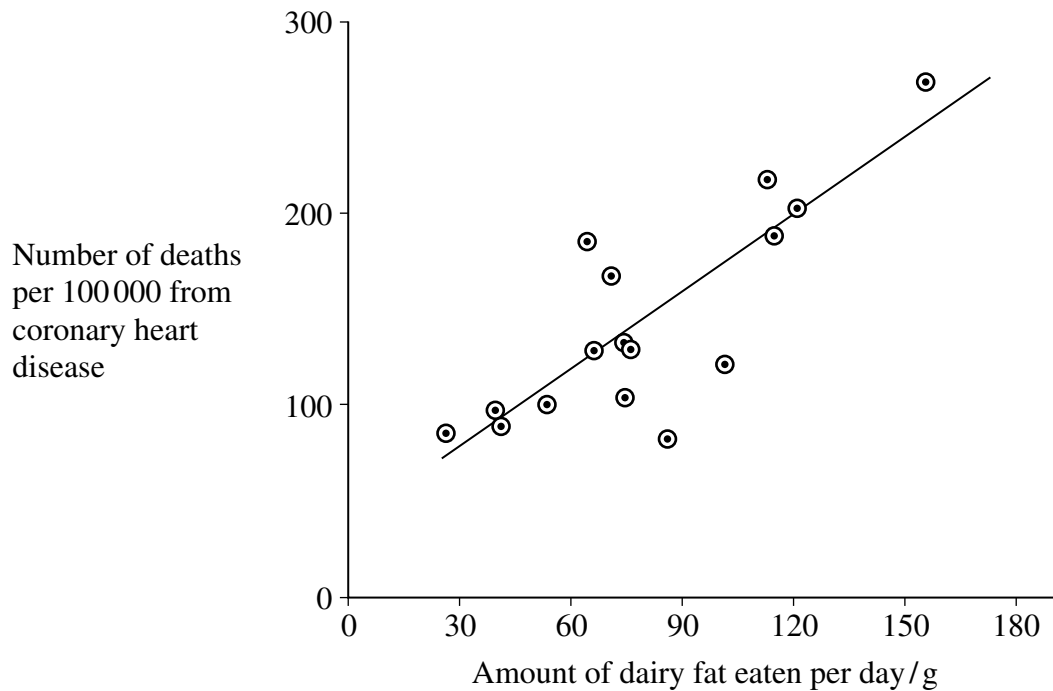
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(3 marks)

(Extra space) ....

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1 (b) The graph shows the relationship between the amount of dairy fat eaten and the deaths from coronary heart disease (CHD) in different countries.

Number of deaths per 100 000 from coronary heart disease

Amount of dairy fat eaten per day / g

1 (b) (i) The number of deaths is given per 100 000 people. Explain why.

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(2 marks)

1 (b) (ii) Does the evidence from the graph show that eating dairy fat causes coronary heart disease? Explain your answer.

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(2 marks)

9

Turn over ▶

2 (a) Sucrose, maltose and lactose are disaccharides.

**2** (a) (i) Sucrase is an enzyme. It hydrolyses sucrose during digestion. Name the products of this reaction.

.... and ....

(2 marks)

2 (a) (ii) Sucrase does **not** hydrolyse lactose. Use your knowledge of the way in which enzymes work to explain why.

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(2 marks)

(Extra space) ....

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2 (b) A woman was given a solution of sucrose to drink. Her blood glucose concentration was measured over the next 90 minutes. The results are shown on the graph.
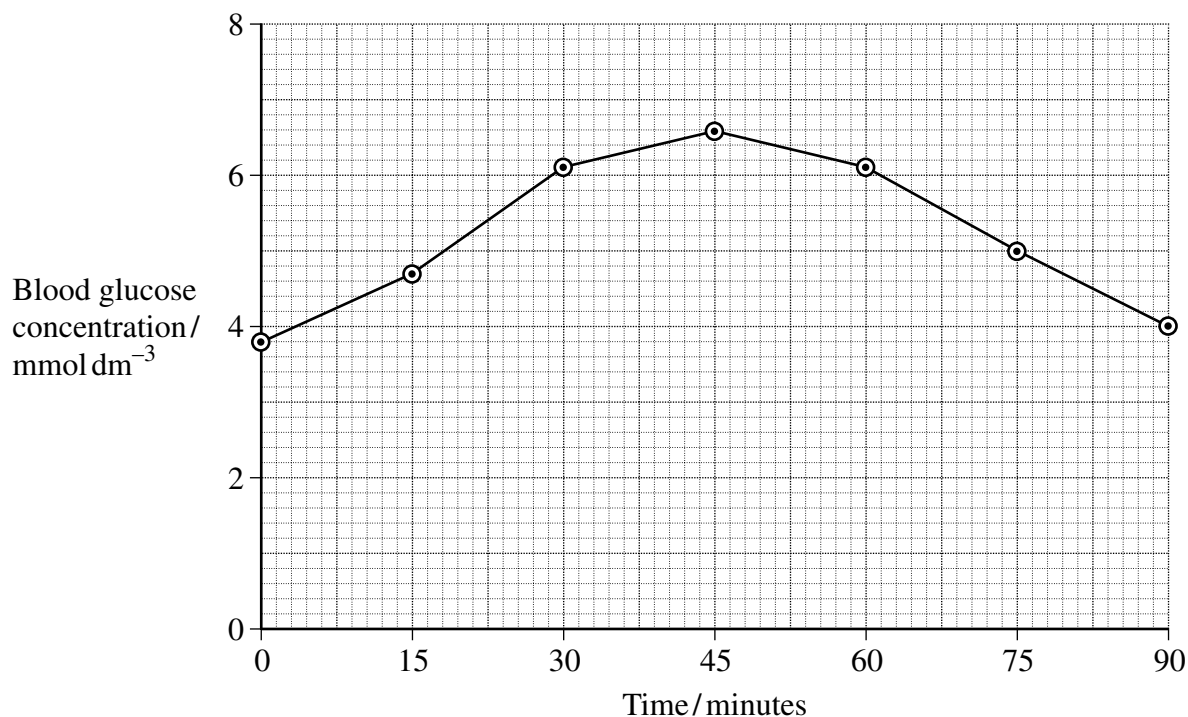
2 (b) (i) Describe how the woman's blood glucose concentration changed in the period shown in the graph.

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(2 marks)

2 (b) (ii) Explain the results shown on the graph.

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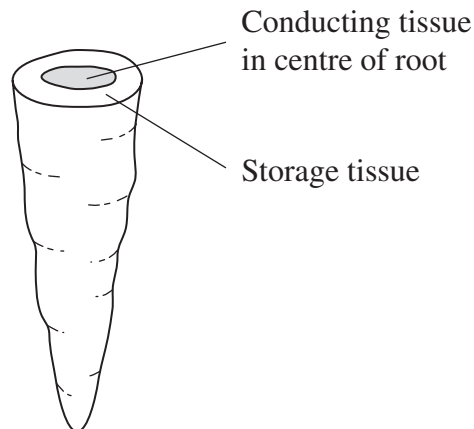
(2 marks)

2 (b) (iii) This woman was lactose intolerant.

On the graph, sketch a curve to show what would happen to her blood glucose concentration if she had been given a solution of lactose to drink instead of a sucrose solution. *(1 mark)*

9

Turn over ▶

3   The diagram shows a carrot.

Conducting tissue
in centre of root

Storage tissue

A group of students investigated the effect of sucrose concentration on the length of cylinders cut from a carrot.

3   (a)   The students used a cork borer to cut cylinders from the carrot. Describe how the students should cut these cylinders to make sure that this was a fair test and would produce reliable results.

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(2 marks)

3   (b)   They measured the initial length of each cylinder then placed the cylinders into test tubes containing different concentrations of sucrose solution. Bungs were placed in the tubes and the tubes were left overnight. Explain why the bungs were placed in the tubes.

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(2 marks)

3 (c) The students then measured the final lengths of the carrot cylinders. Their results are shown in the table.

Concentration of sucrose / $mol\,dm^{-3}$	$\dfrac{\text{Final length}}{\text{Initial length}}$
0.0	1.4
0.2	1.4
0.4	1.2
0.6	1.1
0.8	0.9

3 (c) (i) The students used these results to find the concentration of sucrose that has the same water potential as the carrot cylinders. Describe how they could have done this.

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(2 marks)

(Extra space) ....

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3 (c) (ii) Was it important in this investigation that the carrot cylinders had the same initial length? Explain your answer.

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(1 mark)

7

Turn over ▶

4   The diagram shows part of an alveolus and a capillary.

A ———————————— Lumen of alveolus
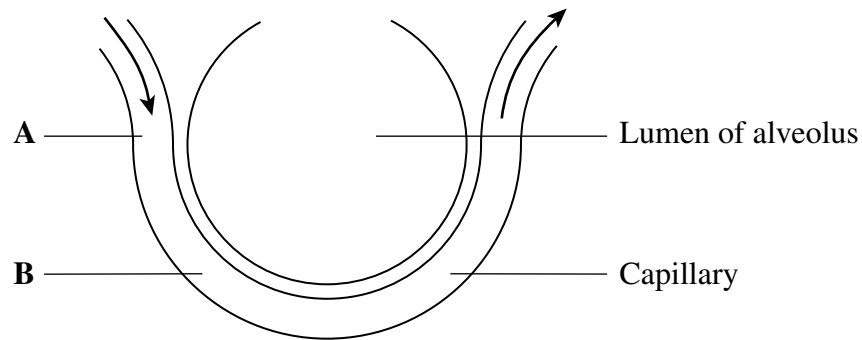
B ———————————— Capillary

10 μm

4   (a)   The rate of blood flow in the capillary is $0.2\,\text{mm}\,\text{s}^{-1}$.
Calculate the time it would take for blood in the capillary to flow from point **A** to point **B**. Show your working.

Answer .... seconds

(2 marks)

4   (b)   The rate of diffusion of oxygen is affected by the difference between its concentration in the alveolus and its concentration in the blood.

4   (b)   (i)   Circulation of the blood helps to maintain this difference in oxygen concentration. Explain how.

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(1 mark)

4 (b) (ii) During an asthma attack, less oxygen diffuses into the blood from the alveoli. Explain why.

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(2 marks)

(Extra space) ....

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4 (c) Scientists investigated a new drug to treat asthma. People with asthma took part in a trial. They were divided into two groups, an experimental group and a control group.

4 (c) (i) It was important to have a control group in this trial. Explain why.

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(1 mark)

4 (c) (ii) People in the experimental group were given the drug in an inhaler. Describe how the control group should have been treated.

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(2 marks)

(Extra space) ....

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8

Turn over ▶

5 (a) Phagocytes and lysosomes are involved in destroying microorganisms. Describe how.

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(3 marks)

(Extra space) ....

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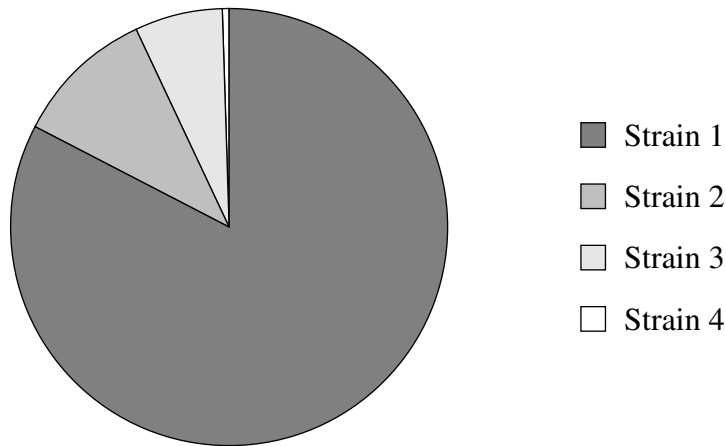...

5 (b) The pie chart shows the proportions of people infected with four different strains of influenza virus early in 2004.

■ Strain 1

▨ Strain 2

□ Strain 3

□ Strain 4

5 (b) (i) A person may develop influenza twice within a short time. Use information from the pie chart to explain why.

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(2 marks)

5 (b) (ii) The information in the pie chart is valuable to companies who make influenza vaccines. Use your knowledge of antigens to explain why.

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(2 marks)

7

Turn over ▶

6 Read the following passage.

Campylobacter jejuni is a bacterium. It is one of the commonest causes of diarrhoea
in humans. The illness that it causes does not usually last very long and many sufferers
do not even go to the doctor. The only treatment required is the use of oral rehydration
solutions to replace the water lost by diarrhoea. In 1998, laboratory tests confirmed
60 000 cases of diarrhoea caused by this bacterium in the UK. The bacterium was   5
more frequently found in males than in females with a ratio of 1.5 : 1.

In rare cases, the nervous system may be affected. Scientists are now beginning to
understand the cause of this. Sugars in the antigens on the surface of the bacteria are
identical to some of the sugars on the surface of nerve cells. Antibodies produced
against the bacteria may therefore attack the body's nerve cells. There can be serious   10
problems if this leads to paralysis of the diaphragm. Breathing difficulties result and
the patient may die.

Use information in the passage and your own knowledge to answer the following questions.

6 (a) (i) The number of cases of diarrhoea confirmed as being caused by *Campylobacter
jejuni* in the UK in 1998 was 60 000 (lines 4–5). Explain why the true number
of cases is thought to be more than this.

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(1 mark)

6 (a) (ii) Calculate the number of cases of diarrhoea confirmed as being caused by
Campylobacter jejuni in men in 1998.

Answer ....

(1 mark)

6 (b) Explain how an oral rehydration solution (ORS) replaces water lost by diarrhoea (lines 3–4).

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(3 marks)

(Extra space) ....

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6 (c) Explain why antibodies produced against *Campylobacter jejuni* also attack nerve cells (lines 9–10).

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(3 marks)

(Extra space) ....

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6 (d) Explain how paralysis of the diaphragm leads to breathing difficulties (line 11).

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(2 marks)

10

Turn over ▶

7 (a) The structure of a cholera bacterium is different from the structure of an epithelial cell from the small intestine. Describe how the structure of a cholera bacterium is different.

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(5 marks)

(Extra space) ....

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7 (b) Scientists use optical microscopes and transmission electron microscopes (TEMs) to investigate cell structure. Explain the advantages and the limitations of using a TEM to investigate cell structure.

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(5 marks)

(Extra space) ....

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10

END OF QUESTIONS

Practice 2

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 Read through the following passage that describes the process of blood clotting, then write on the dotted lines the most appropriate word or words to complete the passage.

(6)

A blood clot may form when a blood vessel wall becomes damaged.

Cell fragments called .... stick to the wall of the damaged

blood vessel forming a plug. A series of chemical changes occur in the blood,

resulting in .... being converted into thrombin.

Thrombin is an .... that catalyses the conversion

of .... into long insoluble strands of

.... These strands form a mesh that trap

.... to form the clot.

(Total for Question 1 = 6 marks)

2 Transcription and translation are two main stages in protein synthesis.

(a) Complete the table below by writing the word **transcription** or **translation** next to the appropriate statement about protein synthesis.

Statement	Stage of protein synthesis
Ribosomes are involved	
DNA acts as a template	
tRNA is involved	
Peptide bonds are made	
mRNA is made	

(b) The table below shows some amino acids and their corresponding DNA triplet codons. The DNA triplet codons for a stop signal are also shown.

Amino acid / stop signal	DNA triplet codons
Proline	GGT GGG GGA
Alanine	CGG CGA CGT CGC
Cysteine	ACA ACG
Serine	AGG AGA AGT AGC
Leucine	GAA GAG GAT GAC
Arginine	GCA GCG GCT GCC
Glutamine	CTT CTC
Glycine	CCT CCG CCA CCC
Threonine	TGC TGA TGT TGG
Stop signal	ATT ATC ACT

The diagram below shows part of a DNA molecule.

codon 84   codon 85   codon 86   codon 87   codon 88   codon 89

A   C   A   C   T   T   A   C   A   G   C   C   G   G   T   G   G   G
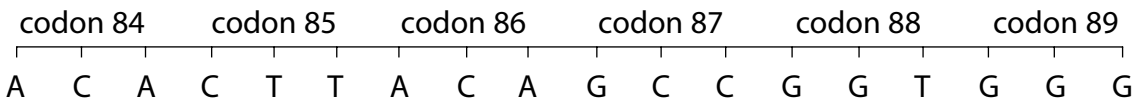
(i) Place a cross ⊠ in the box next to the amino acid coded for by codon 85.

(1)

Leucine   ☒

Glutamine   ☒

Glycine   ☒

Serine   ☒

(ii) Place a cross ⊠ in the box next to the sequence of amino acids found in the polypeptide chain that is coded for by this part of the DNA strand.

(1)

cysteine glutamine cysteine arginine proline proline   ☒

threonine leucine threonine alanine glycine glycine   ☒

cysteine glutamine cysteine arginine glycine glycine   ☒

cysteine proline cysteine arginine proline proline   ☒

4

(iii) If codon 89 coded for the last amino acid in the polypeptide chain, place a cross ⊠ in the box next to codon 90.

(1)

GGG ⊠

ATC ⊠

TAG ⊠

AGT ⊠

(iv) Place a cross ⊠ in the box next to the sequence of bases on a molecule of messenger RNA (mRNA) synthesised from this part of the DNA molecule.

(1)

A C A C T T A C A G C C G G T G G G   ⊠

T G T G A A T G T C G G C C A C C C   ⊠

U G U G A A U G U C G G C C A C C C   ⊠

A G A C U U A G A C G G C C U G G G   ⊠

(v) Place a cross ⊠ in the box next to the statement that best describes what the polypeptide chain would be like if the 90th codon was ACT and the 91st codon was CTT on the DNA molecule.

(1)

The polypeptide chain would be no more than 89 amino acids long   ⊠

The 89th amino acid would be threonine and the 90th amino acid would be leucine   ⊠

The polypeptide chain would be more than 90 amino acids long   ⊠

The polypeptide chain would be more than 91 amino acids long   ⊠

(Total for Question 2 = 10 marks)

3 Starch is a storage carbohydrate found in plants. Starch is composed of many α-glucose molecules that bond together by condensation reactions.

(a) The diagram below shows the structure of α-glucose.
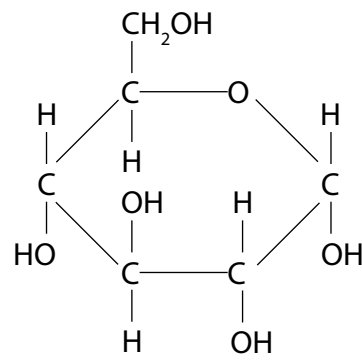
(i) In the space below, draw a diagram to show the products formed when two α-glucose molecules join together by means of a condensation reaction to form maltose.

(3)

(ii) Name the bond that joins the two α-glucose molecules together.

(1)

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(b) Describe the structure of starch and explain why this structure makes it a suitable molecule for storing energy.

(4)

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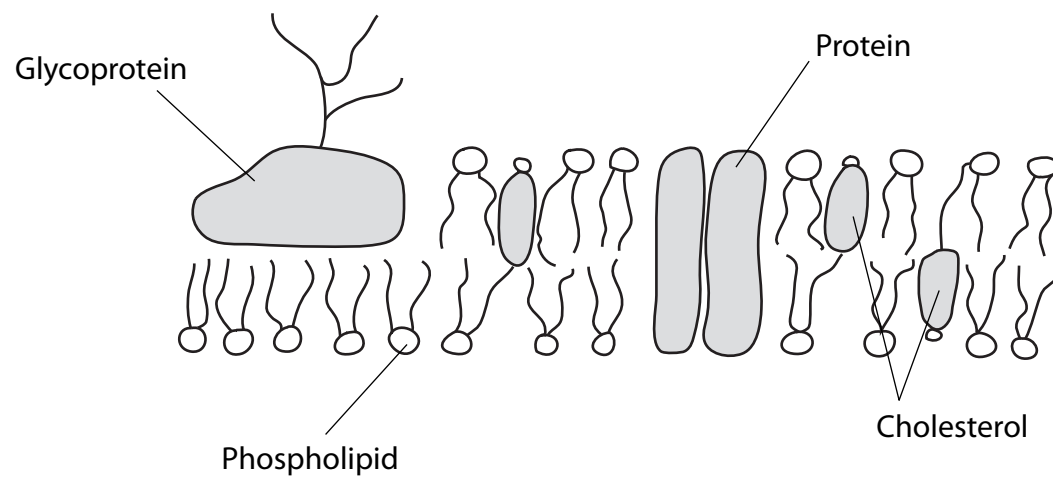
(Total for Question 3 = 8 marks)

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8

4 The diagram below represents the structure of the cell surface membrane.

Glycoprotein

Protein

Phospholipid

Cholesterol

(a) Explain why the phospholipid molecules form a bilayer.

(3)

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(b) A student carried out an experiment to investigate the effect of alcohol concentration on the permeability of beetroot membranes. Beetroots are root vegetables that appear red because the vacuoles in their cells contain a water-soluble red pigment. This pigment cannot pass through membranes.

Eight pieces of beetroot were cut. One piece of beetroot was placed into a tube containing 15 cm³ of water and left for 15 minutes. The procedure was repeated for seven different concentrations of ethanol.

After 15 minutes, each piece of beetroot was removed from the tubes and a sample of the fluid removed and placed in a colorimeter. The colorimeter was used to determine the intensity of red coloration of the fluid.

The results of the investigation are shown in the graph below.

Intensity of red coloration / arbitrary units (y-axis)
Concentration of ethanol (%) (x-axis)
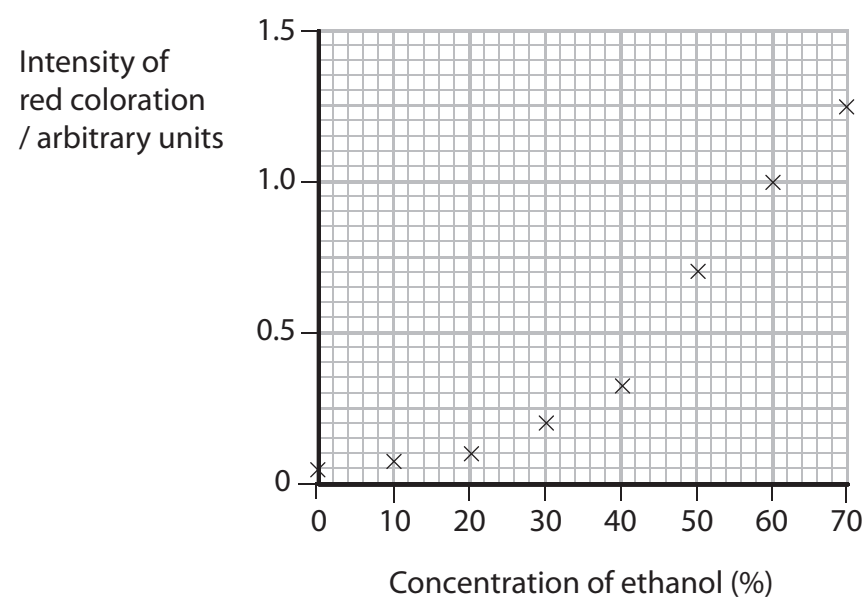
(i) Suggest **two** variables, other than those stated above, which should be kept constant during this experiment.

(2)

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(ii) There was some red coloration in the tube containing only water. Suggest an explanation for this.

(2)

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(iii) Describe what the student should have done to reduce the red coloration in the tube containing only water.

(1)

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(c) The graph on page 10 shows that ethanol has an effect on the permeability of beetroot.

(i) State the effect that the ethanol concentration has on the intensity of the red coloration.

(1)

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(ii) Suggest an explanation for this effect.

(2)

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(Total for Question 4 = 11 marks)

5 (a) In the space below, draw a labelled diagram to show the structure of an artery.

(3)

(b) Explain how the structure of an artery relates to its function.

(2)

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(c) Give **two** differences between the structure of a vein and the structure of a capillary.

(2)

1 ....

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2 ....

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(Total for Question 5 = 7 marks)

6 High blood cholesterol levels are associated with an increased risk of developing cardiovascular disease (CVD). There are cholesterol-reducing drugs available to lower this risk.

(a) Two groups of patients were treated with a different type of cholesterol-reducing drug, Drug A or Drug B.

The graphs below show the percentage changes of total cholesterol (TC), low-density lipoproteins (LDL) and high-density lipoproteins (HDL) in the blood of these patients, after treatment.

Patients treated with Drug A   Patients treated with Drug B
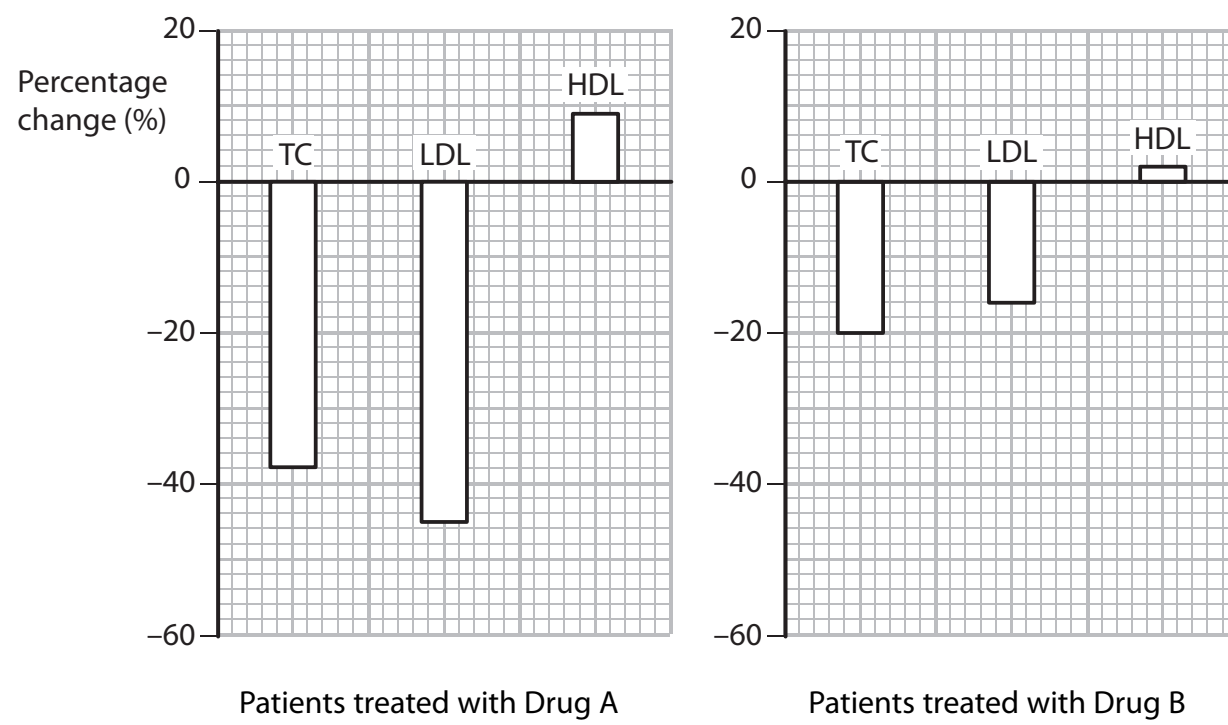
(i) Compare the effects of Drug A and Drug B on the percentage changes in total cholesterol (TC), LDL and HDL in the blood of these two groups of patients.

(3)

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(ii) The enzyme HMG-CoA reductase catalyses the synthesis of cholesterol. When this enzyme is active, there are fewer LDL receptors on liver cells. These receptors are needed to remove LDL from the blood.

Statins are a group of cholesterol-reducing drugs that act by inhibiting this enzyme. Suggest which of the two drugs, Drug A or Drug B, is more likely to be a statin. Give reasons for your answer.

(3)

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(b) State **two** risks of treatments using statins.

(2)

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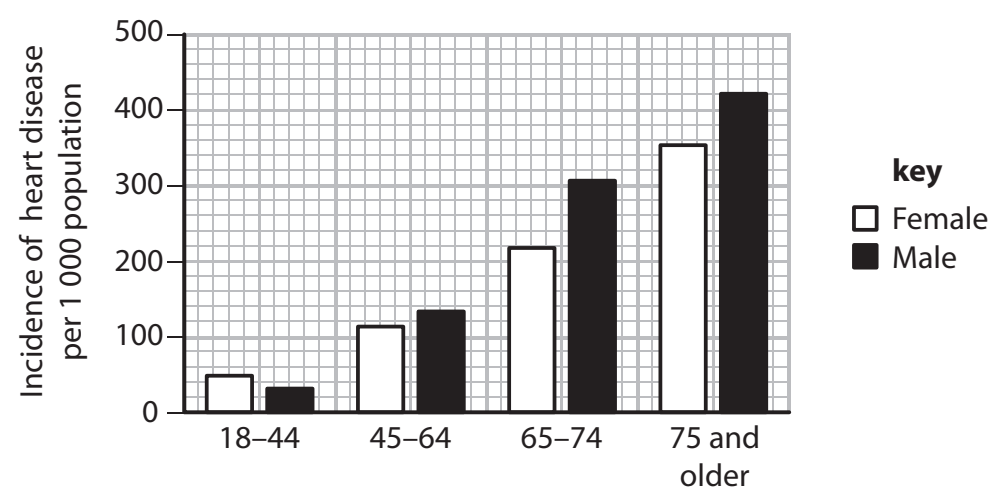
(c) Age and gender are two other factors that may influence the development of heart disease in an individual.

The graph below shows the results of a survey in America, on the incidence of heart disease in adults aged 18 and older.

(i) Using the information in the graph, describe how the incidence of heart disease is affected by age and gender.

(3)

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(ii) Calculate the increased risk that a man who is 75 or older has of developing heart disease, compared to a man aged between 18 and 44 years old.

(2)

Answer ....

(Total for Question 6 = 13 marks)

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7 A study was carried out into the number of cigarettes smoked by men per year and the number of deaths from lung cancer.
The graph below shows the results of this study.
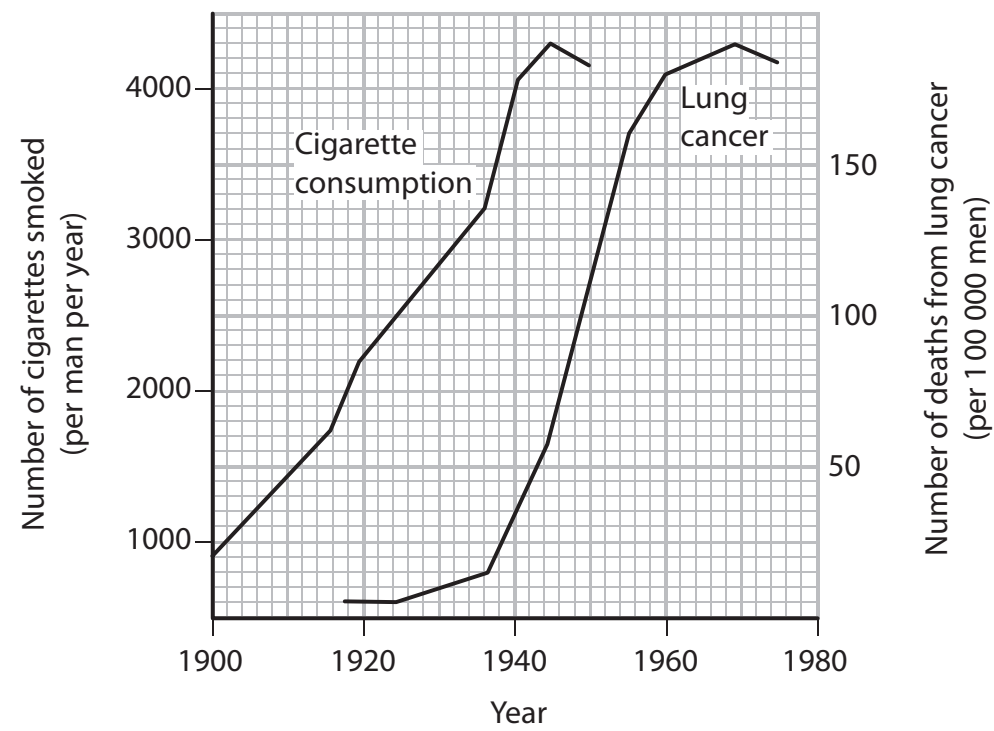
(a) Describe the changes in the number of deaths from lung cancer between 1920 and 1975.

(3)

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(b) The results of this study indicate that there is a correlation between cigarette smoking and lung cancer.

(i) Explain the meaning of the term **correlation**.

(1)

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(ii) Describe the evidence shown in this graph that suggests there is a correlation between cigarette smoking and the number of deaths from lung cancer.

(2)

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(iii) Give **two** additional pieces of information that would increase the **validity** of any conclusions made from this study.

(2)

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18

(c) Emphysema is another lung disease associated with cigarette smoking. One symptom of emphysema is shortness of breath. This is due to the damage to the alveoli and destruction of capillaries surrounding the alveoli.

The diagram below show alveoli from a lung of a person with emphysema and some alveoli from a healthy person.

Alveoli from a lung of a person with emphysema
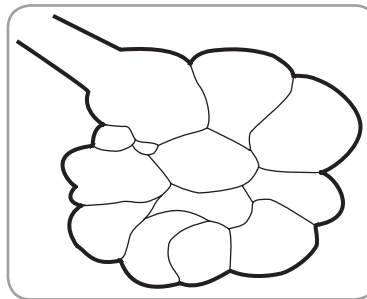
Alveoli from a healthy person
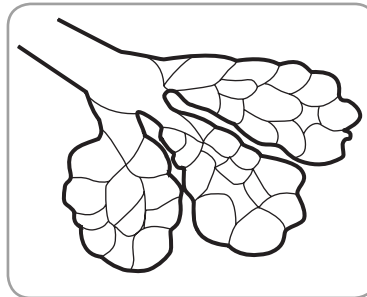
Use your knowledge of the structure of the lung and its adaptations for gas exchange to explain why a person with emphysema has problems with gas exchange.

(4)

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(Total for Question 7 = 12 marks)

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8 Phenylketonuria is a recessive genetic disorder characterised by a lack of the enzyme phenylalanine hydroxylase. When there is an excess of phenylalanine in the diet, this enzyme converts the amino acid phenylalanine into the amino acid tyrosine.

(a) The diagram below shows the structure of the R group of phenylalanine and tyrosine.

Phenylalanine   **Tyrosine**
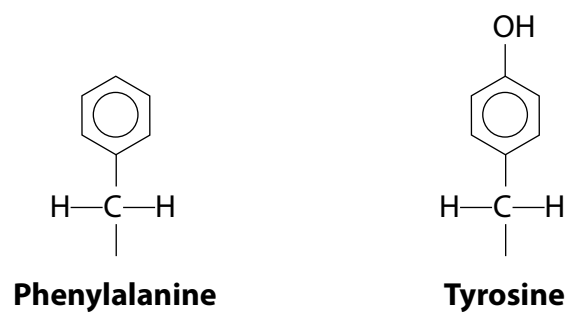
(i) In the space below draw a diagram to show the structure of the amino acid phenylalanine.

(3)

Turn over ▶

(ii) The enzyme phenylalanine hydroxylase converts its substrate, phenylalanine, into the product, tyrosine. Using the information shown in the diagram and your knowledge of the mechanism of action of enzymes, suggest how this reaction takes place.

(4)

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(b) A number of investigations have been carried out into the use of somatic gene therapy to treat mice that have phenylketonuria.
The graph below shows the results of one such investigation.

22
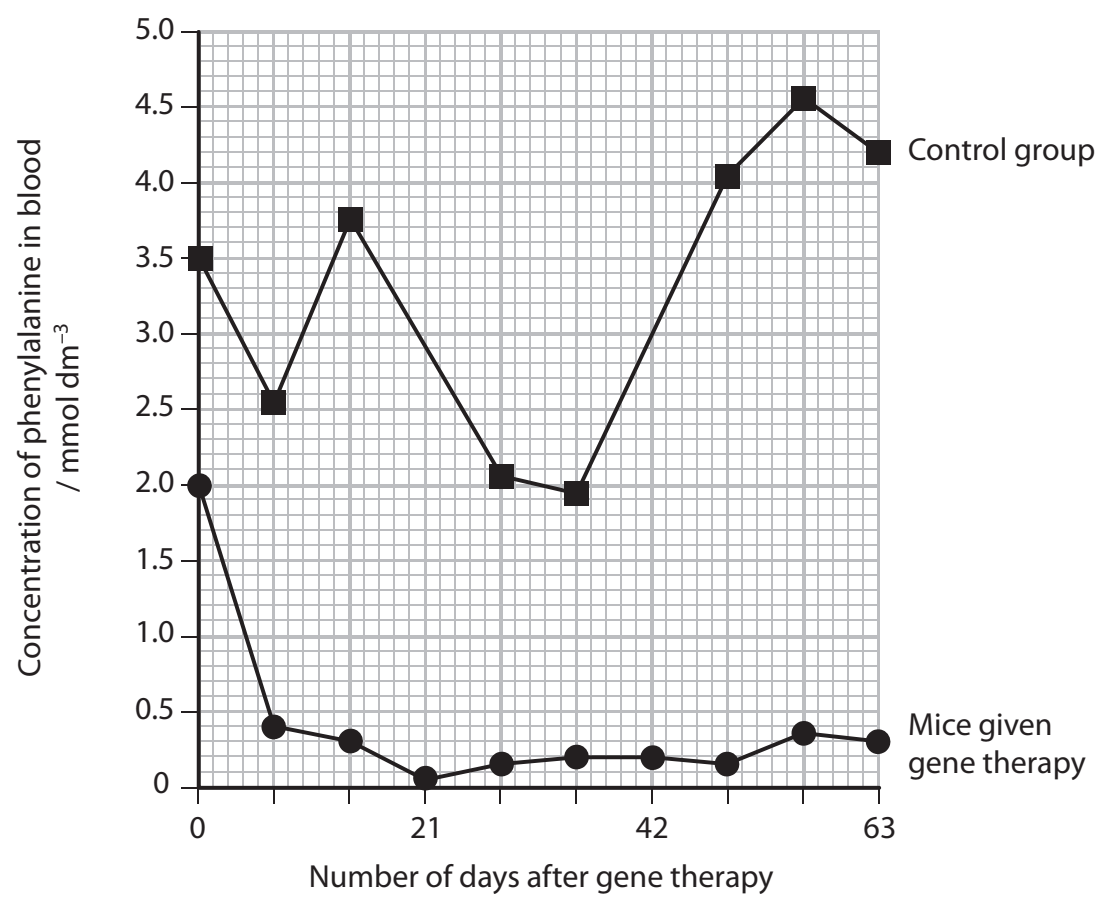
(i) Use the graph to describe the effect that gene therapy has on the phenylalanine concentration in the blood of these mice.

(2)

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(ii) Describe how somatic gene therapy may have been carried out to treat phenylketonuria in these mice.

(3)

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(iii) Suggest what treatment the control group of mice may have been given in this investigation.

(1)

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(Total for Question 8 = 13 marks)

TOTAL FOR PAPER = 80 MARKS

Answer **all** questions in the spaces provided.

1 (a) Some people cannot digest lactose when they are adult. They could digest lactose when they were children.

Use your knowledge of water potential to explain why these adults get diarrhoea when they drink milk.

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(2 marks)

1 (b) (i) The equation shows the reaction catalysed by the enzyme lactase. Complete this equation.

Lactose + ... $\longrightarrow$ Glucose + ...

(2 marks)

1 (b) (ii) Name the type of chemical reaction shown in this equation.

....

(1 mark)

1 (c) Lactase is an enzyme. Lactose is a reducing sugar.

1 (c) (i) Describe how you could use the biuret test to distinguish a solution of the enzyme, lactase from a solution of lactose.

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(1 mark)

1 (c) (ii) Explain the result you would expect with the enzyme.

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(1 mark)

7

Turn over ▶

2 Miner's lung is a disease caused by breathing in dust in coal mines. The dust causes the alveolar epithelium to become thicker. People with miner's lung have a lower concentration of oxygen in their blood than healthy people.

2 (a) (i) Describe the path by which oxygen goes from an alveolus to the blood.

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(2 marks)

2 (a) (ii) Explain why people with miner's lung have a lower concentration of oxygen in their blood.

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(1 mark)

2 (b) In healthy lungs, a gradient is maintained between the concentration of oxygen in the alveoli and the concentration of oxygen in the lung capillaries.

2 (b) (i) Describe how ventilation helps to maintain this difference in oxygen concentration.

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(2 marks)

2 (b) (ii) Give **one** other way that helps to maintain the difference in oxygen concentration.

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(1 mark)

2 (c) Scientists investigated the number of cases of miner's lung reported in Britain between 1992 and 2006.
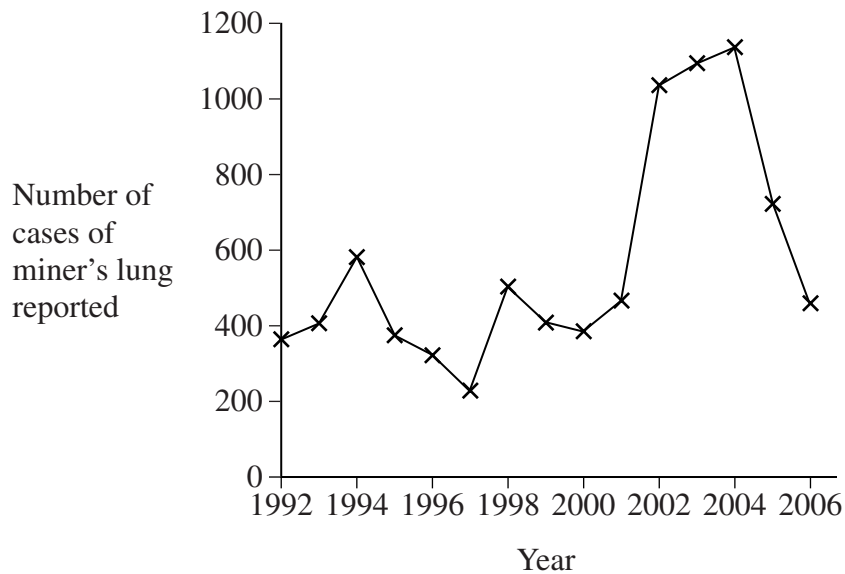
Coal mining in Britain had been dramatically reduced by 1990.

Some scientists concluded that the rise in reported cases of miner's lung after 1992 shows that the disease takes a long time to develop.

Evaluate this conclusion.

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(2 marks)

(Extra space)...

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8

Turn over ▶

3 The graph shows the effect of substrate concentration on the rate of an enzyme-controlled reaction.

Rate of reaction

Substrate concentration / arbitrary units
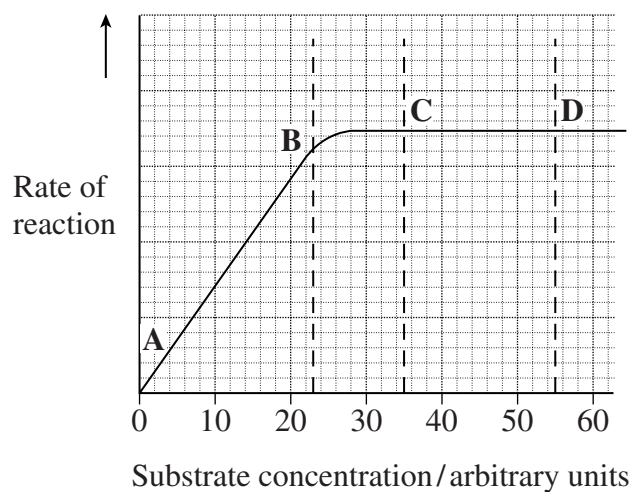
3 (a) (i) Describe what the graph shows about the effect of substrate concentration on the rate of this enzyme-controlled reaction.

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(2 marks)
(Extra space) ....

....

3 (a) (ii) What limits the rate of this reaction between points **A** and **B**? Give the evidence from the graph for this.

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(2 marks)
(Extra space) ....

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3 (a) (iii) Suggest a reason for the shape of the curve between points **C** and **D**.

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(1 mark)

3 (b) Sketch a curve on the graph to show the rate of this reaction in the presence of a competitive inhibitor.

(1 mark)

3 (c) Methotrexate is a drug used in the treatment of cancer. It is a competitive inhibitor and affects the enzyme folate reductase.

3 (c) (i) Explain how the drug lowers the rate of reaction controlled by folate reductase.

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(2 marks)

(Extra space) ....

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3 (c) (ii) Methotrexate only affects the rate of the reaction controlled by folate reductase. Explain why this drug does not affect other enzymes.

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(1 mark)

9

Turn over for the next question

Turn over ▶

4 The diagram shows an epithelial cell from the small intestine.
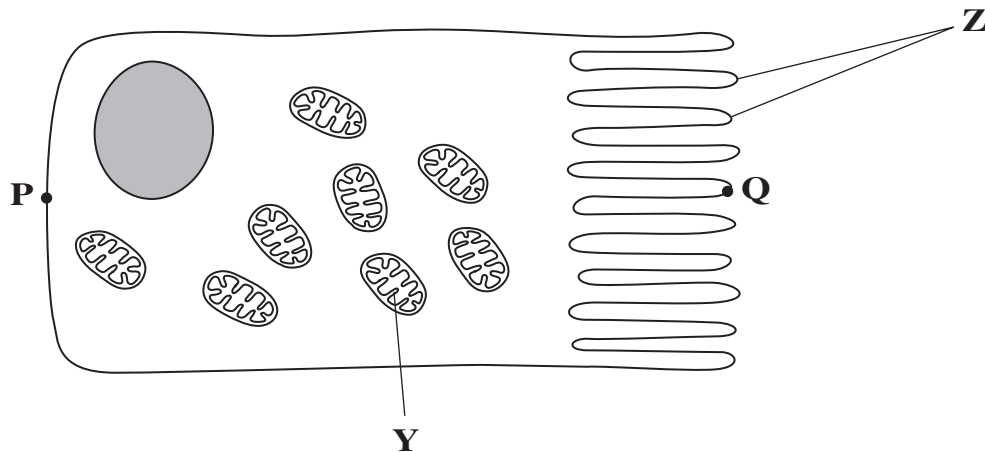
4 (a) (i) Name organelle **Y**.

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(1 mark)

4 (a) (ii) There are large numbers of organelle **Y** in this cell. Explain how these
organelles help the cell to absorb the products of digestion.

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(2 marks)

(Extra space) ....

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4 (b) This diagram shows the cell magnified 1000 times. Calculate the actual length of the cell between points **P** and **Q**. Give your answer in μm. Show your working.

Answer .... μm

(2 marks)

4 (c) Coeliac disease is a disease of the human digestive system. In coeliac disease, the structures labelled **Z** are damaged.

Although people with coeliac disease can digest proteins they have low concentrations of amino acids in their blood.

Explain why they have low concentrations of amino acids in their blood.

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(2 marks)

(Extra space)...

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7

Turn over for the next question

5 Students investigated the effect of different concentrations of sodium chloride solution on discs cut from an apple. They weighed each disc and then put one disc into each of a range of sodium chloride solutions of different concentrations. They left the discs in the solutions for 24 hours and then weighed them again. Their results are shown in the table.

Concentration of sodium chloride solution /mol dm^{-3}	Mass of disc at start/g	Mass of disc at end/g	Ratio of mass at start to mass at end
0.00	16.1	17.2	0.94
0.15	19.1	20.2	0.95
0.30	24.3	23.2	1.05
0.45	20.2	18.7	1.08
0.60	23.7	21.9	
0.75	14.9	13.7	1.09

5   (a)   (i)   Calculate the ratio of the mass at the start to the mass at the end for the disc placed in the 0.60 mol dm^{-3} sodium chloride solution.

Answer ....
(1 mark)

5   (a)   (ii)   The students gave their results as a ratio. What is the advantage of giving the results as a ratio?

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(2 marks)

5 (a) (iii)   The students were advised that they could improve the reliability of their results
by taking additional readings at the same concentrations of sodium chloride.
Explain how.

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(2 marks)

5 (b) (i)   The students used a graph of their results to find the sodium chloride solution
with the same water potential as the apple tissue. Describe how they did this.

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(2 marks)

5 (b) (ii)   The students were advised that they could improve their graph by taking
additional readings. Explain how.

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(2 marks)

9

Turn over ▶

6 Read the following passage.

Pathogens affect humans. They also affect farm animals. Once pathogens have entered the body of an animal they can cause disease. Vets sometimes have difficulty identifying the disease from which a particular animal is suffering. Until recently, they have had to take blood samples and send them to a laboratory. The laboratory carries out tests on the sample. 5

New tests have been developed. Some of these new tests use monoclonal antibodies. Tests using monoclonal antibodies are fast, specific and allow vets to identify a disease while they are still on the farm.

Brucellosis is a disease of cattle. It is caused by bacteria. These bacteria can infect people who drink milk or eat dairy products from infected cattle. A test using 10 monoclonal antibodies allows vets to identify cattle that are carriers. The carriers are cattle that carry the brucellosis bacteria but do not show any symptoms of the disease.

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

6 (a) Other than bacteria, name **one** type of pathogen (line 1).

   ....
   (1 mark)

6 (b) Give **two** ways in which a pathogen may cause disease when it has entered the body (lines 1–2).

   1 ....

   ....

   2 ....

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   (2 marks)

6 (c) Some new tests use monoclonal antibodies (lines 6–7).

6 (c) (i) Explain why these antibodies are referred to as monoclonal.

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(1 mark)

6 (c) (ii) Tests using monoclonal antibodies are specific (line 7). Use your knowledge of protein structure to explain why.

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(3 marks)

(Extra space) ....

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6 (d) The tests using monoclonal antibodies allow vets to identify brucellosis while they are still on a farm. Explain the advantages of this.

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(3 marks)

(Extra space) ....

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Turn over ▶

7 (a) The cardiac cycle is controlled by the sinoatrial node (SAN) and the atrioventricular node (AVN). Describe how.

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(5 marks)

(Extra space) ....

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7 (b) What is atheroma and how may it cause myocardial infarction?

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(5 marks)

(Extra space) ....

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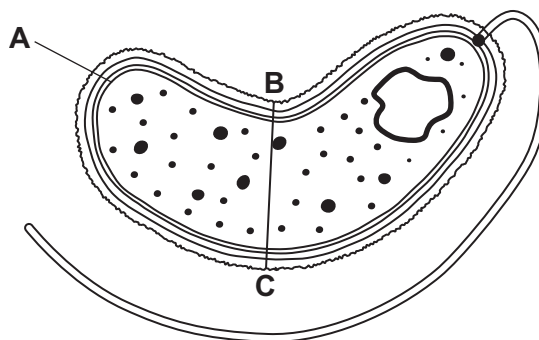
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10

END OF QUESTIONS

Answer **all** questions in the spaces provided.

1   The diagram shows a cholera bacterium. It has been magnified 50 000 times.

1 (a)   Name **A**.

....

(1 mark)

1 (b)   Name **two** structures present in an epithelial cell from the small intestine that are **not** present in a cholera bacterium.

1 ....

2 ....

(2 marks)

1 (c)   Cholera bacteria can be viewed using a transmission electron microscope (TEM) or a scanning electron microscope (SEM).

1 (c) (i)   Give **one** advantage of using a TEM rather than a SEM.

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(1 mark)

1 (c) (ii) Give **one** advantage of using a SEM rather than a TEM.

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(1 mark)

Do not write outside the box

1 (d) Calculate the actual width of the cholera bacterium between points **B** and **C**.
Give your answer in micrometres and show your working.

.....................................µm
(2 marks)

1 (e) An outbreak of cholera occurred in London in 1849. The graph shows the relationship between the number of deaths from cholera and the height at which people lived above sea level.

Number of deaths per 10 000 from cholera

Height above sea level / m
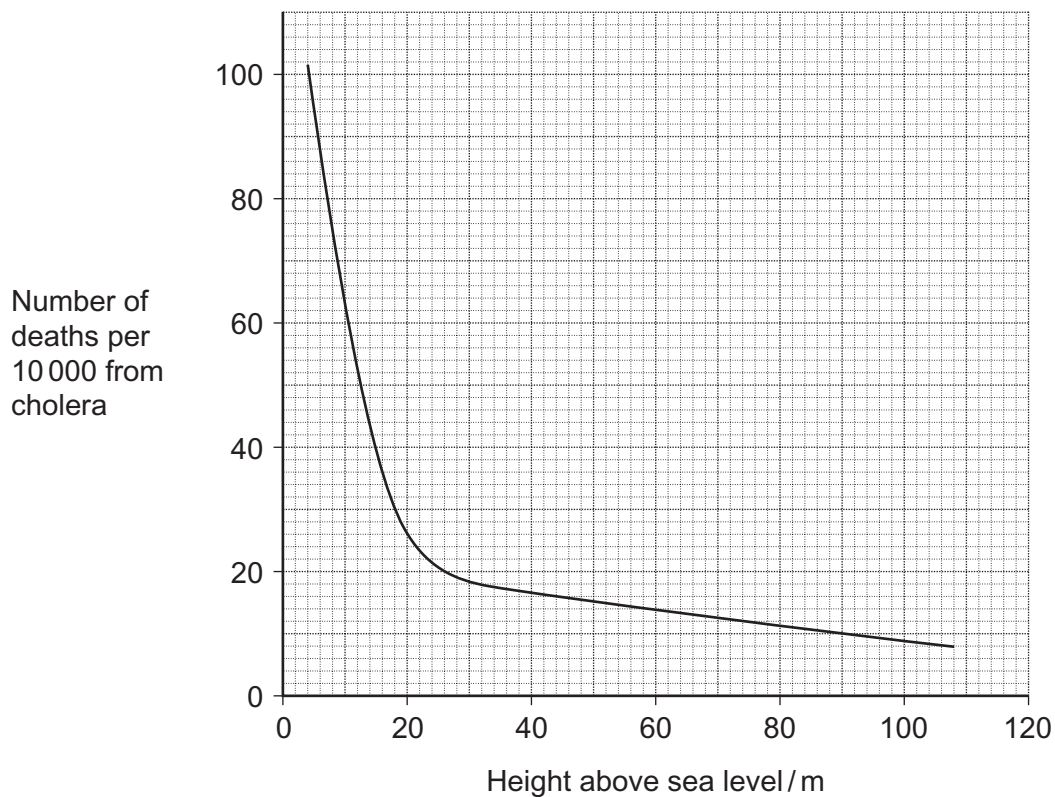
Describe the relationship between the number of deaths from cholera and the height at which people lived above sea level.

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(2 marks)

9

Turn over ▶

2 (a)   *Induced fit* and *lock and key* are two models used to explain the action of enzymes.

2 (a) (i)   Describe the *induced fit* model of enzyme action.

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(2 marks)

2 (a) (ii)   Describe **one** way that the *lock and key* model is different from the *induced fit* model.

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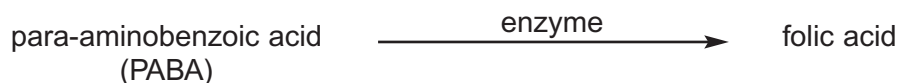
*(1 mark)*

2 (b) Folic acid is a substance required by bacteria for cell growth. Bacteria produce folic acid by the following reaction.

$$\text{para-aminobenzoic acid} \xrightarrow{\text{enzyme}} \text{folic acid}$$
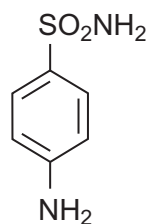$$\text{(PABA)}$$

The diagram shows the structure of a molecule of PABA. It also shows the structure of a molecule of a drug called sulfanilamide, which can be used to treat bacterial infections. Sulfanilamide prevents bacteria producing folic acid.

PABA   sulfanilamide

CO_2H SO_2NH_2

NH_2 NH_2
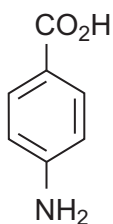
Use the diagram and your knowledge of enzymes to explain how sulfanilamide prevents bacteria producing folic acid.

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(3 marks)

(Extra space) ....

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6

Turn over ▶

3 The diagram shows a human heart as seen from the front. The main blood vessels are labelled **D** to **G**. The arrows show the pathways taken by the electrical activity involved in coordinating the heartbeat in the cardiac cycle.
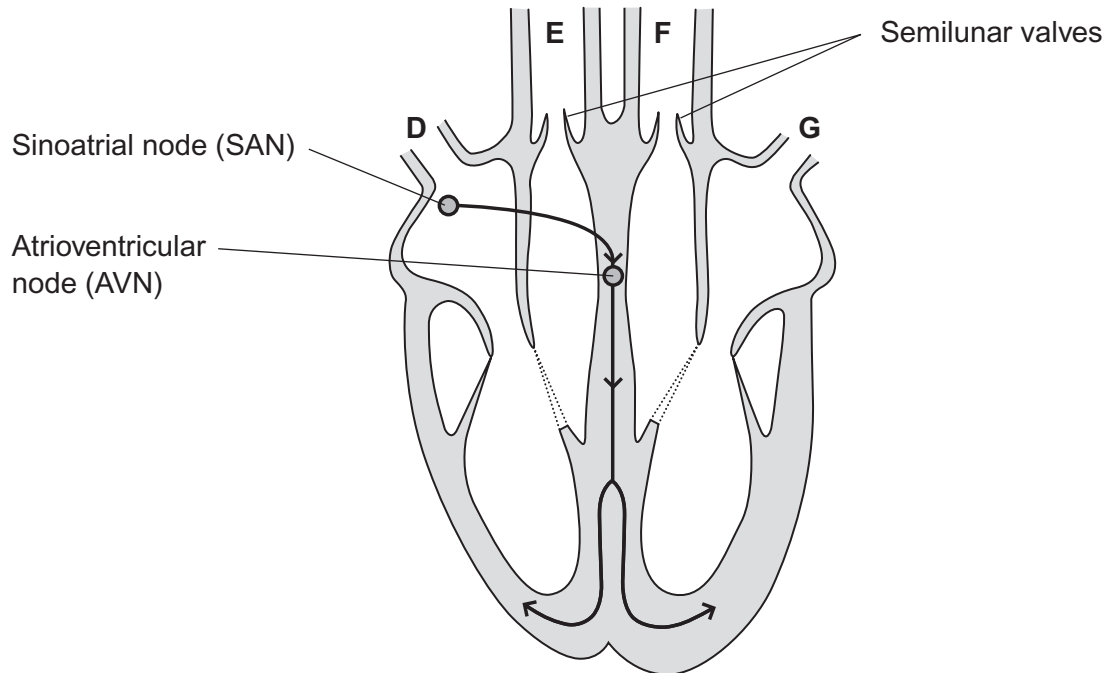
3 (a) Which of the blood vessels, **D** to **G**

3 (a) (i) carries oxygenated blood to the heart

(1 mark)

3 (a) (ii) carries deoxygenated blood to the lungs?

(1 mark)

3 (b) Explain, in terms of pressure, why the semilunar valves open.

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(1 mark)

Do not write outside the box

3 (c) When a wave of electrical activity reaches the AVN, there is a short delay before a new wave leaves the AVN. Explain the importance of this short delay.

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(2 marks)

3 (d) The table shows the cardiac output and resting heart rate of an athlete before and after completing a training programme.

	Before training	After training
Cardiac output / cm^3	5000	5000
Resting heart rate / beats per minute	70	55

3 (d) (i) Calculate the athlete's stroke volume after training. Show your working.

.............................cm^3

(2 marks)

3 (d) (ii) Use information from the table to explain how training has caused the resting heart rate of this athlete to be lower.

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(2 marks)

9

Turn over ▶

4 (a)   Omega-3 fatty acids are unsaturated. What is an *unsaturated* fatty acid?

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(2 marks)

4 (b)   Scientists investigated the relationship between the amount of omega-3 fatty acids eaten per day and the risk of coronary heart disease. The graph shows their results.
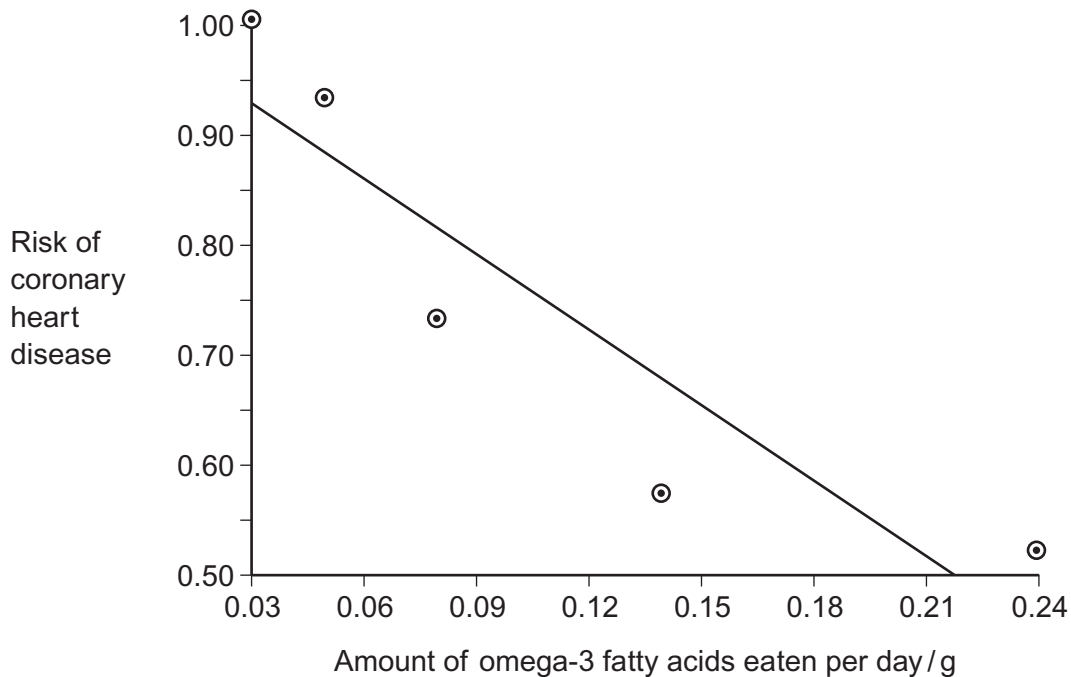
Do the data show that eating omega-3 fatty acids prevents coronary heart disease? Explain your answer.

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(3 marks)

4 (c)   Olestra is an artificial lipid. It is made by attaching fatty acids, by condensation, to a sucrose molecule. The diagram shows the structure of olestra. The letter **R** shows where a fatty acid molecule has attached.
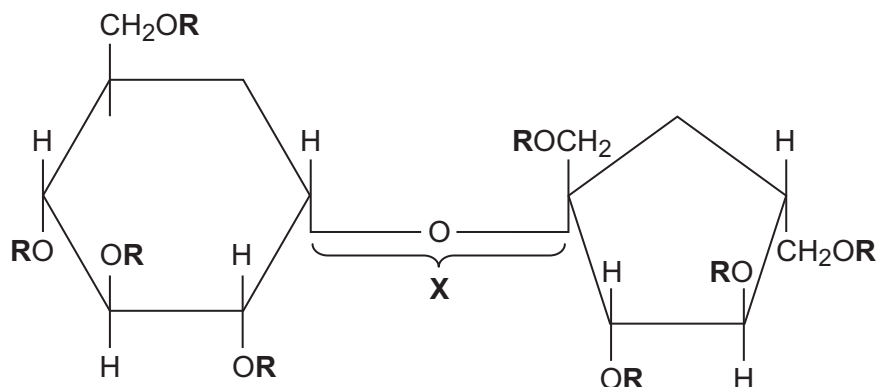
4 (c) (i)   Name bond **X**.

....
(1 mark)

4 (c) (ii)   A triglyceride does **not** contain sucrose or bond **X**.
Give **one** other way in which the structure of a triglyceride is different to olestra.

....

....
(1 mark)

4 (c) (iii)   Starting with separate molecules of glucose, fructose and fatty acids, how many molecules of water would be produced when one molecule of olestra is formed?

(1 mark)

8

Turn over ▶

5 A student investigated the effect of putting cylinders cut from a potato into sodium chloride solutions of different concentration. He cut cylinders from a potato and weighed each cylinder. He then placed each cylinder in a test tube. Each test tube contained a different concentration of sodium chloride solution. The tubes were left overnight. He then removed the cylinders from the solutions and reweighed them.

5 (a) Before reweighing, the student blotted dry the outside of each cylinder. Explain why.

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(2 marks)

The student repeated the experiment several times at each concentration of sodium chloride solution. His results are shown in the graph.

Mean percentage change in mass

Concentration of sodium chloride solution / mol dm⁻³
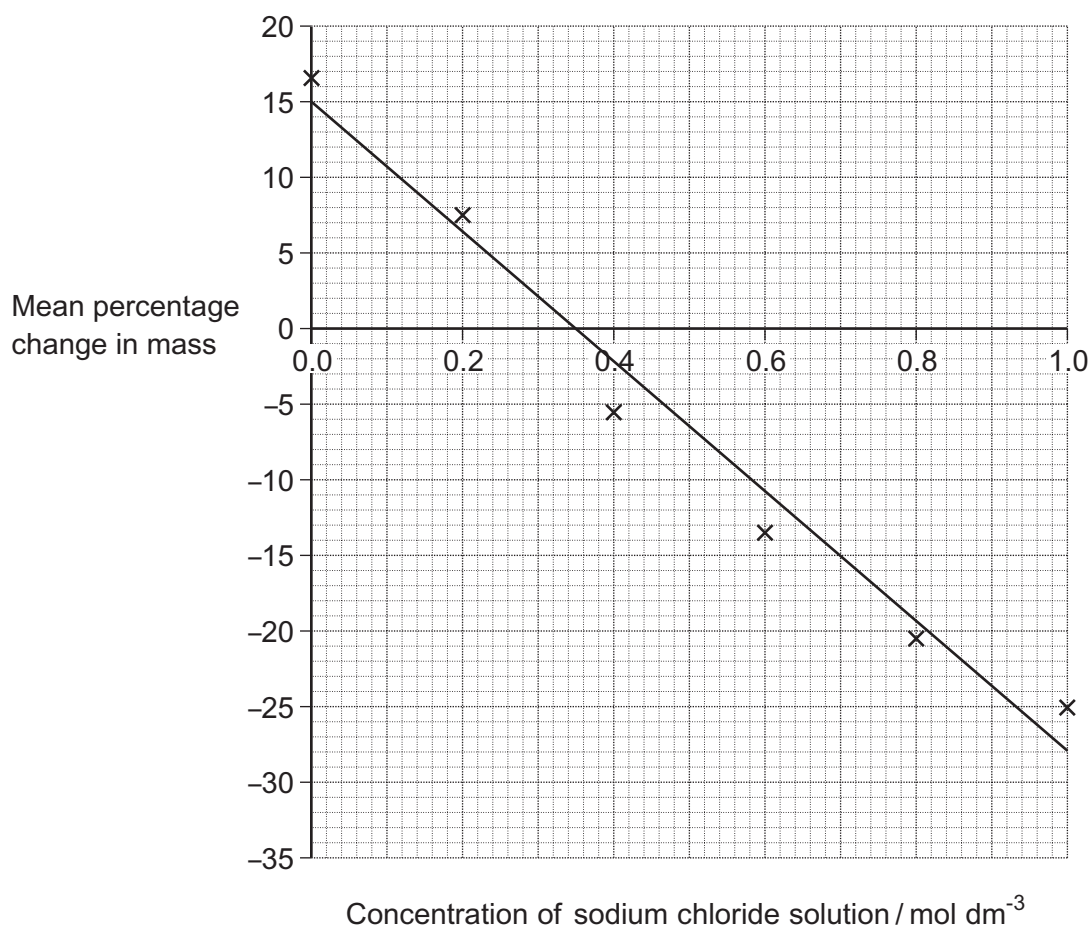
5 (b) The student made up all the sodium chloride solutions using a 1.0 mol dm⁻³ sodium chloride solution and distilled water.

Complete the table to show how he made 20 cm³ of a 0.2 mol dm⁻³ sodium chloride solution.

Volume of 1.0 mol dm⁻³ sodium chloride solution	Volume of distilled water

(1 mark)

5 (c) The student calculated the *percentage* change in mass rather than the change in mass. Explain the advantage of this.

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(2 marks)

5 (d) The student carried out several repeats at each concentration of sodium chloride solution. Explain why the repeats were important.

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(2 marks)

5 (e) Use the graph to find the concentration of sodium chloride solution that has the same water potential as the potato cylinders.

..............................mol dm⁻³
(1 mark)

8

Turn over ▶

6   Read the passage below.

Most cases of cervical cancer are caused by infection with Human Papilloma Virus (HPV). This virus can be spread by sexual contact. There are many types of HPV, each identified by a number. Most of these types are harmless but types 16 and 18 are most likely to cause cervical cancer.

A vaccine made from HPV types 16 and 18 is offered to girls aged 12 to 13. Three   5
injections of the vaccine are given over six months. In clinical trials, the vaccine has proved very effective in protecting against HPV types 16 and 18. However, it will be many years before it can be shown that this vaccination programme has reduced cases of cervical cancer. Until then, smear tests will continue to be offered to women, even if they have been vaccinated. A smear test allows abnormal cells in   10 the cervix to be identified so that they can be removed before cervical cancer develops.

The Department of Health has estimated that 80% of girls aged 12 to 13 need to be vaccinated to achieve herd immunity to HPV types 16 and 18. Herd immunity is where enough people have been vaccinated to reduce significantly the spread of   15 HPV through the population.

Use information from this passage and your own knowledge to answer the following questions.

6 (a)   HPV vaccine is offered to girls aged 12 to 13 (line 5). Suggest why it is offered to this age group.

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(1 mark)

6 (b)   The vaccine is made from HPV types 16 and 18 (line 5). Explain why this vaccine may **not** protect against other types of this virus.

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(2 marks)

6 (c) Three injections of the vaccine are given (lines 5 to 6). Use your knowledge of immunity to suggest why.

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(2 marks)

6 (d) It will be many years before it can be shown that this vaccination programme has reduced cases of cervical cancer (lines 7 to 9). Suggest **two** reasons why.

1 ....

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2 ....

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(2 marks)

6 (e) Smear tests will continue to be offered to women, even if they have been vaccinated (lines 9 to 10). Suggest why women who have been vaccinated still need to be offered smear tests.

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(1 mark)

6 (f) Suggest **one** reason why vaccinating a large number of people would reduce significantly the spread of HPV through the population (lines 14 to 16).

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(2 marks)

10

Turn over ▶

7 (a) Pulmonary tuberculosis is a disease of the lungs.
Describe the transmission and course of infection of pulmonary tuberculosis.

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(5 marks)

(Extra space) ....

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Do not write outside the box

7 (b)   Emphysema is another disease of the lungs. People with emphysema may feel weak and tired. Explain why.

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(5 marks)

(Extra space) ....

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END OF QUESTIONS

Answer **all** questions in the spaces provided.

1 (a)   Some seeds contain lipids. Describe how you could use the emulsion test to show that a seed contains lipids.

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(3 marks)

(Extra space) ....

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1 (b)   A triglyceride is one type of lipid. The diagram shows the structure of a triglyceride molecule.
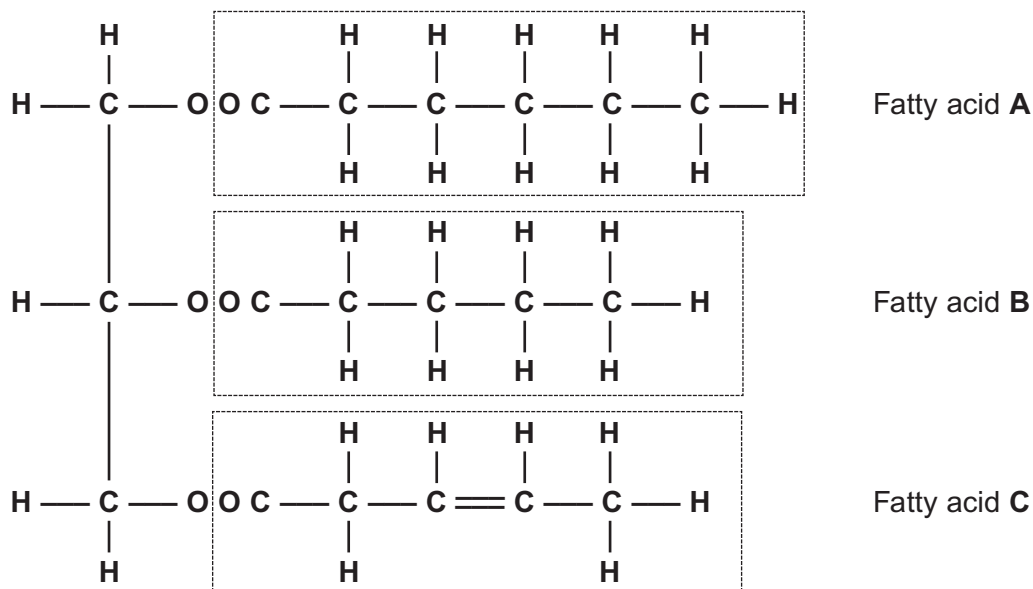
1 (b) (i) A triglyceride molecule is formed by condensation. From how many molecules is this triglyceride formed?

(1 mark)

1 (b) (ii) The structure of a phospholipid molecule is different from that of a triglyceride. Describe how a phospholipid is different.

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(2 marks)

1 (b) (iii) Use the diagram to explain what is meant by an unsaturated fatty acid.

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(2 marks)

8

Turn over for the next question

Turn over ▶

2   A person with asthma breathed out as hard as he could. The graph shows the volume of air he breathed out in the first 6 seconds of a breath. Curve **A** shows the volume before he used an inhaler. Curve **B** shows the volume after he used an inhaler.
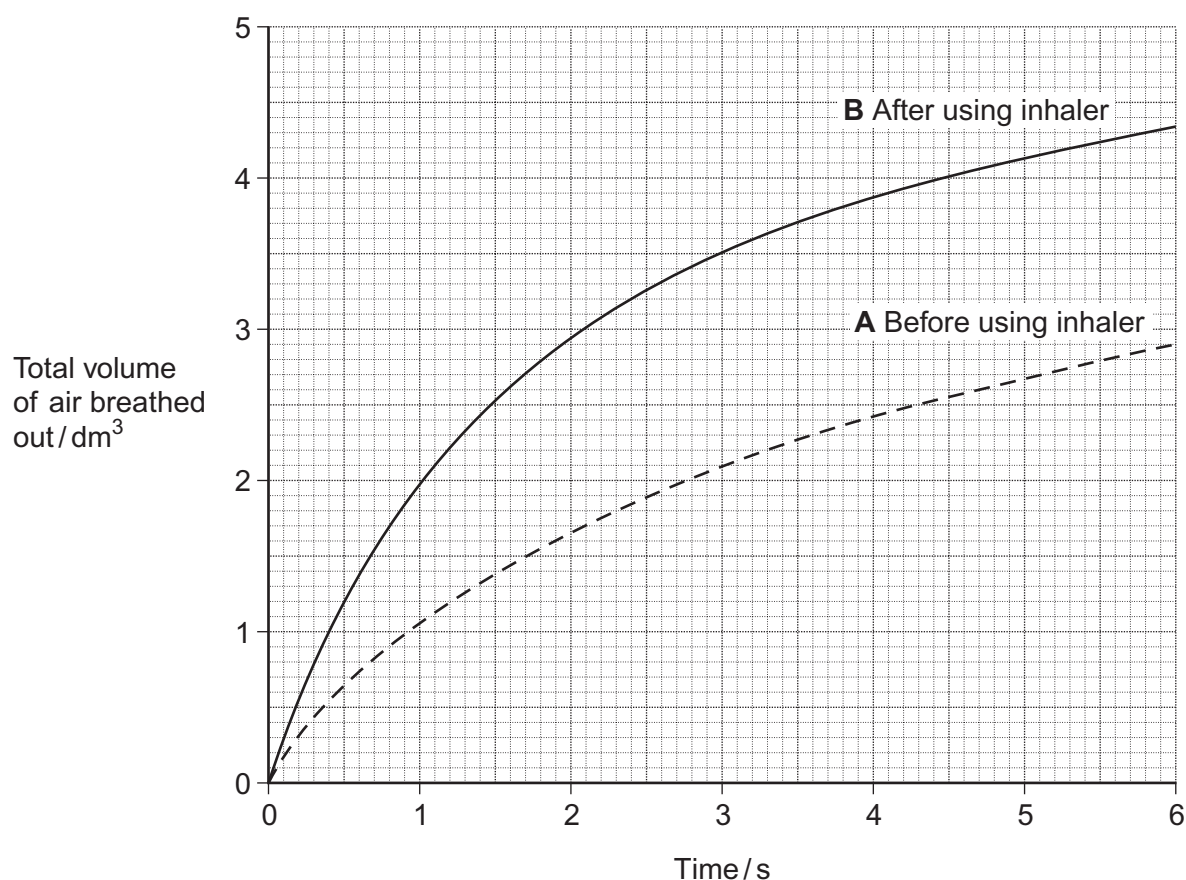
2 (a)   The diaphragm helps to bring about the changes shown by the curve **A**.
Explain how.

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(3 marks)

(Extra space) ....

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2 (b)   You could use curve **A** to find the total volume of air that this person could breathe out in one complete breath. Describe how.

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(2 marks)

2 (c)   The inhaler which the person used contained a substance that dilates bronchioles. Use this information to explain why curve **A** is different from curve **B**.

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(2 marks)

7

Turn over for the next question

Turn over ▶

Do not write outside the box

3 (a)   The table shows some features of cells. Complete the table by putting a tick in the box
if the feature is present in the cell.

Feature	Cell		
	Cholera bacterium	Epithelial cell from intestine	Epithelial cell from alveolus of lung
Cell-surface membrane			
Flagellum			
Nucleus			

(3 marks)

3 (b)   The diagram shows part of an epithelial cell from an insect's gut.

Lumen of gut

Microvillus

Golgi apparatus

Ribosomes on endoplasmic reticulum

Mitochondrion

Blood
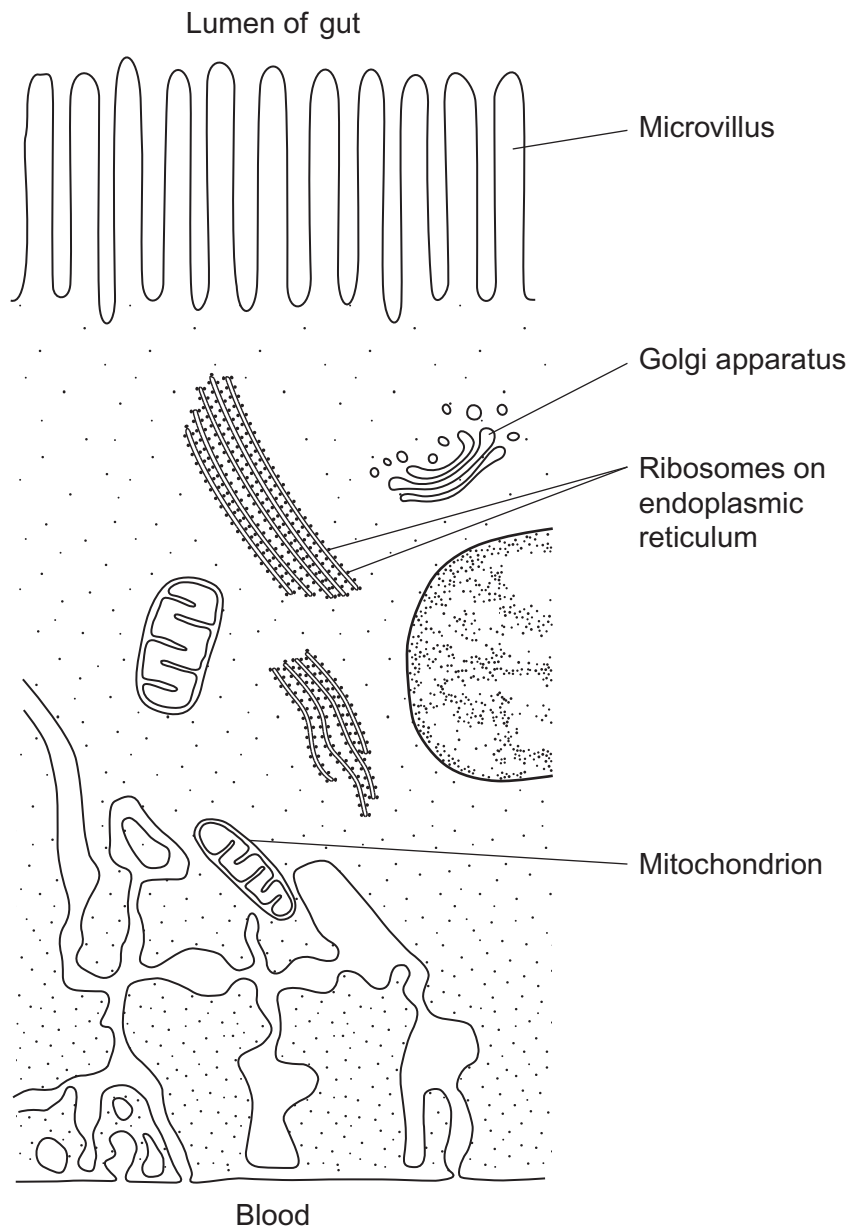
This cell is adapted for the three functions listed below. Use the diagram to explain how this cell is adapted for each of these functions.

Use a **different** feature in the diagram for each of your answers.

3 (b) (i)   the active transport of substances from the cell into the blood

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(2 marks)

3 (b) (ii)   the synthesis of enzymes

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(2 marks)

3 (b) (iii)   rapid diffusion of substances from the lumen of the gut into the cytoplasm

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(1 mark)

8

Turn over ▶

4 (a)   Scientists who investigate disease may look at risk factors. What is a risk factor?

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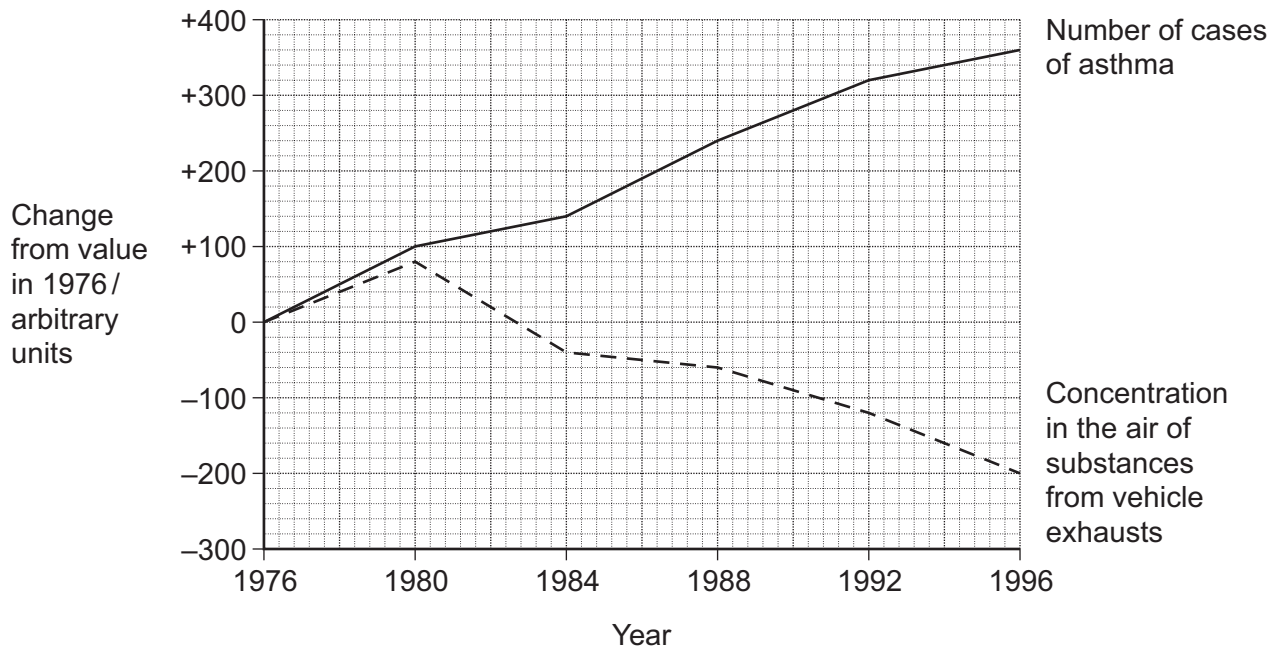
(1 mark)

Scientists investigated the link between pollution from vehicle exhausts and the number of cases of asthma. Between 1976 and 1996, the scientists recorded changes in the following

* the concentration in the air of substances from vehicle exhausts
* the number of cases of asthma.

The graph shows their results

Do not write outside the box

4 (b) Between which years on the graph was there

4 (b) (i) a positive correlation between the number of cases of asthma and the concentration in the air of substances from vehicle exhausts

....

(1 mark)

4 (b) (ii) a negative correlation between the number of cases of asthma and the concentration in the air of substances from vehicle exhausts?

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(1 mark)

4 (c) The scientists concluded that substances in the air from vehicle exhausts did **not** cause the increase in asthma between 1976 and 1980. Explain why.

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(3 marks)

(Extra space) ....

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6

Turn over ▶

5 (a) (i) The human heart has four chambers.
In which **one** of the four chambers of the human heart does pressure reach the highest value?

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(1 mark)

5 (a) (ii) Explain how the structure of this chamber causes this high pressure.

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(1 mark)

Figure 1 shows the volume of blood in a man's right ventricle at different times during one cardiac cycle.

Figure 1

Time / s	Volume of blood / cm³
0.0	125
0.1	148
0.2	103
0.3	70
0.4	56
0.5	55
0.6	98
0.7	125

5 (b) (i) Use the data in the **Figure 1** to calculate the man's heart rate.

Heart rate = ... beats per minute

5 (b) (ii) Use the data in **Figure 1** and your answer to part **5 (b) (i)** to calculate the man's cardiac output. Show your working.

Cardiac output = ... cm^3 per minute

(3 marks)

5 (c) Use information from **Figure 1** to complete the table below to show whether the valves are **open** or **closed** at each of the times shown. Write open or closed in the appropriate boxes.

Time / s	Valve between right atrium and right ventricle	Valve between right ventricle and pulmonary artery
0.2		
0.6		

(2 marks)

7

Turn over ▶

There are no questions printed on this page

**DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED**

6   The diagram shows an antibody molecule.

Polypeptide chains

Binding site

Variable region
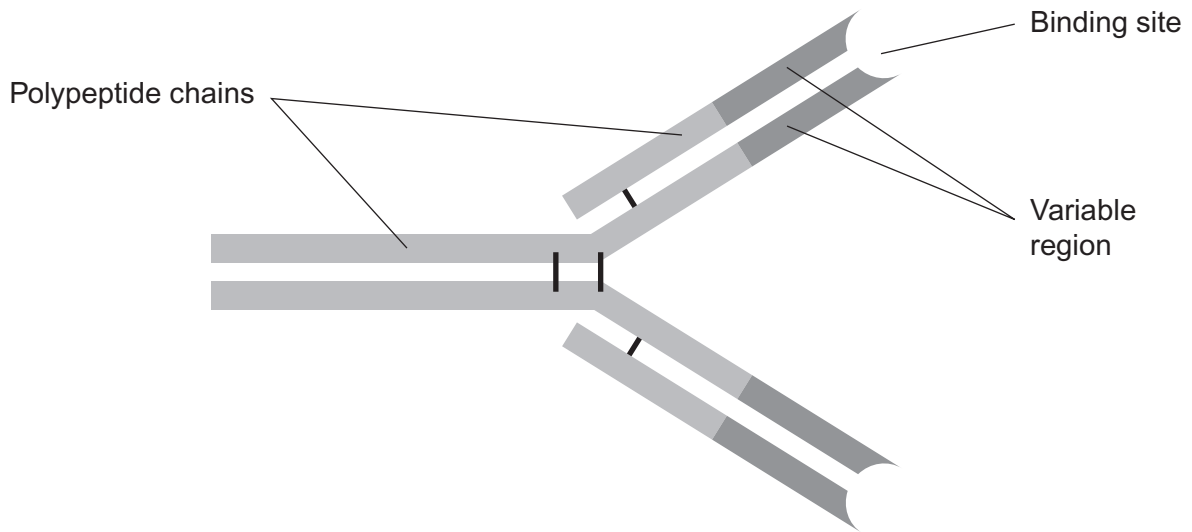
6 (a)   What is the evidence from the diagram that this antibody has a quaternary structure?

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(1 mark)

6 (b)   Scientists use this antibody to detect an antigen on the bacterium that causes stomach ulcers. Explain why the antibody will only detect this antigen.

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(3 marks)

(Extra space) ....

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4

Turn over ▶

Do not write outside the box

7   Read the following passage.

Aspirin is a very useful drug. One of its uses is to reduce fever and inflammation. Aspirin does this by preventing cells from producing substances called prostaglandins. Prostaglandins are produced by an enzyme-controlled pathway. Aspirin works by inhibiting one of the enzymes in this pathway. Aspirin attaches permanently to a   5
chemical group on one of the monomers that make up the active site of this enzyme.

The enzyme that is involved in the pathway leading to the production of prostaglandins is also involved in the pathway leading to the production of thromboxane. This is a substance that promotes blood   10
clotting. A small daily dose of aspirin may reduce the risk of myocardial infarction (heart attack).

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

7 (a)   Name the monomers that make up the active site of the enzyme (lines 6 – 7).

....
(1 mark)

7 (b)   The diagram shows the pathways by which prostaglandins and thromboxane are formed.

Substance **A**

↓

Substance **B**

↓ Enzyme **X**

Substance **C**

Enzyme **Y** ↙   ↘ Enzyme **Z**

Prostaglandins   Thromboxane
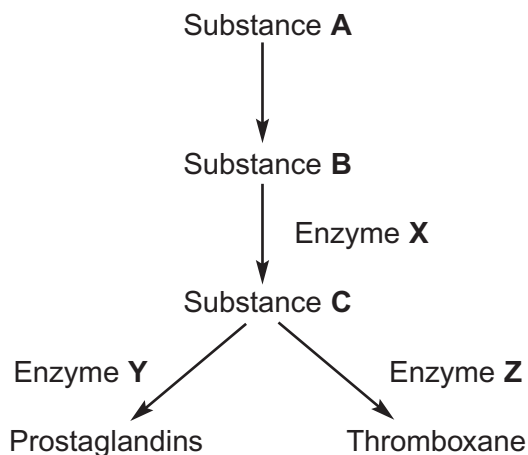
7 (b) (i)   Aspirin only affects one of the enzymes in this pathway. Use information in lines 5 – 7 to explain why aspirin does **not** affect the other enzymes.

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(2 marks)

7 (b) (ii) Which enzyme, **X**, **Y** or **Z**, is inhibited by aspirin? Explain the evidence from the passage that supports your answer.

Enzyme ....

Explanation ....

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(2 marks)

7 (c) Aspirin is an enzyme inhibitor. Explain how aspirin prevents substrate molecules being converted to product molecules.

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(2 marks)

7 (d) Aspirin may reduce the risk of myocardial infarction (lines 8 – 12). Explain how.

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(3 marks)

(Extra space) ....

10

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Turn over ▶

8 (a)   Vaccines protect people against disease. Explain how.

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(5 marks)

(Extra space) ....

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Do not write outside the box

8 (b)   Oral rehydration solutions (ORS) are used to treat diarrhoeal disease. What does an ORS consist of and how does it work?

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(5 marks)

(Extra space) ....

10

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END OF QUESTIONS