

PEARSON EDEXCEL IAL BIOLOGY • YBI11

BIOLOGY



EXAM QUESTION PACK

UNIT 1: MOLECULES, TRANSPORT AND HEALTH

SCORE

/601

PERCENTAGE

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STEMUP

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Q1.

A number of diseases are associated with lifestyle risk factors.

Some of these risk factors cause mutations.

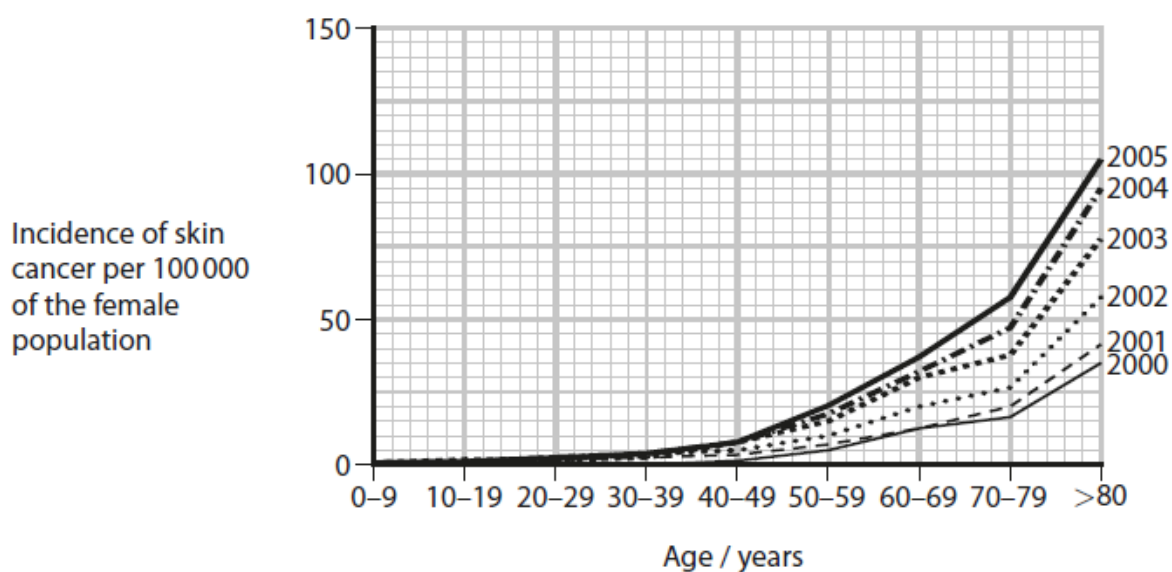
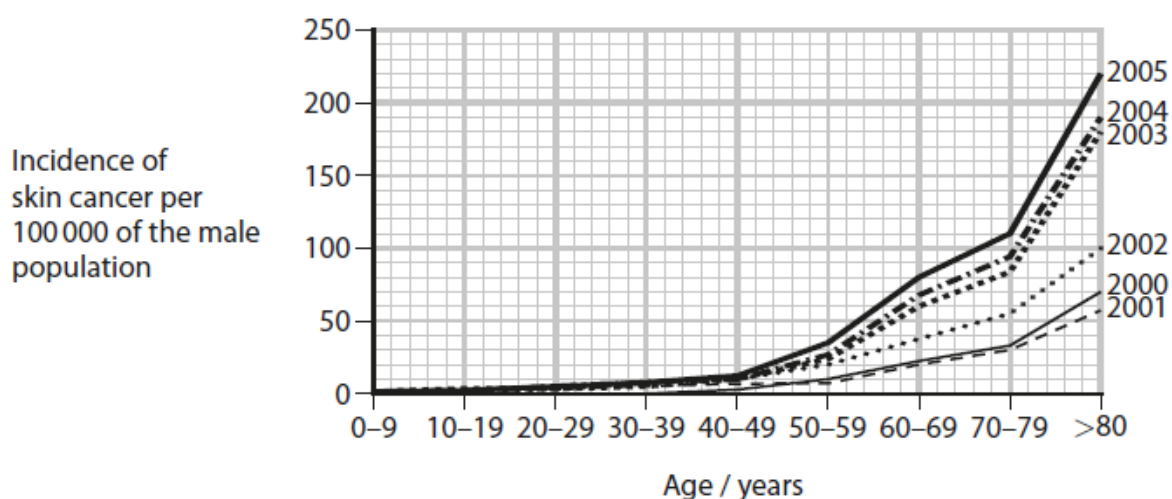
(a) Mutations can give rise to cancer.

State the meaning of the term **mutation**.

(1)

(b) Exposure to ultraviolet light is associated with the development of skin cancer.

The graphs show the incidence of skin cancer in males and females in one country in the Far East, from 2000 to 2005.



(i) The graphs show some correlations.

State the meaning of the term **correlation**.

(1)

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(ii) Describe the correlations shown by these graphs.

(3)

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(iii) Suggest a reason for each of the correlations shown by these graphs.

(3)

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*(c) The table shows some information from a study of the incidence of emphysema in smokers and non-smokers.

Information	Males	Females
Number of individuals in the study	25	25
Mean age when diagnosed / years	53.1	54.2
Range of ages when diagnosed / years	32 to 77	34 to 68
Number of smokers	5	6
Number of non-smokers	20	19
Number of smokers with emphysema	1	6
Number of non-smokers with emphysema	0	0

Criticise the design of this study.

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Q2.

Obesity increases the risk of cardiovascular disease (CVD).

Body mass index (BMI), waist-to-hip ratio (WHR) and skinfold thickness are indicators of obesity.

(a) The table shows some measurements taken from two females, female **J** and female **K**.

Female	Height / cm	Mass / kg	Waist / cm	Hips / cm	BMI	WHR
J	155	59.1	80	100	25	0.80
K	155			125	36	0.80

(i) Calculate the waist size of female **K**.

(1)

Answer cm

(ii) The formula for calculating BMI is:

$$\text{BMI} = \frac{\text{mass in kg}}{(\text{height in m})^2}$$

Calculate the mass of female **K**, using the data in the table.

(3)

Answer kg

(iii) Comment on the risk of developing CVD in these two women.

(2)

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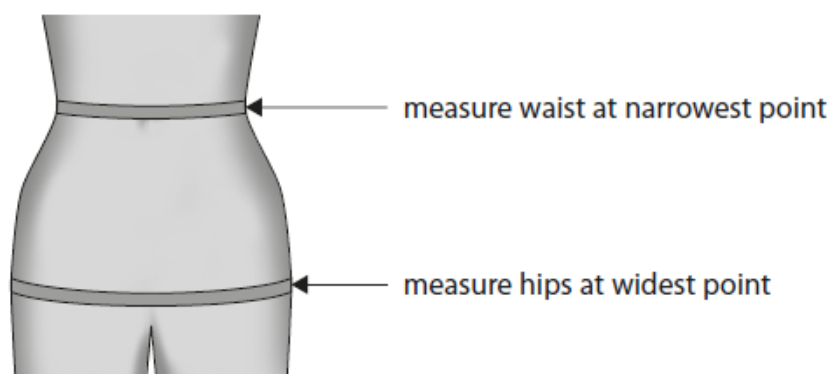
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(iv) The diagram shows how the waist and hip measurements should be taken, using a tape measure.



Explain how the way a person takes these measurements could produce an underestimate of their risk of CVD.

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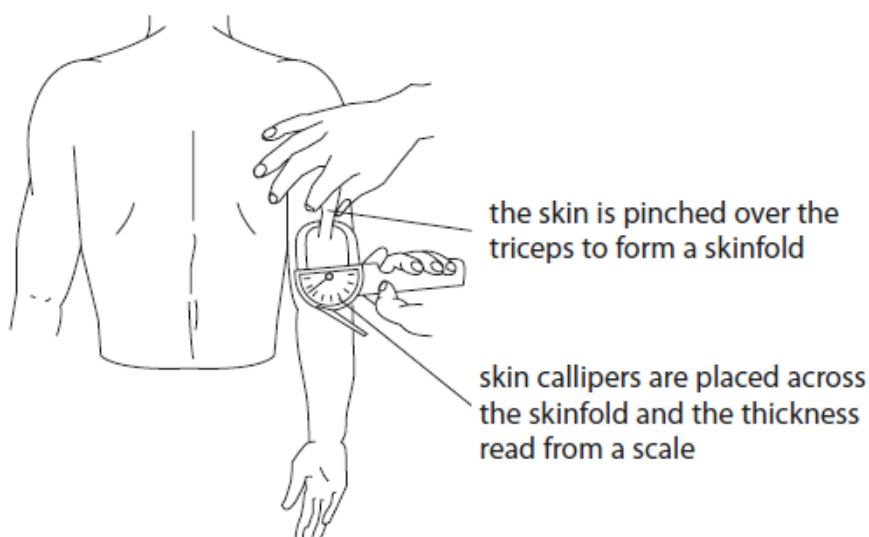
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(b) The diagram shows how a skinfold thickness measurement is taken over the triceps muscle at the back of the arm.



Skinfold thickness measures the thickness of the layer of fat under the skin.

Measurements are taken from several sites on the body.

The table shows the skinfold thickness at four sites on a 42-year-old female.

Site	Skinfold thickness / a.u.
over the biceps at the front of the arm	0.63
over the triceps at the back of the arm	0.82
under the shoulder blade at the back of the neck	0.65
above the hip bone at the side of the body	0.82

(i) Suggest **two** reasons why the skinfold thickness values are different at each site on the body. Assume that the skin callipers have been used correctly.

(2)

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(ii) The table shows a body fat interpretation chart.

The values in the table are the means of the four skinfold thickness measurements.

Age	Level of body fat			
	Low	Moderate	High	Very high
20 to 29	<0.71	0.71 to 0.77	0.78 to 0.82	>0.82
30 to 39	<0.72	0.72 to 0.78	0.79 to 0.84	>0.84
40 to 49	<0.73	0.73 to 0.79	0.80 to 0.87	>0.87
50 to 59	<0.74	0.74 to 0.81	0.82 to 0.88	>0.88

Determine the level of body fat of this female.

(1)

Answer

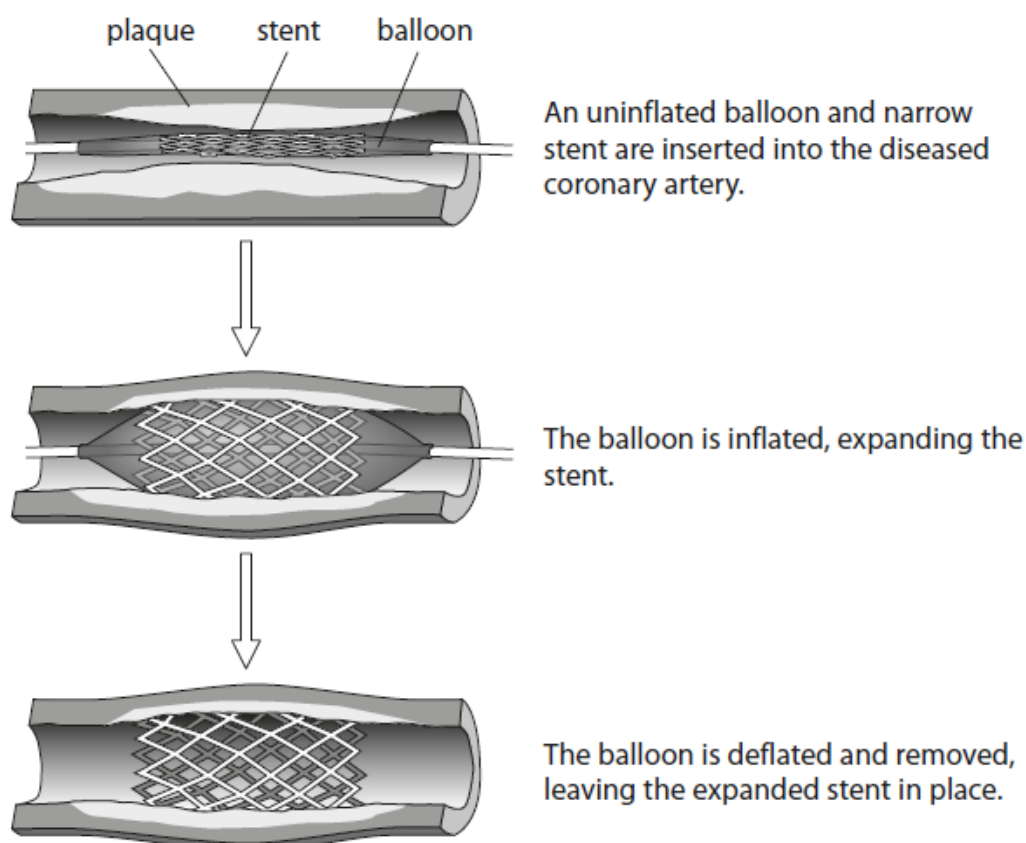
(Total for question = 11 marks)

Q3.

Answer the question with a cross in the box you think is correct ☒ . If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒ .

Stents are used in the treatment of atherosclerosis.

(a) The diagram shows how stents are positioned in a diseased coronary artery.



Explain why a stent is used in the treatment of atherosclerosis in a coronary artery.

(3)

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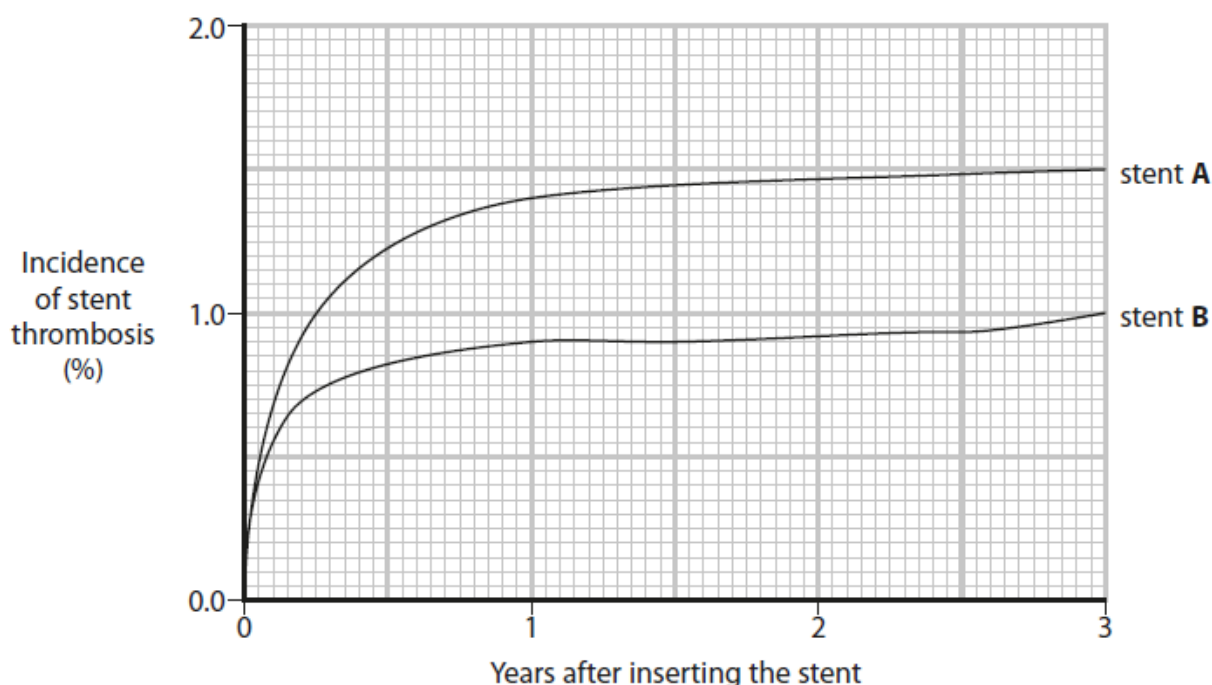
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(b) Inserting a stent can damage the artery.

This damage can result in stent thrombosis if the blood clotting process is stimulated.

A study looked at the damage caused by two different types of stent, stent **A** and stent **B**.

The graph shows the incidence of stent thrombosis found in this study.



(i) In this study, 800 patients had stent **A** inserted and 400 patients had stent **B** inserted.

Calculate the difference in the number of patients who developed stent thrombosis three years after inserting the stent.

(2)

Answer

(ii) State how the formation of a blood clot in the coronary artery could cause the death of the patient.

(1)

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(iii) Which components of the blood clotting process are enzymes in their active form?

(1)

☒ **A** prothrombin and thromboplastin only

☒ **B** prothrombin and thrombin only

- ☐ **C** prothrombin, thrombin and thromboplastin
- ☐ **D** thrombin and thromboplastin only

(iv) Which components of the blood clotting process are soluble in blood plasma?

(1)

- ☐ **A** fibrin and fibrinogen
- ☐ **B** fibrin and thromboplastin
- ☐ **C** fibrinogen and thromboplastin
- ☐ **D** fibrinogen only

(v) Stent **B** contains a drug to prevent stent thrombosis.

Suggest one type of drug that could be used in stent **B**.

(1)

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(Total for question = 9 marks)

Q4.

Answer the question with a cross in the box you think is correct ☐ . If you change your mind about an answer, put a line through the box ☐ and then mark your new answer with a cross ☐ .

A person with diabetes has a blood glucose level that can be too high.

When the blood glucose level of a person without diabetes becomes too high, the liver stores glucose as a polysaccharide.

(a) Which polysaccharide does the liver store?

(1)

- ☐ **A** amylopectin
- ☐ **B** cellulose
- ☐ **C** glycogen
- ☐ **D** starch

(b) Blood glucose levels can become high following the digestion of carbohydrates.

Which of the following can be digested to release glucose?

(1)

- ☐ **A** both fructose and sucrose
- ☐ **B** both fructose and galactose
- ☐ **C** both galactose and lactose
- ☐ **D** both lactose and sucrose

(c) Diabetes is a risk factor for cardiovascular disease.

(i) One estimate is that there are 415 million people with diabetes in the world and that 46% of these people are undiagnosed.

Calculate the number of people who have undiagnosed diabetes.

(1)

Answer

(ii) There are two types of diabetes, Type I and Type II.

The treatment for Type I diabetes is different from the treatment for Type II diabetes, so it is important for a correct diagnosis to be made.

Diagnosis can be difficult, particularly in people aged between 20 and 40 years old.

A genetic screening method is now available for the diagnosis of diabetes.

Explain why doctors are more likely to screen individuals once they develop diabetes than use methods such as prenatal testing.

(3)

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(Total for question = 6 marks)

Q5.

Answer the question with a cross in the box you think is correct ☐. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☐.

Warfarin is an anticoagulant.

The dose of warfarin that is given to a patient has to be monitored regularly. This is done by adding thromboplastin to a blood sample and measuring the time it takes for the blood to clot.

The result is compared with a control sample and is reported as an International Normalised Ratio (INR) level.

(a) How many of the following statements are correct for thromboplastin?

- it is stored in platelets
- it is an active enzyme
- it is converted into thrombin

(1)

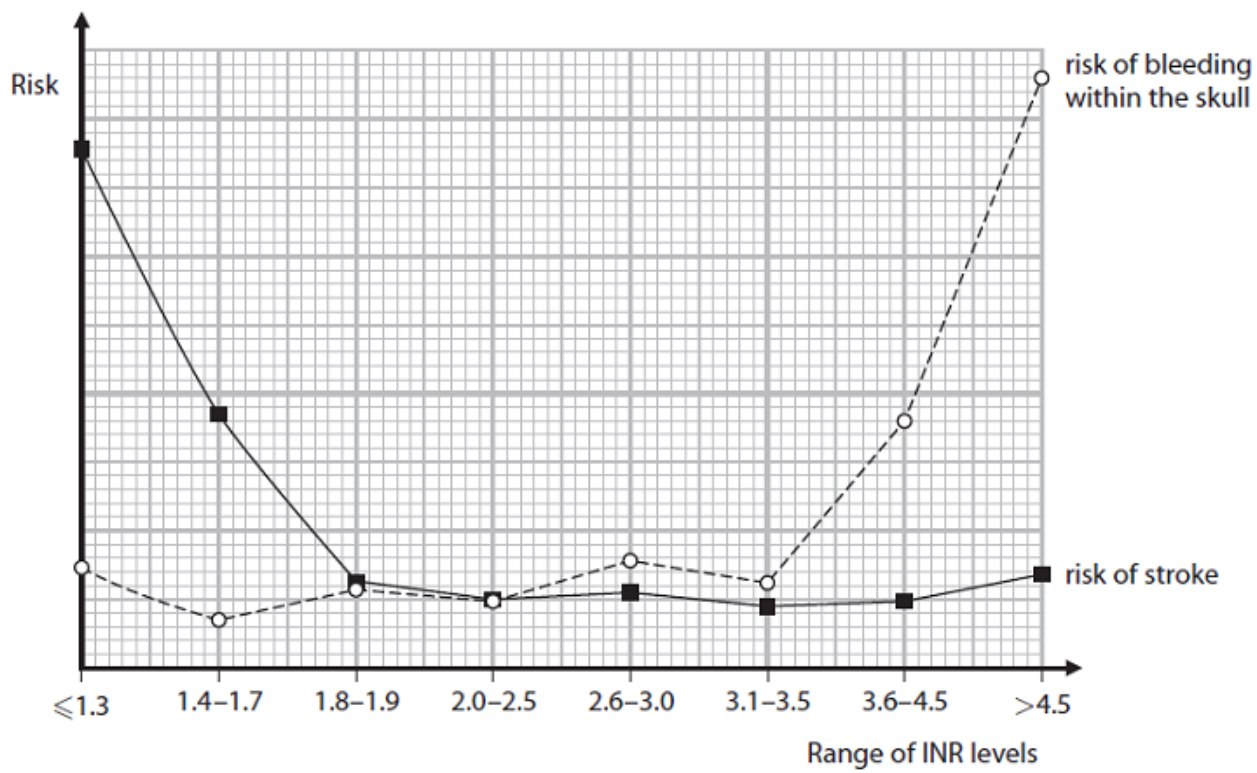
☐ **A** none

☐ **B** one

☐ **C** two

☐ **D** three

(b) The graph shows the relationship between the INR level and the risk of stroke and the risk of bleeding within the skull.



Deduce a safe range for the INR level.

Use the information in the graph to support your answer.

(3)

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(c) Explain how taking this anticoagulant can reduce the risk of cardiovascular disease (CVD).

(3)

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(d) Warfarin is given to patients who have had a heart attack, to prevent further heart attacks and other related health issues.

A study compared warfarin with the use of aspirin, over a four-year period following the first heart attack.

(i) A group of 1216 were given warfarin; 83.3% of these people had no further health issues.

Calculate the number of people given warfarin who had no further health issues following their first heart attack.

(1)

Answer

(ii) A second study compared this result with people given a combination of warfarin and aspirin.

Describe how this study should be carried out to produce a valid comparison.

(4)

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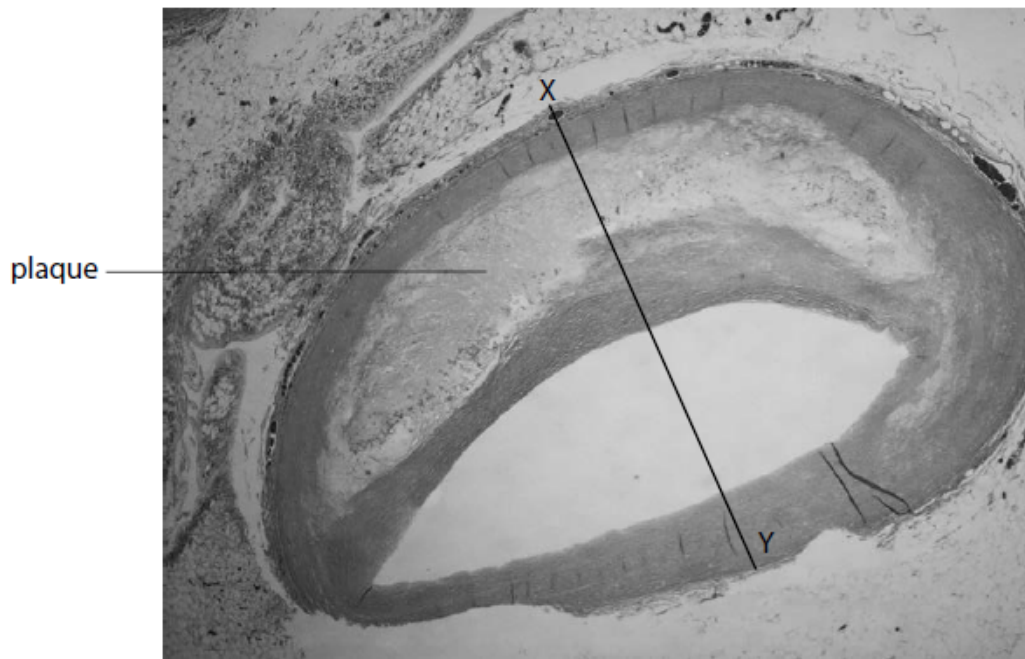
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Q6.

Many studies have linked the development of atherosclerosis with cardiovascular disease (CVD).

(a) The photograph shows a section through an artery with a plaque (atheroma) from a patient with atherosclerosis.



© Ogphoto/iStock

Calculate the percentage increase in the thickness of the artery wall where the plaque is located.

Take your measurements along the line labelled X-Y.

(3)

Answer %

(b) Explain how atherosclerosis can result in damage to the heart muscle.

(4)

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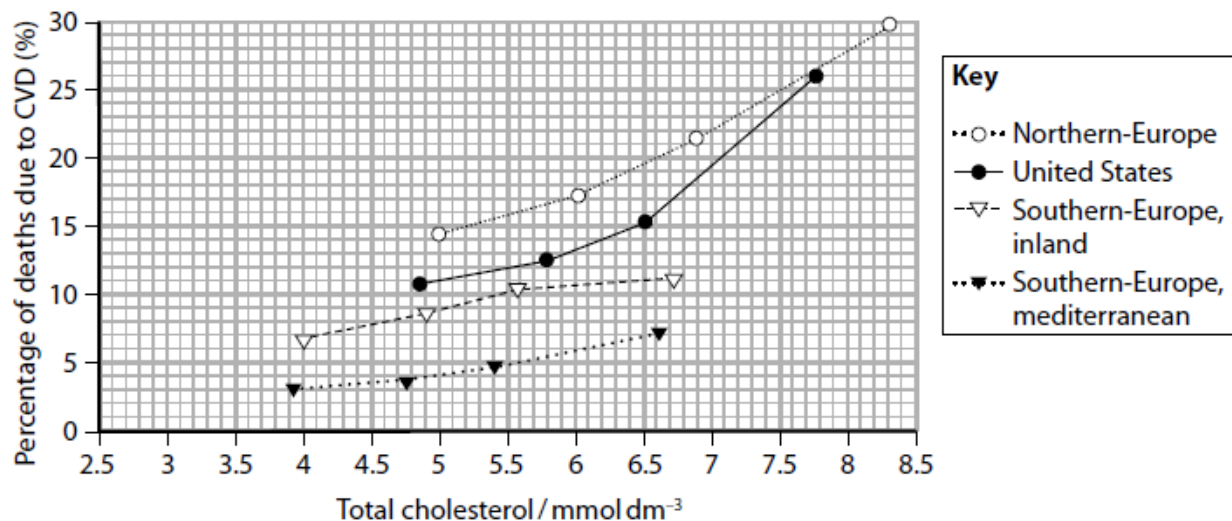
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The results are shown in the graph.



Graph 1

The results are shown in the graph.



(6)

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins or other markings on the paper.

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(Total for question = 13 marks)

Q7.

Haemophilia A is an inherited genetic disorder.

Haemophilia A results in the blood not being able to clot.

(a) The table gives some information about blood clotting components.

Complete the table by filling in the empty boxes with either the name of the component, the role of the component or the solubility of the component.

(6)

Name	Role	Solubility
thromboplastin		soluble
.....	catalyses the conversion of fibrinogen into fibrin	
fibrin	1 2	

(b) Haemophilia A is inherited in a similar way to red-green colour blindness.

Explain why more males than females are affected with haemophilia A.

(3)

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(Total for question = 9 marks)

Q8.

Answer the question with a cross in the box you think is correct ☐ . If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☐ .

Warfarin is a drug used to treat people who have a blood clot.

(a) (i) Read through the following passage about warfarin.

Write on the dotted lines the most appropriate word or words to complete the passage.

(3)

Warfarin is used to treat people with blood clots as it lowers the number of clotting factors in the blood.

One clotting factor in blood is prothrombin.

Prothrombin is converted to the enzyme thrombin by

The of thrombin binds to fibrinogen and as a result a mesh of fibres and is formed.

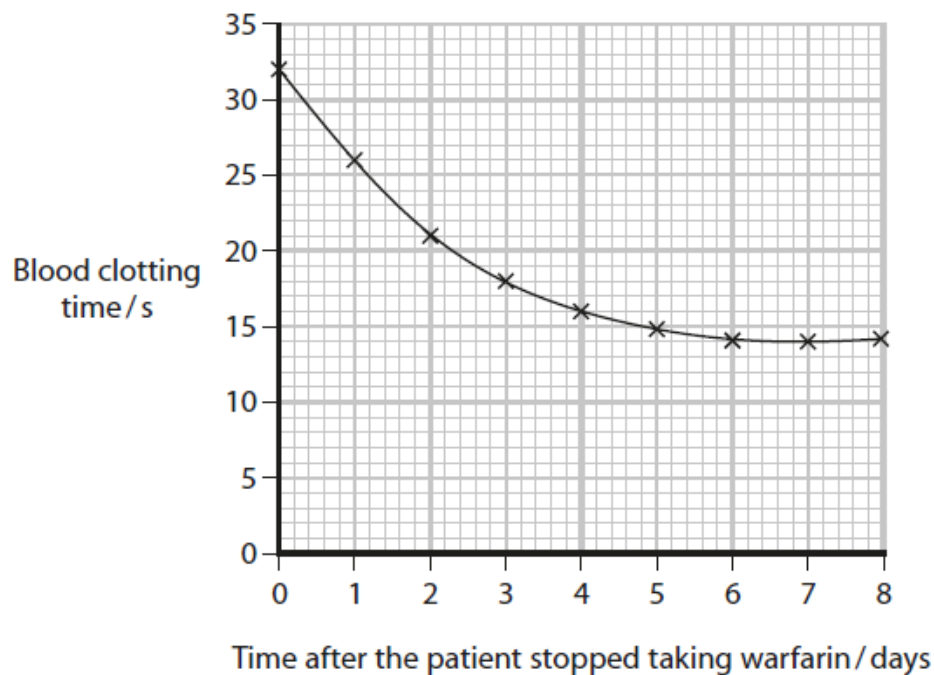
(ii) Which type of drug is warfarin?

(1)

- ☐ **A** an anticoagulant
- ☐ **B** an antihypertensive
- ☐ **C** a platelet inhibitor
- ☐ **D** a statin

(b) The time taken for a blood sample to form a blood clot can be measured. This is called the clotting time.

The graph shows the blood clotting time after a patient has stopped taking warfarin.



Calculate the rate of decrease in the clotting time at two days after stopping taking warfarin.

Use a tangent for your calculation.

(2)

Answer

(Total for question = 6 marks)

Q9.

Answer the questions with a cross in the boxes you think are correct ☐. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☐.

The blood clotting process has to be fast to prevent loss of blood from wounds.

(a) Which molecule traps red blood cells and platelets in the formation of a blood clot at a wound?

(1)

- ☐ **A** cholesterol
- ☐ **B** collagen
- ☐ **C** fibrin
- ☐ **D** fibrinogen

(b) How many of the following are converted into an active enzyme during blood clotting?

- fibrin
- fibrinogen
- prothrombin
- thrombin

(1)

- ☐ **A** 1
- ☐ **B** 2
- ☐ **C** 3
- ☐ **D** 4

(c) How many of the following are soluble in blood plasma?

- fibrin
- fibrinogen
- prothrombin
- thrombin

(1)

- ☐ **A** 1
- ☐ **B** 2
- ☐ **C** 3

(d) Thromboplastin is stored inside platelets.

Explain the advantages of storing thromboplastin inside platelets.

(3)

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(Total for question = 6 marks)

Q10.

Many animals have a heart and circulatory system.

(a) Five litres of blood can pass through a human heart each minute.

Calculate the volume of blood that passes through this heart in 24 hours.

Give your answer in standard form.

(2)

Answer litres

(b) Blood leaves the heart through the arteries.

Compare and contrast the structure of the aorta with the structure of the pulmonary artery.

(2)

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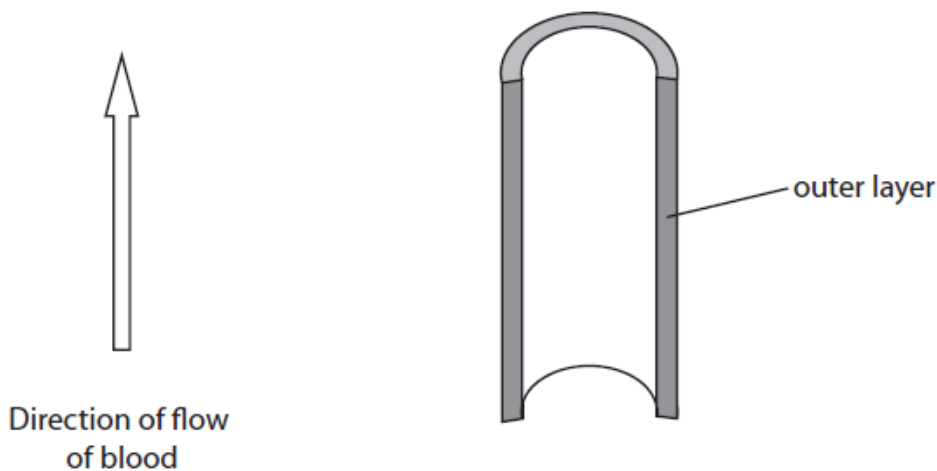
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(c) Blood returns to the heart through the veins.

The diagram shows the outline of a vein. The direction of flow of blood is also shown.

Complete and label the diagram to show the structures present in a vein.

(3)



(Total for question = 7 marks)

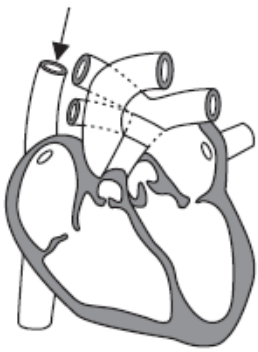
Q11.

Answer the questions with a cross in the boxes you think are correct ☐. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☐.

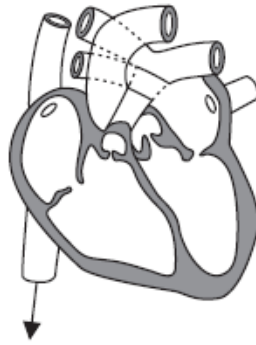
Blood flows through the heart during the cardiac cycle.

(a) Which diagram shows the direction of blood flow through the vena cava?

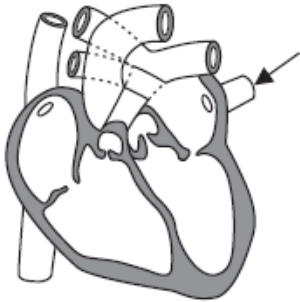
(1)



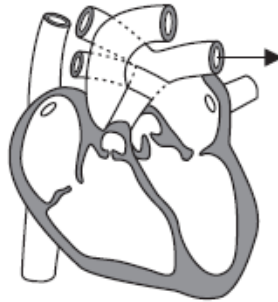
☐ A



☐ C



☐ B



☐ D

(b) Which row in the table describes the blood flow through the pulmonary artery and the pulmonary vein?

(1)

	Blood flow through pulmonary artery	Blood flow through pulmonary vein
☐ A	deoxygenated blood flowing away from the heart	oxygenated blood flowing towards the heart
☐ B	deoxygenated blood flowing towards the heart	oxygenated blood flowing away from the heart
☐ C	oxygenated blood flowing away from the heart	deoxygenated blood flowing towards the heart
☐ D	oxygenated blood flowing towards the heart	deoxygenated blood flowing away from the heart

(c) The table describes the atrioventricular (AV) valves and the semilunar (SL) valves during the cardiac cycle.

Which description is true for each stage of the cardiac cycle?

(3)

Stage of the cardiac cycle	AV valves open and SL valves open	AV valves open and SL valves closed	AV valves closed and SL valves open	AV valves closed and SL valves closed
atrial systole	☐	☐	☐	☐
ventricular systole	☐	☐	☐	☐
diastole	☐	☐	☐	☐

(d) Describe how the events of the cardiac cycle change when the demand of body cells for oxygen increases.

(2)

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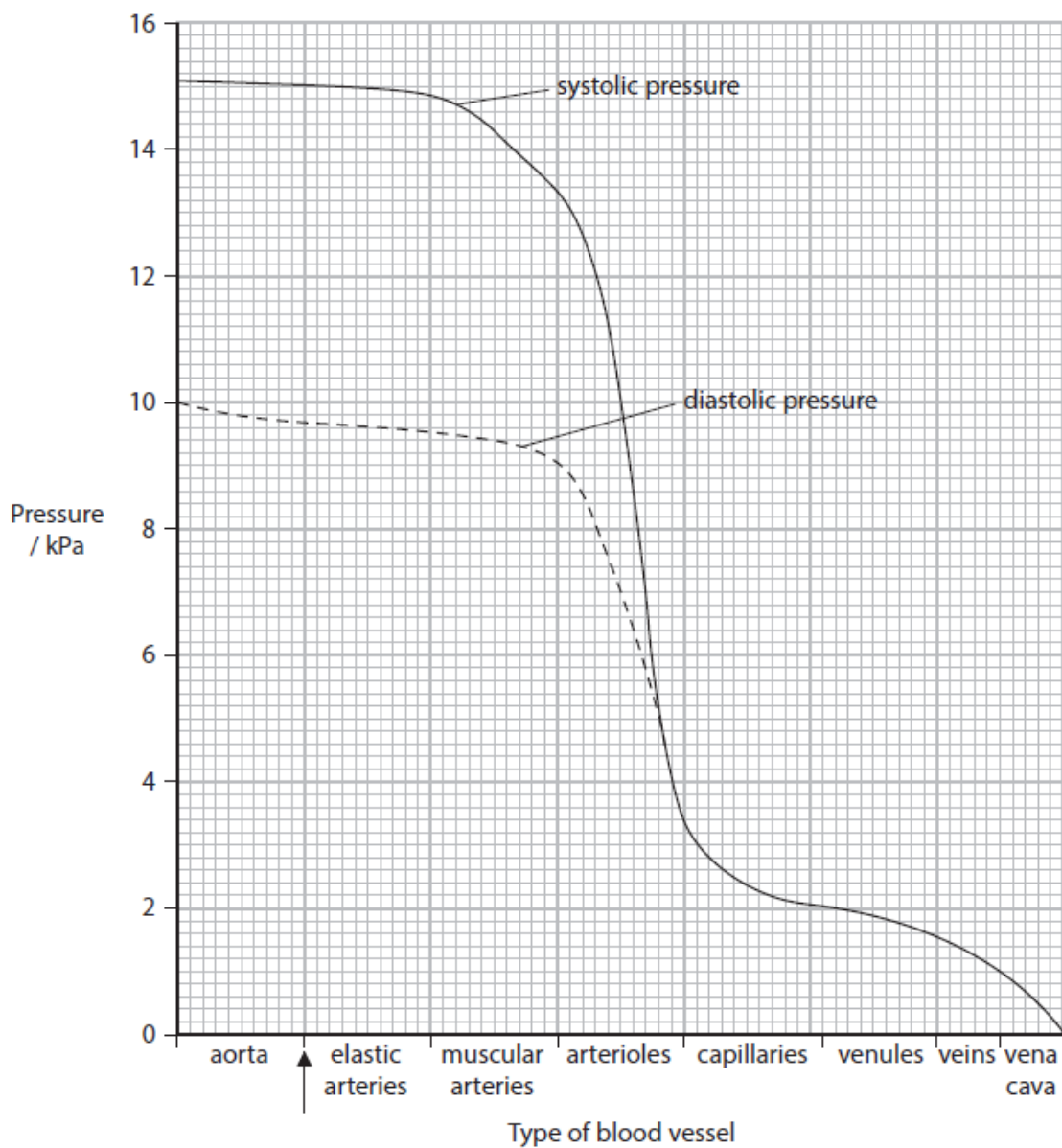
(Total for question = 7 marks)

Q12.

Blood flow and blood pressure are affected by a number of factors.

Abnormal blood flow and abnormal blood pressure affect the health of a person.

(a) The graph shows the systolic pressure and the diastolic pressure as blood flows through human blood vessels.



(i) Pulse pressure is the difference between systolic pressure and diastolic pressure.

In a healthy person, pulse pressure should be at least 25% of the systolic pressure.

Determine whether this person is healthy, using the point indicated by the arrow on the x-axis of the graph.

(2)

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(ii) The mean arterial pressure (MAP) can be approximated using the formula

$$\text{MAP} = \text{diastolic blood pressure} + \frac{(\text{systolic blood pressure} - \text{diastolic blood pressure})}{3}$$

Estimate the MAP in the elastic arteries for this person.

(2)

Answer kPa

(iii) If the mean arterial pressure (MAP) value is less than 8 kPa, the force pushing the blood through the vessels will be too low.

Explain how a low MAP could affect a person.

(2)

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(b) Blood flow depends on the change in pressure (ΔP), the radius of the blood vessel lumen (r), the length of the blood vessel (λ) and the viscosity of the blood (η).

Blood flow can be calculated using the formula

$$\text{Blood flow} = \frac{\pi \Delta P r^4}{8 \eta \lambda}$$

Blood flow can also be calculated using the formula

$$\text{Blood flow} = \frac{\Delta P}{\text{resistance}}$$

(i) Which formula can be used to calculate resistance?

(1)

☐ A $\frac{8 \eta \lambda}{\pi \Delta P r^4}$

☐ B $\frac{\pi \Delta P r^4}{8 \eta \lambda}$

☐ C $\frac{\pi r^4}{8 \eta \lambda}$

☐ D $\frac{8 \eta \lambda}{\pi r^4}$

(ii) A change in which factor has the biggest effect on resistance?

(1)

- ☐ **A** blood pressure
- ☐ **B** length of the blood vessel
- ☐ **C** radius of the blood vessel lumen
- ☐ **D** thickness of the blood vessel wall

(iii) Explain how arteries are adapted to reduce resistance to blood flow.

(2)

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(c) Blood vessels can expand to accommodate increased blood flow. This is known as compliance.

(i) Explain how arteries are adapted to accommodate sudden increases in blood flow.

(2)

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(ii) Explain why a reduction in the compliance of a blood vessel can lead to cardiovascular disease (CVD).

(3)

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(Total for question = 15 marks)

Q13.

The structure of blood vessels relates to their function.

(a) Describe how the structure of capillaries relates to their function.

(2)

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(b) Draw a cross-section of an artery to show details of its structure.

Label **two** features of the artery on your diagram.

(3)

(c) Explain why veins need valves along their length.

(2)

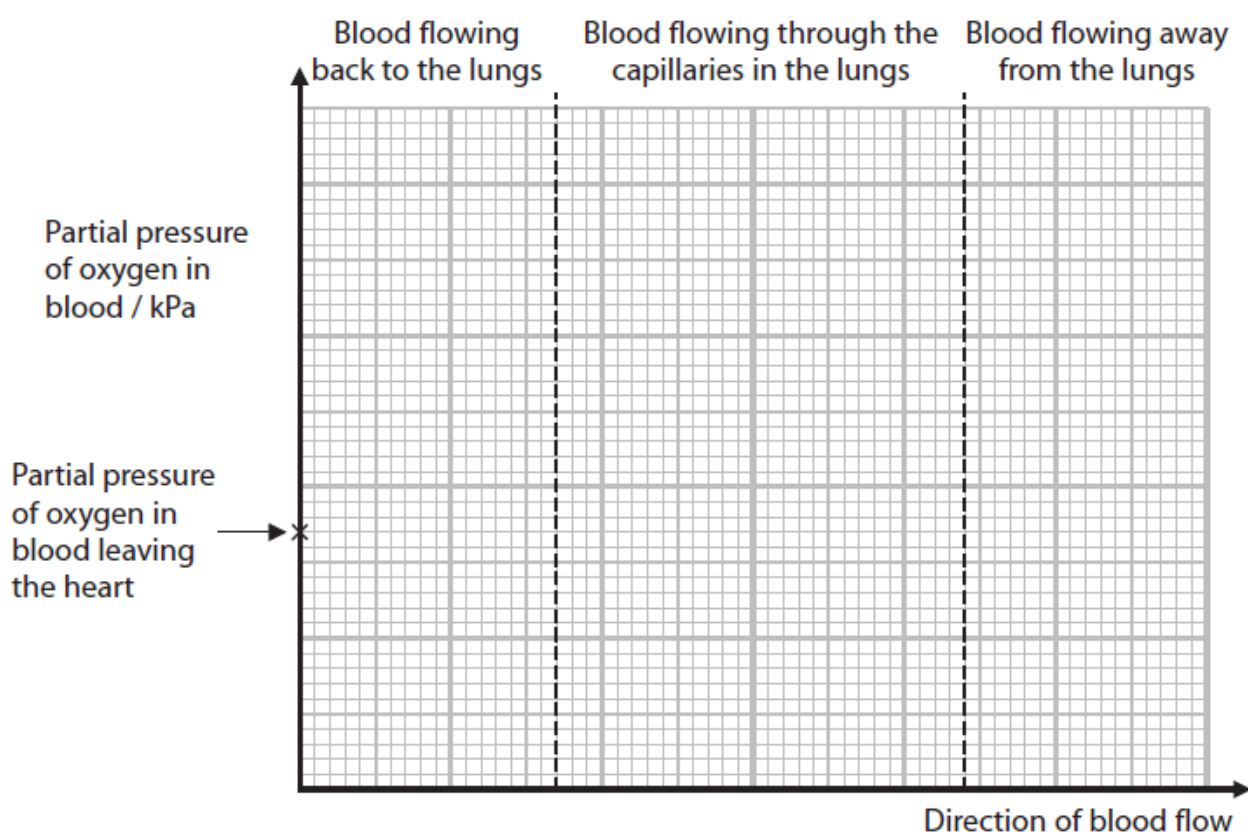
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(d) Deoxygenated blood is taken to the lungs and oxygenated blood is taken away from the lungs.

Complete the graph to show the changes in partial pressure of oxygen in the blood as it flows back to the lungs, through the lungs and away from the lungs.

(3)

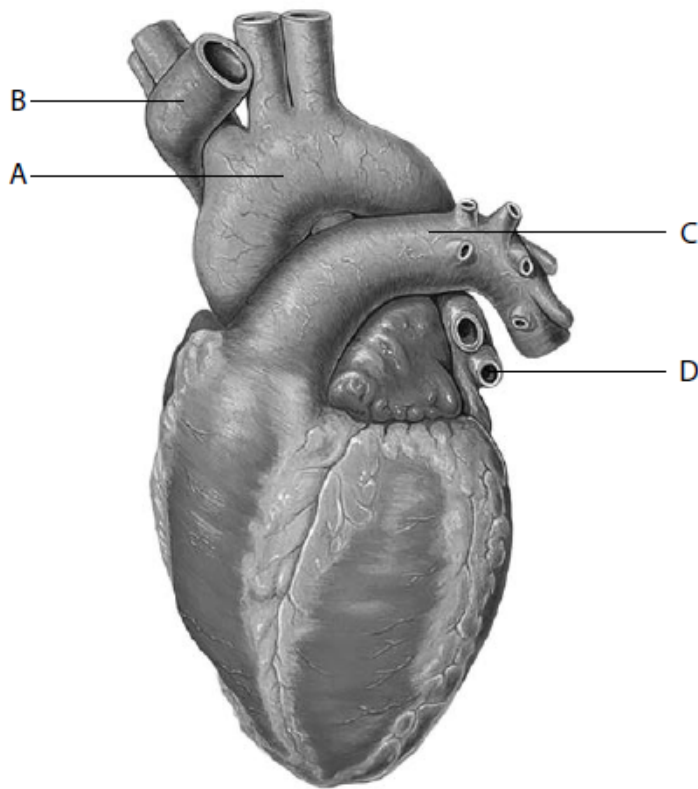


(Total for question = 10 marks)

Q14.

Mammals have a heart that pumps blood through a network of blood vessels.

(a) The drawing shows a human heart.



Used under Creative Commons Attribution-ShareAlike License - Patrick J Lynch

(i) Which blood vessel takes blood from the heart to the body?

(1)

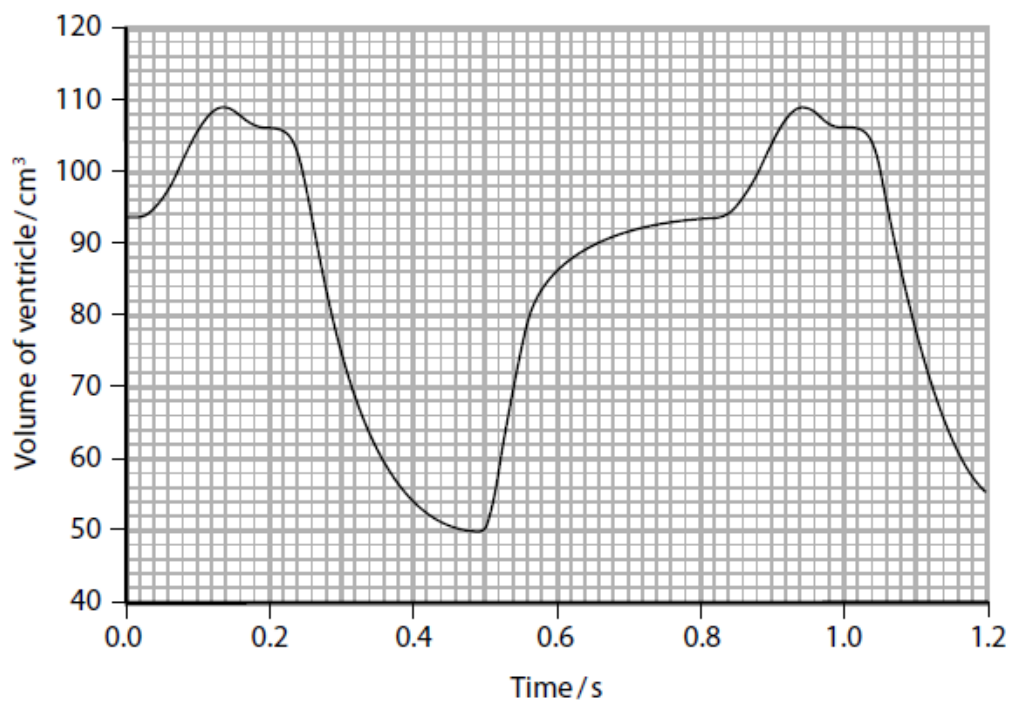
- ☐ A
- ☐ B
- ☐ C
- ☐ D

(ii) Which blood vessel has semilunar valves and contains blood with the highest concentration of carbon dioxide?

(1)

- ☐ A
- ☐ B
- ☐ C
- ☐ D

(b) The graph shows the change in volume of the left ventricle during the cardiac cycle.



(i) When is this heart in ventricular systole?

(1)

- ☐ **A** at 0.1 seconds
- ☐ **B** at 0.4 seconds
- ☐ **C** at 0.6 seconds
- ☐ **D** at 0.8 seconds

(ii) Calculate the volume of blood in dm^3 that will be pumped out of this heart by the left ventricle each minute.

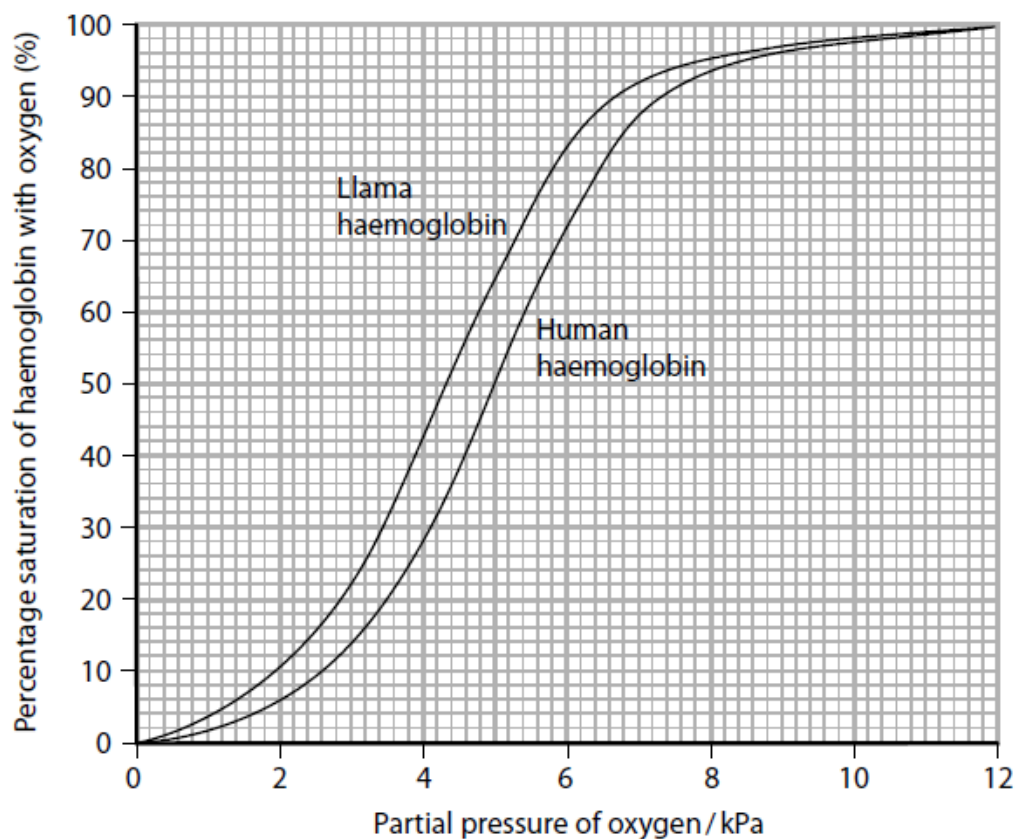
(3)

Answer dm^3

(c) As altitude (height above sea level) increases, the partial pressure of oxygen in the air decreases.

Llamas are mammals that are adapted to living at high altitudes.

The graph shows the oxygen dissociation curves for llama haemoglobin and human haemoglobin.



Explain the differences between the dissociation curves. Use the information in the graph to support your answer.

(4)

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(Total for question = 10 marks)

Q15.

Answer the question with a cross in the box you think is correct ☒ . If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒ .

The butterfly is an insect that feeds on nectar produced by flowers.

The photograph shows a butterfly feeding on a flower.



(Source: James Schwabel / Alamy Stock Photo)

(a) The nectar in flowers contains nutrients including sugars, amino acids and lipids.

(i) The sugars in the nectar are fructose, glucose and sucrose.

Which of these contain glycosidic bonds?

(1)

- ☐ **A** fructose only
- ☐ **B** sucrose only
- ☐ **C** fructose and glucose
- ☐ **D** fructose and sucrose

(ii) Which row of the table describes how amino acids are joined together to form a protein?

(1)

	name of bond	type of reaction
☐ A	ester	condensation
☐ B	ester	hydrolysis
☐ C	peptide	condensation
☐ D	peptide	hydrolysis

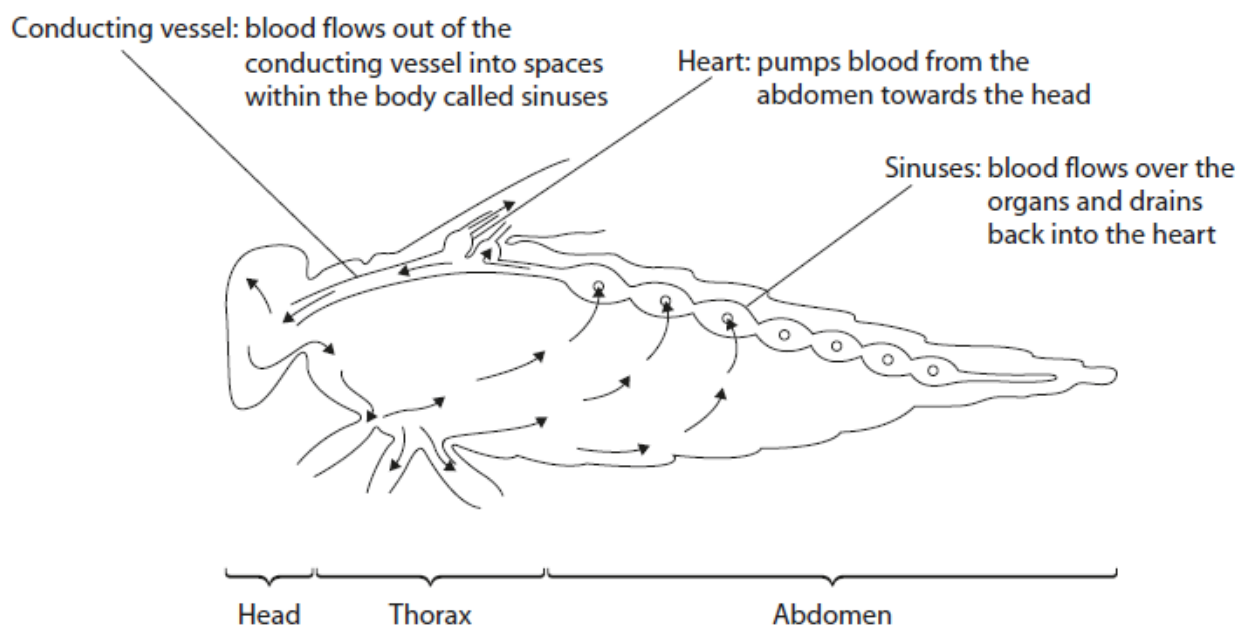
(iii) Which row of the table describes a saturated lipid?

(1)

	carbon-carbon double bonds	carbon : hydrogen ratio
☐ A	absent	higher than in an unsaturated fatty acid chain
☐ B	absent	lower than in an unsaturated fatty acid chain
☐ C	present	higher than in an unsaturated fatty acid chain
☐ D	present	lower than in an unsaturated fatty acid chain

(b) The circulatory system of an insect is described as an open system. This means that the blood is not contained inside blood vessels but flows through cavities called sinuses.

The diagram shows part of the circulatory system of an insect.



(i) The length of the head of a butterfly is 4 mm, the thorax is 6 mm and the abdomen is 18 mm.

Estimate the surface area to volume ratio of the butterfly.

Assume that the insect is a cylinder of diameter 4 mm and the surface area is 360 mm².

(2)

Answer

(ii) Explain why the circulation of a butterfly is different from the circulation of a mammal.

(2)

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(iii) The blood flowing through the sinuses of the butterfly is separated from the organs by collagen.

Describe the structure of collagen.

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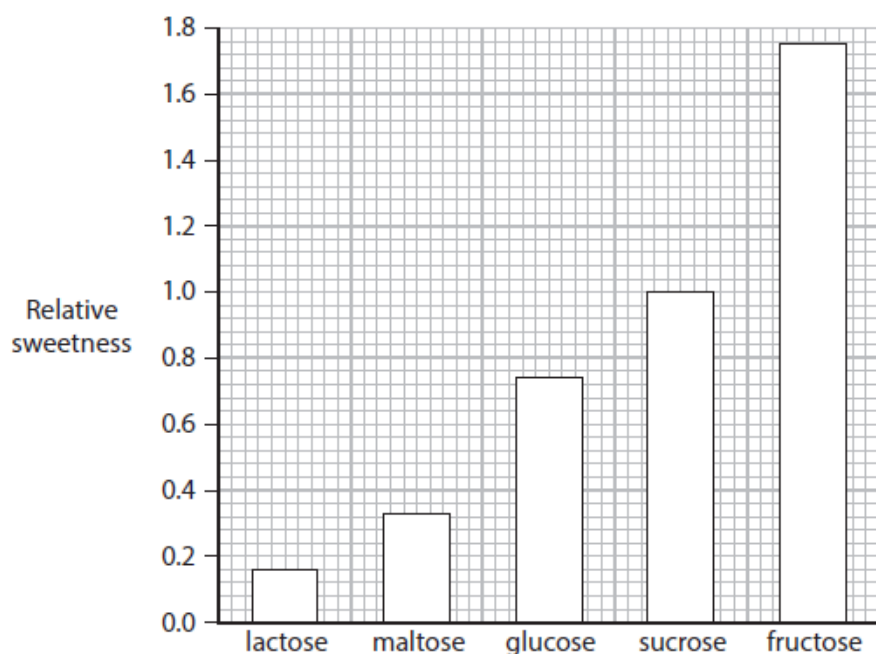
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(Total for question = 6 marks)

Q16.

Carbohydrates are important molecules in living organisms.

(a) The graph shows the relative sweetness of some monosaccharides and some disaccharides.



(i) Which row in the table gives the correct number of monosaccharides and disaccharides shown in this graph?

(1)

	Number of monosaccharides	Number of disaccharides
☐ A	1	4
☐ B	2	3
☐ C	3	2
☐ D	4	1

(ii) Which bond joins two monosaccharides together to form a disaccharide?

(1)

- ☐ A ester
- ☐ B glycosidic
- ☐ C hydrogen
- ☐ D phosphodiester

(iii) State **two** conclusions that can be made about the relative sweetness of monosaccharides and of disaccharides.

(2)

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(iv) Devise an investigation that a student could carry out to confirm the data shown in the graph.

(3)

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(b) Amylose and amylopectin are components of starch.

Compare and contrast the structure of amylose with the structure of amylopectin.

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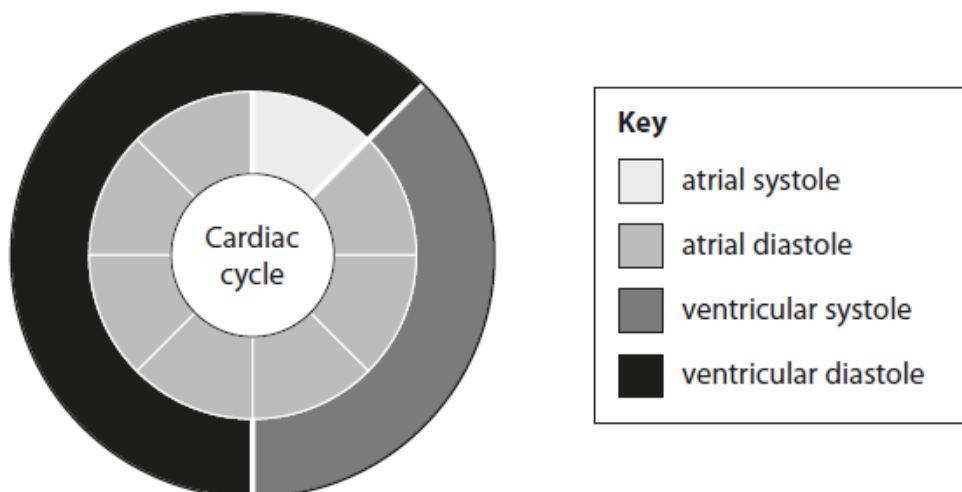
(Total for question = 10 marks)

Q17.

The cardiac cycle is the sequence of events that occurs when the heart beats.

A typical cardiac cycle takes 0.86 seconds.

(a) The diagram illustrates the cardiac cycle.



(i) Which row of the table describes the atria and ventricles during atrial systole?

(1)

	Atria	Ventricles
☒ A	contracted	contracted
☒ B	contracted	relaxed
☒ C	relaxed	contracted
☒ D	relaxed	relaxed

(ii) Explain why there is a delay of 0.01 seconds between atrial systole and ventricular systole.

(2)

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(iii) Using the information in the diagram, calculate the duration of ventricular systole in milliseconds.

Express your answer in standard form.

(2)

Answer ms

(iv) State what proportion of the cardiac cycle is spent in ventricular diastole.

(1)

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(b) A typical cardiac cycle takes 0.86 seconds.

During exercise, the heart rate increases and the duration of the cardiac cycle decreases.

Calculate the increase in heart rate if the cardiac cycle decreases by 0.4 seconds.

(3)

Answer beats per minute

(Total for question = 9 marks)

Q18.

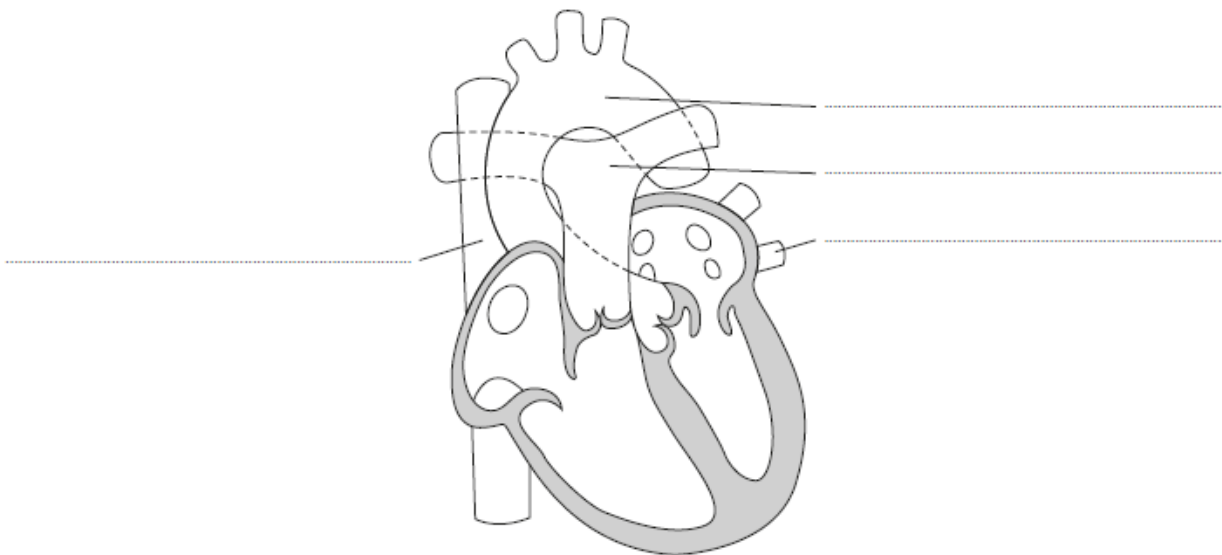
Answer the question with a cross in the box you think is correct ☐ . If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☐ .

Many animals have a heart and circulation.

(a) The diagram shows the structure of a human heart.

Label the diagram with the names of the four major blood vessels.

(3)

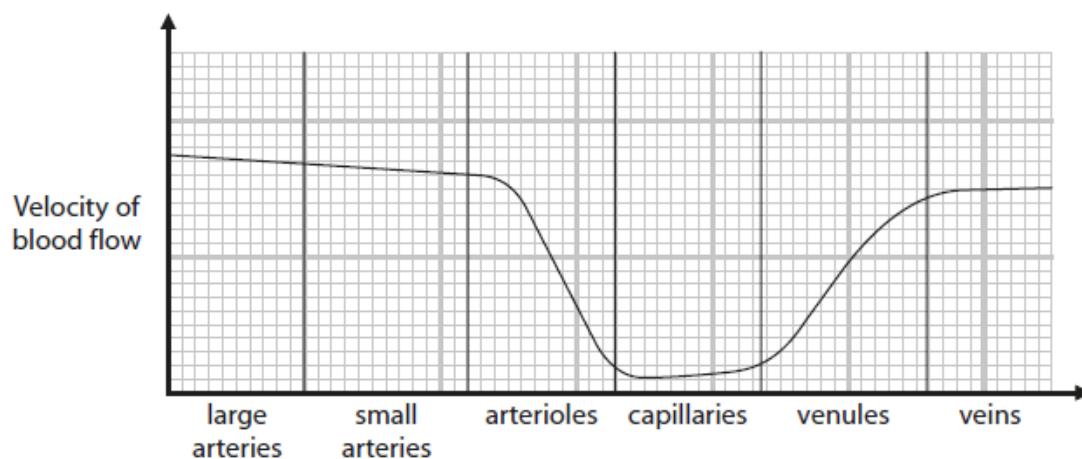
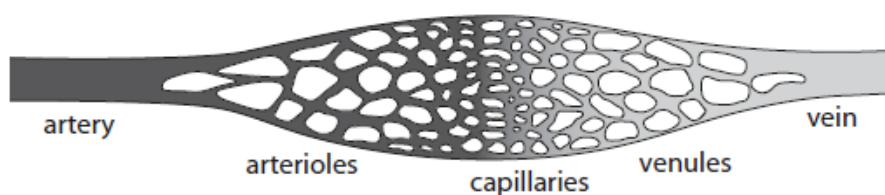


(b) The table shows some structures and the types of blood vessel that they are found in. Put a cross ☒ in each row to show where these structures are found.

(3)

Structures	Found in arteries only	Found in capillaries only	Found in veins only	Found in arteries, capillaries and veins
Lining of endothelial cells	☐	☒	☐	☐
Valves along the length of the blood vessel	☒	☒	☒	☒
Wall only one cell thick	☐	☒	☐	☐

(c) The graph shows the velocity of the blood as it flows through the arteries into the capillaries and then into the veins.



Describe the changes in the velocity of the blood as it flows from an artery to a vein.

(3)

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(Total for question = 9 marks)

Q19.

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 ☐.

The risk of developing cardiovascular disease (CVD) is affected by two groups of factors:

- lifestyle factors that can be changed
- non-lifestyle factors that cannot be changed.

Methods to reduce the risk of developing CVD include drug treatments and lifestyle changes.

(a) (i) Which row of the table identifies one lifestyle factor and one non-lifestyle factor?

(1)

	Lifestyle factor	Non-lifestyle factor
☐ A	body mass index (BMI)	age
☐ B	gender	high alcohol intake
☐ C	genetics	high blood pressure
☐ D	high blood cholesterol	inactivity

(ii) Explain why a person might have to take several types of drugs to reduce the risk of CVD.

(2)

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(b) Nutritional studies have shown that dietary antioxidants can reduce the risk of CVD.

(i) Explain why antioxidants in the diet reduce the risk of CVD.

(3)

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(ii) Some studies do not assess the nutritional quality of the diet of the participants.

Explain why the results of these studies have to be treated with caution.

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(iii) Explain why changes in diet, other than antioxidants, can reduce the risk of CVD.

(2)

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(Total for question = 11 marks)

Q20.

Answer the questions with a cross in the boxes you think are correct ☐. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☐.

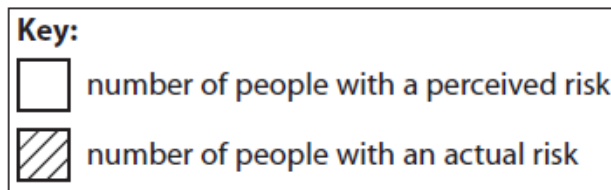
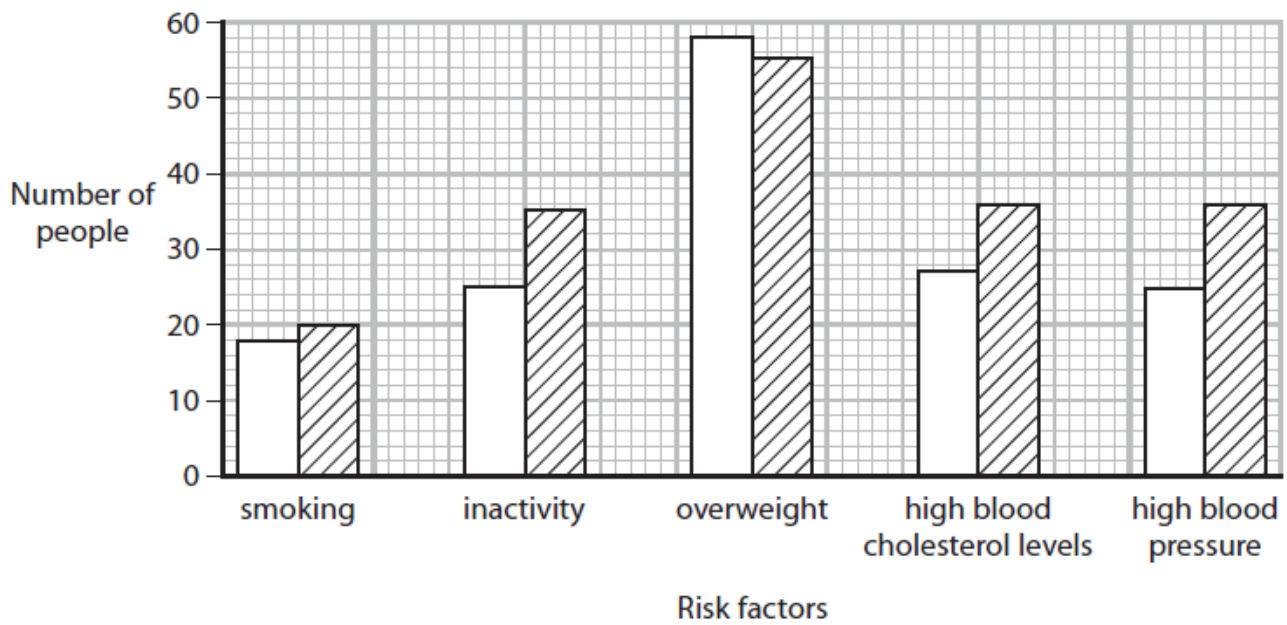
The risk of developing cardiovascular disease (CVD) is dependent on a number of factors.

(a) People's perception of these risks are often very different from the actual risks.

A study was designed to compare perceived risks with actual risks.

A group of people were asked if they thought they were at risk (perceived risk) of CVD. The same group of people were then examined to determine their actual risks of CVD.

The graph shows the results of this study.



(i) Describe **two** conclusions that can be drawn from this study.

(2)

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(ii) Explain how this study should have been designed to allow valid conclusions to be made.

(3)

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(iii) Explain why it is important that a person's perception of a risk is close to the actual risk.

(3)

(b) The 10-year risk of a person developing CVD can be estimated in a number of ways.

The Framingham Risk Score uses a point scoring system to estimate the 10-year risk of developing CVD.

Table 1 shows the point scores for different risk factors in women.

Table 1

Risk factor	Points per age group			
	35 to 39	40 to 44	45 to 49	50 to 54
age	−3	0	+3	+6
total cholesterol level / mg dm^{−3}				
<160	0	0	0	0
160 to 199	+4	+3	+3	+2
200 to 239	+8	+6	+6	+4
240 to 279	+11	+8	+8	+5
smoker	+9	+7	+7	+4
systolic blood pressure / mm Hg				
<120	0	0	0	0
120 to 129	+1	+1	+1	+1
130 to 139	+2	+2	+2	+2

Table 2 shows the 10-year risk for the total points scored, calculated using the information in Table 1.

Table 2

Total points scored	10-year risk of developing CVD (%)
16	4
17	5
18	6
19	8
20	11
21	14
22	17

(i) Calculate the 10-year risk of CVD for a 35-year-old woman who:

- has a total cholesterol level of 242 mg dm⁻³
- is a smoker
- has a systolic blood pressure of 132 mm Hg.

(2)

Answer

.....%

(ii) Explain the lifestyle changes this woman could make to reduce her 10-year risk of CVD.
Use the information in the table to support your answer.

(2)

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(iii) Which pair of drugs may reduce the 10-year risk of CVD for this woman?

(1)



A anticoagulants and statins

☐ **B** anticoagulants and antihypertensives

☐ **C** antihypertensives and platelet inhibitors

☐ **D** antihypertensives and statins

(iv) Suggest why this method of determining the 10-year risk of CVD may not be accurate.

(2)

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(Total for question = 15 marks)

Q21.

Answer the questions with a cross in the boxes you think are correct ☐. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☐.

The cell membrane controls which substances can enter and leave a cell.

The cell membrane is a phospholipid bilayer with proteins embedded in it.

(a) (i) The shapes show the components of a phospholipid.

phosphate group



glycerol



fatty acid



covalent bond



Draw a diagram to show the structure of a phospholipid, using these shapes.

(2)

(ii) Which type of bond is found in this molecule?

(1)

- ☐ **A** ester
- ☐ **B** glycosidic
- ☐ **C** hydrogen
- ☐ **D** peptide

(b) (i) How does a nonpolar molecule move through a cell membrane, down a concentration gradient into a cell?

(1)

- ☐ **A** by active transport
- ☐ **B** by diffusion
- ☐ **C** by exocytosis
- ☐ **D** by osmosis

(ii) How many of the following statements are correct for the transport of a substance by endocytosis?

(1)

- transports substances out of the cell
- the cell membrane surrounds the substance
- can only transport substances down a concentration gradient

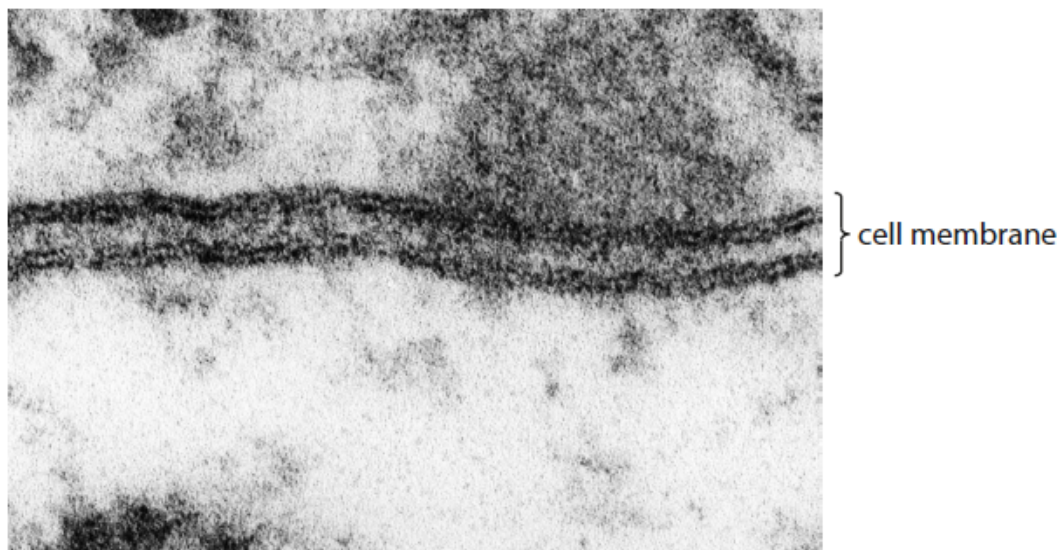
- ☐ **A** none
- ☐ **B** one
- ☐ **C** two
- ☐ **D** three

(Total for question = 5 marks)

Q22.

The structure and properties of the cell membrane are important in controlling which molecules can enter and leave a cell.

(a) The photograph shows part of a cell membrane, as seen using an electron microscope.



(Source: © Dennis Kunkel Microscopy / Science Photo Library)

The width of this cell membrane is 5.00 nm.

A phosphate head of a phospholipid is between 0.8 and 0.9 nm in diameter and the fatty acid tails are between 1.25 and 1.75 nm long.

Explain how this electron micrograph provides evidence for the structure of the cell membrane.

Use the information given to support your answer.

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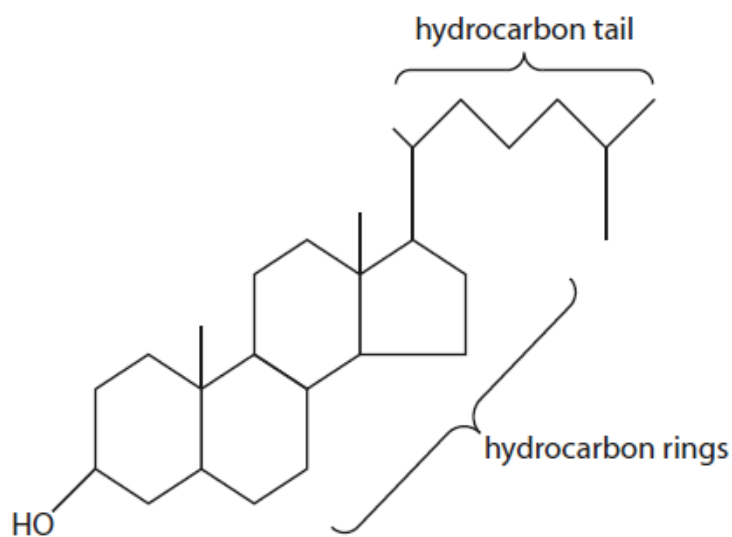
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(b) Cell membranes contain cholesterol.

The molecular formula of cholesterol is $C_{27}H_{46}O$.

The diagram shows a cholesterol molecule.



Explain the location of cholesterol in cell membranes.

Use the information in the diagram to support your answer.

(3)

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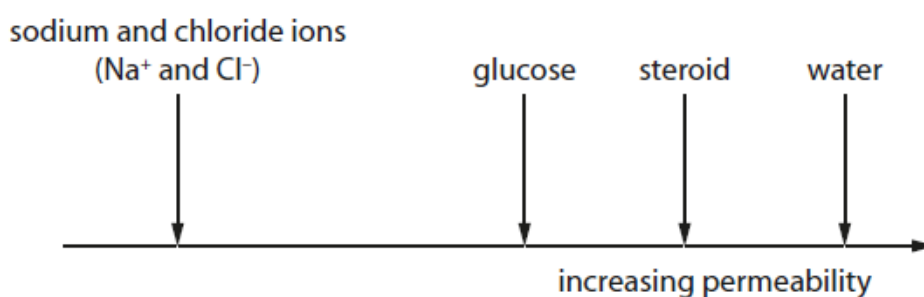
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(c) The diagram shows the permeability of cell membranes to some chemicals.



The sodium and chloride ions, glucose and water are polar chemicals.

A steroid is a non-polar chemical.

(i) Describe the dipolar nature of water.

(2)

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(ii) Explain the permeability of cell membranes to each chemical shown in the diagram.

(4)

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(Total for question = 12 marks)

Q23.

Answer the questions with a cross in the boxes you think are correct ☐. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☐.

The components of a cell membrane determine its properties.

The membrane is a phospholipid bilayer.

(a) The table shows one way that the components of phospholipids can be drawn.

Component	Way of drawing the component
phosphate group	
glycerol	
fatty acid	
bond	

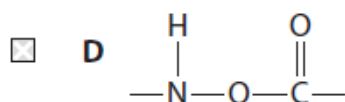
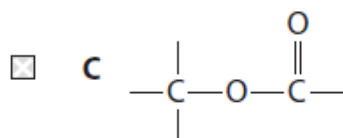
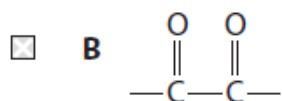
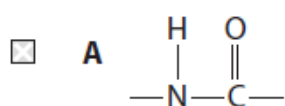
(i) Draw a diagram of a phospholipid, using the information in the table.

(2)

(ii) One of the bonds present in phospholipids is an ester bond.

Which diagram shows an ester bond?

(1)



(b) The fluidity of a membrane is increased by a number of factors:

- increase in temperature
- increase in the proportion of unsaturated fatty acids
- decrease in cholesterol
- fatty acids with shorter side chains.

(i) Explain why an increase in temperature increases the fluidity of the membrane.

(2)

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(ii) Which row in the table describes an unsaturated fatty acid compared with a saturated fatty acid with the same number of carbon atoms?

(1)

	Has double bonds between two carbons	Number of hydrogens
☐ A	no	fewer than the saturated fatty acid
☐ B	no	more than the saturated fatty acid
☐ C	yes	fewer than the saturated fatty acid
☐ D	yes	more than the saturated fatty acid

(iii) Explain why a decrease in cholesterol increases the fluidity of the membrane.

(2)

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(iv) Suggest why a fatty acid with a shorter side chain will increase the fluidity of a membrane.

(1)

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(c) Studies have shown that when fish are moved into water at a lower temperature, the fatty acid content of their membranes changes.

(i) Suggest how the content of the fatty acids in these membranes may have changed.

(2)

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(ii) Suggest why these changes are necessary for the survival of the fish.

(2)

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(Total for question = 13 marks)

Q24.

Collagen is a component of the wall of the aorta.

(a) (i) Describe the structure of collagen.

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(ii) Explain the role of collagen in the wall of the aorta.

(2)

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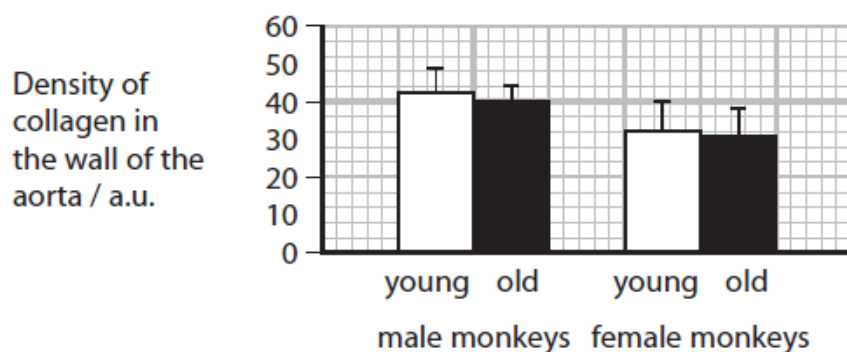
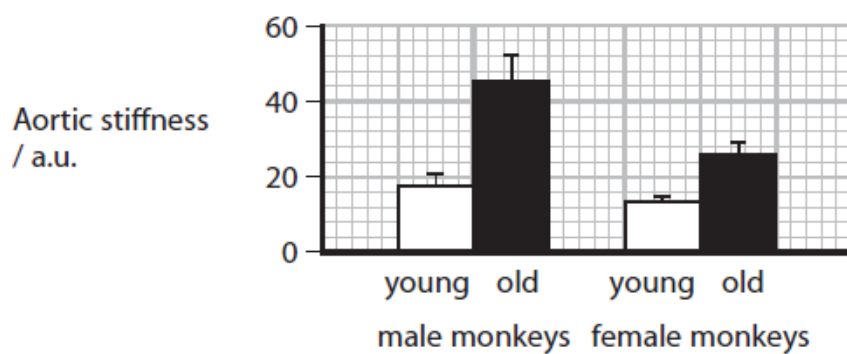
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*(b) Age and sex affect the types and density of collagen found in the wall of the aorta.

These are thought to cause aortic stiffness.

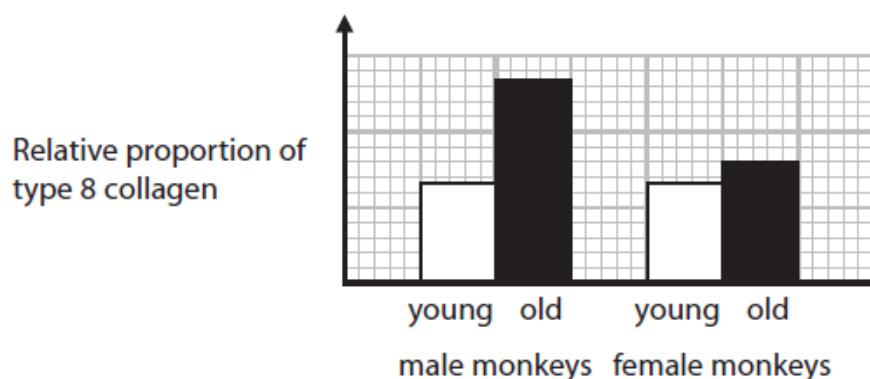
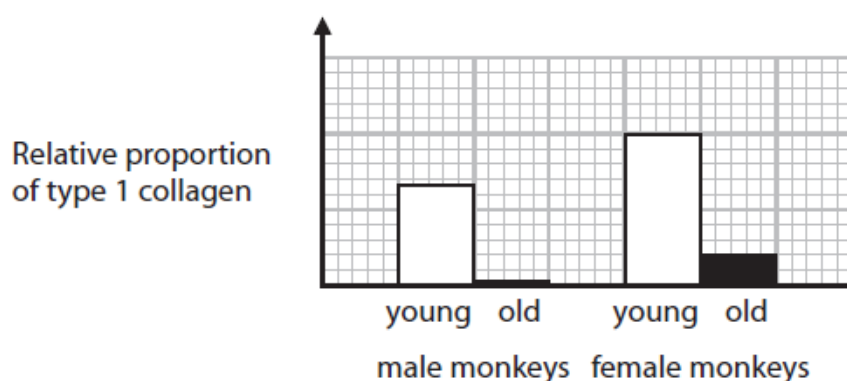
In one study, scientists investigated the effect of age and sex on aortic stiffness and the density of collagen in the wall of the aorta.

The graphs show the results of this study.



In another study, scientists investigated the effect of age and sex on two types of collagen present in the wall of the aorta.

The graphs show the relative proportion of each type of collagen in each group of monkeys.



Comment on the effect of age and sex on the types of collagen found in the wall of the aorta and aortic stiffness.

Use the information in the graphs to support your answer.

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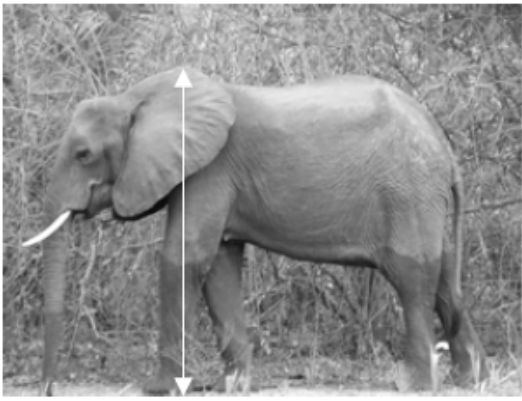
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(Total for question = 11 marks)

Q25.

The photographs show two mammals, an elephant and a mouse.



Magnification $\times 0.02$

(a) The height of a mouse is 3 cm.

Calculate how many times taller an elephant is than a mouse.

Use the white line drawn on the photograph of the elephant to calculate this value.

(2)

Answer

(b) The respiratory system of an elephant is different from that of other mammals.

The lungs are attached to the chest cavity wall and diaphragm by collagen fibres.

Describe how the lungs of an elephant are adapted for gas exchange.

(3)

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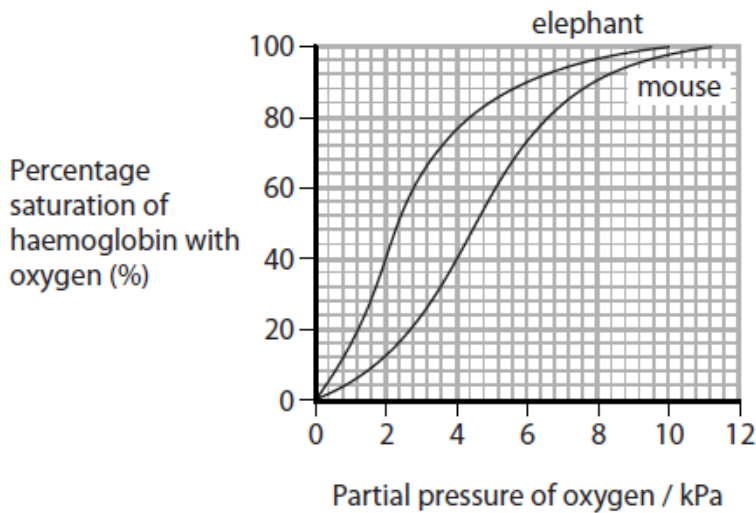
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* (c) Graph 1 shows the oxygen dissociation curve of haemoglobin for a mouse and for an elephant.

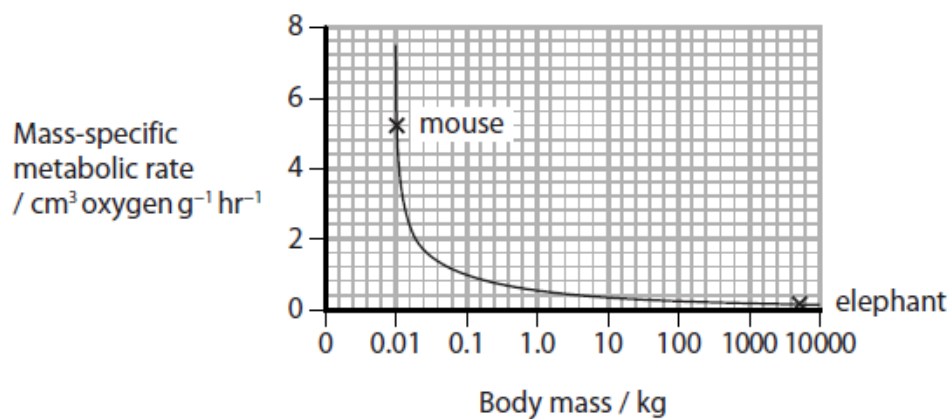
Graph 1



Graph 2 shows the mass-specific metabolic rate for a mouse and for an elephant.

Mass-specific metabolic rate is a measure of how much oxygen is needed for chemical reactions per gram of body tissue.

Graph 2



Explain the difference in the oxygen dissociation curves of haemoglobin for a mouse and for an elephant.

Use the information in both graphs to support your answer.

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(Total for question = 11 marks)

Q26.

Polysaccharides, lipids, nucleic acids and proteins are large molecules found in living organisms.

(a) Polymers are large molecules made of monomers. The table gives information about some of these polymers.

Complete the table by filling in the empty boxes with either the name of the monomer, the elements present in each monomer or the type of bond between monomers.

(4)

Polymer	Monomer	Elements present in monomer	Type of bond between monomers
polysaccharides	monosaccharide		glycosidic
nucleic acid		carbon, hydrogen, oxygen, phosphorus and nitrogen	
protein	amino acid		peptide

(b) Triglycerides are lipids.

Describe how an unsaturated triglyceride is synthesised.

(3)

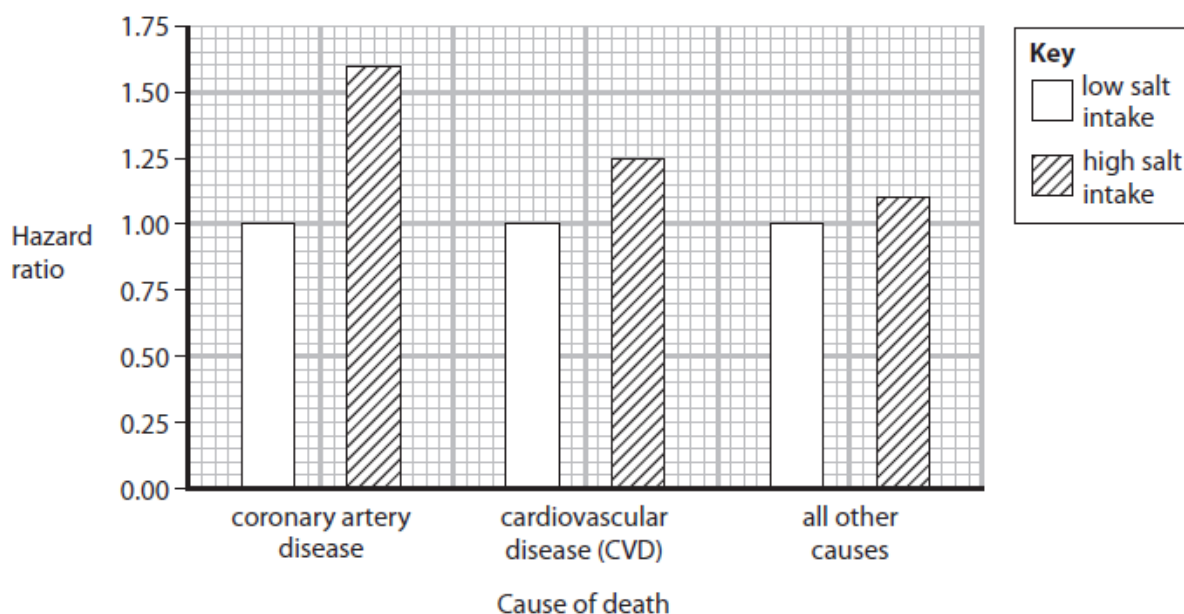
(Total for question = 7 marks)

Q27.

A diet high in salt has been shown to increase the risk of some diseases.

The graph shows the results of one study into the increased risk of death related to a diet high in salt.

An increased risk of death is associated with a high hazard ratio.



(a) State **two** conclusions that can be drawn from these results.

(2)

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(b) The values for the hazard ratio were adjusted for a number of factors, including age and smoking.

(i) Explain why age and smoking were taken into account when determining the hazard ratio.

(3)

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(ii) State **two** factors, other than age and smoking, that may have been considered when adjusting the values for the hazard ratio.

(2)

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(c) Suggest why the hazard ratio for low salt intake was 1.00 for each cause of death.

(2)

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(d) (i) The results of this study suggest that there is a correlation between salt intake and cause of death.

State the meaning of the term **correlation**.

(1)

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(ii) Suggest why studies of this type are unreliable.

(2)

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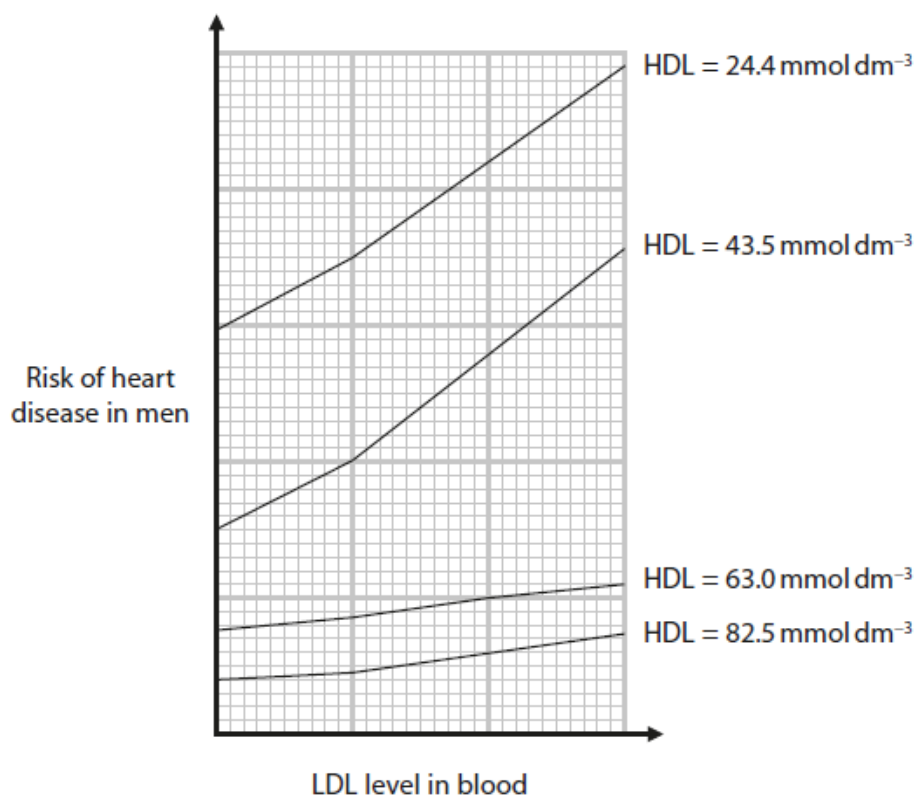
(Total for question = 12 marks)

Q28.

A number of factors affect the risk of a person developing heart disease.

One factor affecting this risk is the level of high-density lipoprotein (HDL) in the blood.

* (a) The graph shows the effects of HDL levels and low-density lipoprotein (LDL) levels in the blood on the risk of men developing heart disease.



For men, a blood HDL level greater than 40 mg dm⁻³ is thought to be optimal.

Explain why a man with a blood HDL level greater than 40 mg dm⁻³ may still have a high risk of developing heart disease.

Use the information in the graph and your own knowledge to support your answer.

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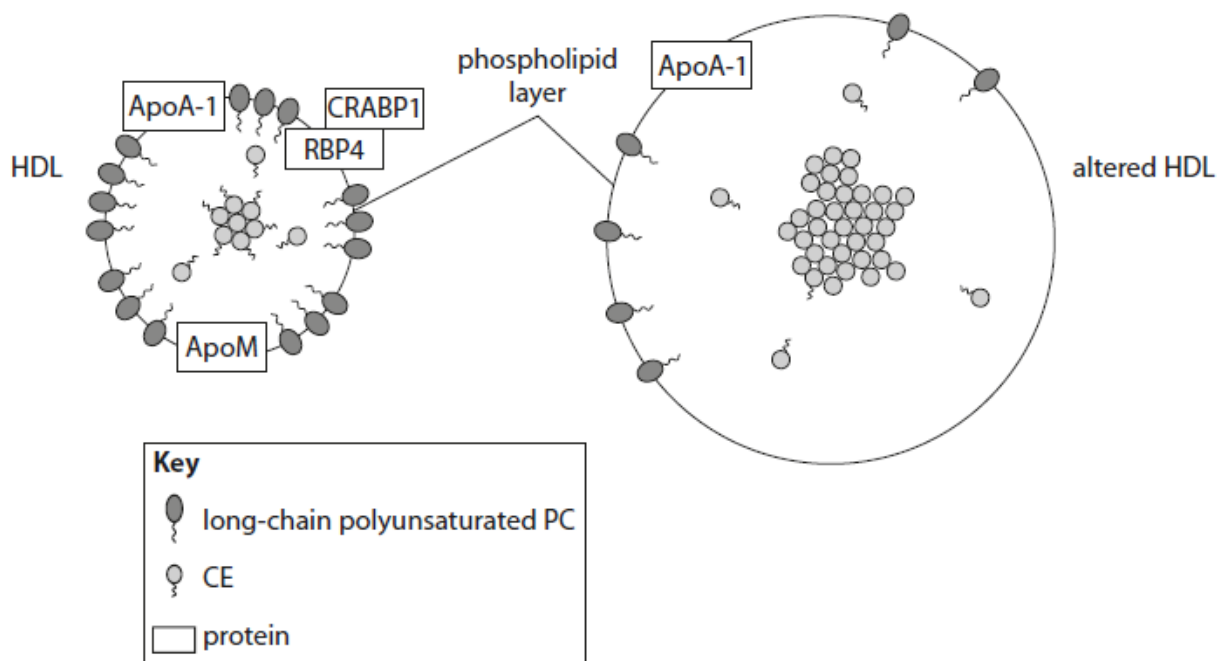
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(b) Very high levels of cholesterol in the blood can alter the structure of HDL.
This altered HDL is less effective in reducing the risk of heart disease.

The diagram shows the structure of HDL in blood with a low level of cholesterol and altered HDL in blood with a high level of cholesterol.



(Source: <https://www.sciencedirect.com/science/article/pii/S0735109717373448>)

(i) Compare and contrast the structure of HDL with altered HDL.

(3)

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(ii) The antioxidant properties of altered HDL are reduced.

Explain the effect that this has on reducing the risk of heart disease.

(3)

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(Total for question = 12 marks)

Q29.

Platelets are involved in the blood clotting process.

(a) The table shows the phospholipid content of the membranes of platelets.

Phospholipid	Percentage of total membrane phospholipids (%)	Percentage distribution of phospholipids in the membrane (%)
		inner layer outer layer 100 100
phosphatidylethanolamine	30	
phosphatidylcholine	27	
sphingomyelin	23	
phosphatidylserine	15	
other types	5	

When platelets trigger the blood clotting process, more phosphatidylserine molecules move into the outer layer of the membrane.

(i) Estimate the ratio of phosphatidylserine in the inner layer to that in the outer layer before the blood clotting process is triggered.

(1)

Answer

(ii) Describe the effect that the movement of phosphatidylserine into the outer layer will have

on the content of phospholipids in the membranes of platelets.

(2)

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(iii) Describe how the movement of phosphatidylserine into the outer layer results in the production of thrombin in the blood clotting process.

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(b) Thrombin inhibitors are drugs that have an effect on the time taken for blood to clot. Explain why thrombin inhibitors affect the time taken for blood to clot.

(4)

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(Total for question = 11 marks)

Q30.

Acute hepatic porphyria (AHP) is a very rare genetic disorder.

A drug has been developed to treat AHP.

(a) This drug was tested in a clinical trial involving 94 patients from 18 countries.

The drug was given to 48 of the patients. The other 46 patients were a control group.

(i) Comment on the design of this clinical trial.

(2)

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(ii) Each patient was given 2.5 mg of the drug per kg of body mass, once a month.

The drug is available as a solution with a concentration of 189 mg cm⁻³.

Calculate the volume of drug that was given each month to a patient with a body mass of 64 kg.

(2)

Answer

(iii) Nausea was experienced by 27% of the patients receiving this drug.

Calculate the number of patients who experienced nausea.

(2)

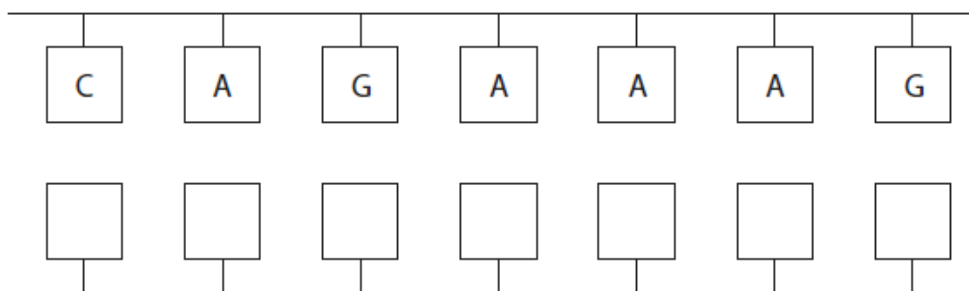
Answer

(b) This drug is a double-stranded RNA molecule.

(i) The diagram shows part of the base sequence on one of the RNA strands.

Complete the diagram to show the base sequence on the other RNA strand.

(2)



(ii) Describe the bonding in this double-stranded RNA molecule.

(3)

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(iii) In AHP, toxic porphyrin molecules build up.

The synthesis of the haem component of haemoglobin involves several steps.

Each step in the synthesis of haem is catalysed by a different enzyme.

This drug works by interfering with the mRNA copies from the gene coding for one of these enzymes.

Explain how the action of this drug helps patients with AHP.

(3)

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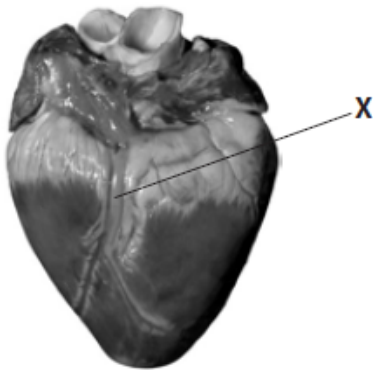
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(Total for question = 14 marks)

Q31.

The photograph shows a mammalian heart.



The blood vessel labelled **X** is a branch from the aorta.

The aorta is one of the major blood vessels of the heart.

(a) Explain why it is important that blood vessel X branches directly from the aorta.

(3)

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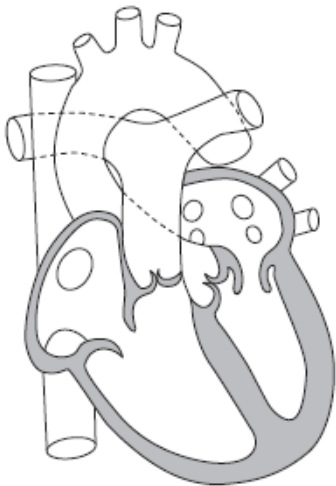
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(b) The diagram shows the internal structure of a mammalian heart.



(i) Explain which stage of the cardiac cycle is shown in this diagram.

(2)

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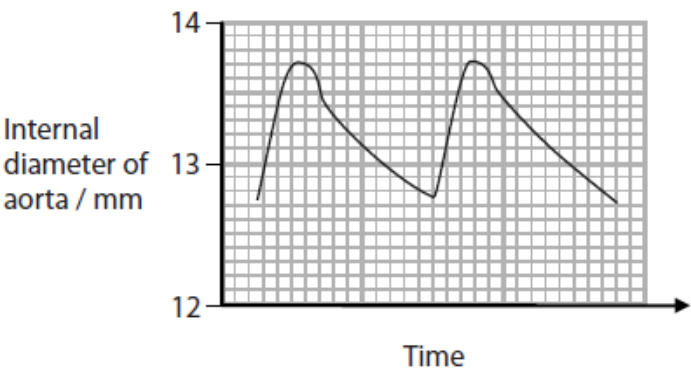
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(ii) Draw arrows on the diagram to show the flow of blood through the left side of the heart and into the aorta.

(3)

(c) The graph shows the changes in the internal diameter of the aorta during two cardiac cycles.



Explain the changes in the internal diameter of the aorta.

(3)

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(Total for question = 11 marks)

Mark Scheme

Q1.

Question number	Answer	Additional guidance	Mark
(a)	change in the base {sequence / order} of DNA	ACCEPT change in the number of chromosomes / damage to chromosome / loss of part of chromosome	(1)

Question number	Answer	Additional guidance	Mark
(b)(i)	a change in one variable is reflected in a change in another variable	ACCEPT a description that only mentions 'change' once DO NOT ACCEPT causes / results in	(1)

Question number	Answer	Additional guidance	Mark
(b)(ii)	A description that includes the following points: - incidence of skin cancer increases with (an increase in) age (1) - incidence of skin cancer increases with an increase in the years (1) - males have higher incidence of skin cancer than females (1)	ACCEPT converse throughout ACCEPT in either context of males or females or both ACCEPT in either context of males or females or both	(3)

Question number	Answer	Additional guidance	Mark
(b)(iii)	An answer that includes three of the following points: - as age increase there is more time for mutations to {build up / occur} (1) - people are spending more time in the sun (1) - more UV light reaching the earth's surface (1) - more men have {jobs / hobbies} outside (1) - men have a greater genetic disposition to skin cancer (1)	ACCEPT the older you are the more exposure to risk factors / the more cell divisions the more chance of mutations ACCEPT an example of why this may happen e.g. going on more holidays in hot countries ACCEPT ozone layer depletion ACCEPT men smoke more	(3)

Question number	Answer
* (c)	Indicative content: Repeatability: - sample size is small - smokers are being studied and their sample size is very small* - no statistical data available - no indication of the location of the individuals (could be a validity comment as well) Validity: - mean age at diagnosis is similar but not identical - there is a greater range of ages for males than females - no indication of the actual ages of the people - so there could be more people at the extremes in one group - no information about other lifestyle factors - e.g. working in polluted environment, living in the city - no information about non-lifestyle factors - e.g. ethnicity - no indication if individuals lived with other smokers (passive smokers) - no indication of how long people been smoking for* - no indication of how many cigarettes were smoked by the smoker each day* - no indication if the non-smokers had ever smoked previously* - no indication of severity of emphysema* - no indication if emphysema is self-diagnosed or clinical diagnosis* Level 1 : comments on the design of the study 1 mark = 1 comment 2 marks = 3 comments Level 2 : comments on the design of the study 3 marks = 4 comments, at least one of which is from each category 4 marks = 5 comments, at least one of which is from each category Level 3 : comments on the design of the study and makes at least one link correctly with repeatability or validity 5 marks = 5 comments at least one of which is linked to repeatability or validity 6 marks = 6 comments at least one of which is linked to repeatability or validity and includes a specific comment about {smoking / emphysema}* ACCEPT reproducible / reliable IGNORE accurate / precise (6)

Q2.

Question number	Answer	Additional guidance	Mark
(a)(i)	100 (cm)		(1)

Question number	Answer	Additional guidance	Mark
(a)(ii)	An answer that includes the following points: • height² calculated (1) • equation rearranged and values substituted in (1) • answer given to {1 decimal place / 3 significant figures} (1)	2.4025 (m²) / 24025 (cm²) mass = $36 \times 2.4025 / 86.49$ 86.5 NB CE if rounded cm² value to 865000 Correct answer of 86.5 with no working shown should be awarded 3 marks. An answer of 86.49 or 865 000 with no working shown should be awarded 2 marks.	(3)

Question number	Answer	Additional guidance	Mark
(a)(iii)	An answer that includes the following points: • using <u>WHR</u> the two women appear to have the same risk of developing CVD (1) • however using {mass / BMI} female K is at a greater risk (1)		(2)

Question number	Answer	Additional guidance	Mark
(a)(iv)	An explanation that includes the following points: • by the tape being pulled tighter around the waist so the waist value is smaller (1) • by the tape being held loosely around the hips so the hip value is greater (1) • so that the waist to hip ratio is smaller (1)	ACCEPT breathing in whilst taking the measurement of the waist ACCEPT make the waist measurement smaller and the hip measurement larger NB If both methods given but no justification = 1 mark	(2)

Question number	Answer	Additional guidance	Mark
(b)(i)	An answer that includes two of the following points: - the distribution of fat under the skin is not even (1) - exercise will replace fat under the skin with muscle (1) - the woman has had a child (1) - liposuction (1) - lipoedema (affecting the arms) (1)	ACCEPT exercising some parts of body will reduce fat / stopping exercise to some parts of body will increase fat	(2)

Question number	Answer	Additional guidance	Mark
(b)(ii)	moderate	DO NOT ACCEPT low / low to moderate	(1)

Q3.

Question number	Answer	Additional guidance	Mark
(a)	An explanation that includes the following points: - to widen (the lumen of) the (coronary) artery / (blood) vessel (1) - so that more blood can flow to the heart {cells / muscle} (1) - for respiration (in the heart muscle) / so that heart muscle can contract (1)	ACCEPT increase in {diameter / cross-sectional area} IGNORE larger / increase in area	(3)

Question number	Answer	Additional guidance	Mark
(b)(i)	An answer that includes the following points: - percentage of one group developing thrombosis calculated (1) - correct difference calculated (1)	1.5% of 800 = 12 OR 1.0% of 400 = 4 difference = 8 Correct answer with no working gain two marks	(2)

Question number	Answer	Additional guidance	Mark
(b)(ii)	blocks the (coronary) {artery / vessel} {so the brain doesnot get oxygen / causing a stroke}	ACCEPT so that the heart muscle doesnot get oxygen / causing a heart attack	(1)

Question number	Answer	Mark
(b)(iii)	D thrombin and thromboplastin The only correct answer is D. <i>A is incorrect because prothrombin is inactive</i> <i>B is incorrect because prothrombin is inactive</i> <i>C is incorrect because prothrombin is inactive</i>	(1)

Question number	Answer	Mark
(b)(iv)	C fibrinogen and thromboplastin The only correct answer is C <i>A is incorrect because fibrin is insoluble</i> <i>B is incorrect because fibrin is insoluble</i> <i>D is incorrect because other factors are also soluble e.g. thromboplastin</i>	(1)

Question number	Answer	Additional guidance	Mark
(b)(v)	anticoagulants / platelet inhibitors	ACCEPT named anticoagulants / platelet inhibitors e.g. heparin, aspirin, warfarin DO NOT ACCEPT antihypertensives / statins	(1)

Q4.

Question number	Answer	Mark
(a)	C glycogen The only correct answer is C. <i>A is incorrect because amylopectin is found in plant cells only</i> <i>B is incorrect because cellulose is found in plant cells only</i> <i>D is incorrect because starch is found in plant cells only</i>	(1)

Question number	Answer	Mark
(b)	D lactose and sucrose The only correct answer is D. <i>A is incorrect because fructose is a monosaccharide and therefore not digested</i> <i>B is incorrect because fructose and galactose are both monosaccharides and therefore not digested</i> <i>C is incorrect because galactose is a monosaccharide and therefore not digested</i>	(1)

Question number	Answer	Additional guidance	Mark
(c)(i)	190 900 000 / 191 000 000 / 191 million / 1.909×10^8 / 1.91×10^8		(1)

Question number	Answer	Additional guidance	Mark
(c)(ii)	An explanation that includes three of the following points: - because (prenatal testing) can cause abortion (1) - because false negative or false positive results can be avoided (if patient already has diabetes) (1) - because of issues arising if another genetic condition is found (1) - because an individual could live a healthy life (as only a genetic predisposition) (1) - because of the ethics associated with destroying embryos (IVF) (1)		(3)

Question number	Answer	Mark
(a)	The only correct answer is C (two) A is incorrect because thromboplastin is an active enzyme found in the platelets but is not converted into thrombin B is incorrect because thromboplastin is an active enzyme found in the platelets but is not converted into thrombin D is incorrect because thromboplastin is an active enzyme found in the platelets but is not converted into thrombin	(1)

Question number	Answer	Additional guidance	Mark
(b)	An answer that includes the following points: • 1.8 to 3.5 (1) • below 1.8 there is a high risk of stroke (1) • above 3.5 there is an increased risk of bleeding (within the skull) (1) OR • 1.8 to 2.5 (1) • below 1.8 there is a high risk of stroke (1) • above 2.5 the risk of bleeding (within the skull) starts to increase (1) OR • 2.0 to 2.5 (1) • both risks are low / they are the lowest (combination) (1) • 3.1-3.5 has a lower risk of stroke but a higher risk of bleeding (1)	ACCEPT other ranges {have either high risk of bleeding or high risk of stroke / both risks are low} = 1 mark if mp 2 and 3 not awarded ACCEPT other ranges {have either higher risk of bleeding or high risk of stroke / both risks are low} = 1 mark if mp 2 and 3 not awarded	(3)

Question number	Answer	Additional guidance	Mark
(c)	An explanation that includes the following points: - warfarin reduces {a blood clot forming / thrombosis} (1) (if a blood clot does not form) it cannot block the <u>coronary artery</u> (1) - if oxygen is supplied to the heart {muscle / cells} it will continue to {contract / respire} (1)	ACCEPT no blood clots forming less blood clotting reduces blood clot (size)	(3)

Question number	Answer	Additional guidance	Mark
(d)(i)	1012 / 1013 (1)		(1)

Question number	Answer	Additional guidance	Mark
(d)(ii)	An answer that includes the following points: - select a group of patients who have had a heart attack (1) - of similar {age / sex at birth / background / lifestyle} (as in the first study) (1) - give each person the same quantity of warfarin (used in the first study) (1) (monitor for) {the same time period / four years} (1) - use of a statistics (1)	ACCEPT other appropriate factors no other health issues ACCEPT in context of one group split into two groups ACCEPT description of double-blind trial / double-blind trial / suitable named statistics test	(4)

Question number	Answer	Additional guidance	Mark
(a)	A calculation which: - measured widths of wall as 10 mm and 30 mm (1) - shows the difference between widths, divided by smaller value (1) $\times 100\%$ (1) Example of calculation: $(30 - 10) = 20 \text{ mm}$ $(20 \div 10)$ $\times 100 = 200\%$	Accept measurements consistent with printed image Correct answer with no working gains all 3 marks	(3)

Question number	Answer	Mark
(b)	An explanation that includes the following points: - formation of blood clot / thickening of artery wall (1) - therefore {blocks / narrows} coronary arteries (1) - therefore reduces blood flow (1) - therefore deprives heart muscle of {oxygen / nutrients} (1)	(4)

Question number	Answer	Additional guidance	Mark
(c)	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material indicated as relevant. Additional content included in the response must be scientific and relevant. Indicative content - increased cholesterol increases chance of dying from CVD - cholesterol concentrations are different in different countries - same cholesterol level does not confer same risk in different countries - greater the cholesterol to HDL ratio, the greater the risk of CVD - the smaller the diameter the LDL, the greater the risk of CVD - individuals at greatest risk of CVD are those with a large cholesterol to HDL ratio and small LDL diameter and a high cholesterol concentration - not possible to say if different risks for a particular cholesterol concentration in the first study are due to differences in cholesterol to HDL ratio / diameter of LDL	Allow differences in the first study may be due to differences in cholesterol to HDL ratio / diameter of LDL	(6)

Level	Marks	Descriptor
	0	No awardable content.
1	1-2	A scientific assessment is made of a factor, supported by the application of limited relevant evidence from the scientific information provided. No conclusion is attempted.
2	3-4	A scientific assessment is made of some of the factors, supported by the application of some relevant evidence from the analysis and with some interpretation of the scientific information. A conclusion, where needed, is made, demonstrating linkages to elements of biological knowledge and understanding, with some evidence to support the assessment being made.
3	5-6	A scientific assessment is made of the factors, supported throughout by sustained application of relevant evidence from the analysis and interpretation of the scientific information. A conclusion, where needed, is made, demonstrating sustained linkages to biological knowledge and understanding, with sufficient evidence to support the assessment being made.

Q7.

Question number	Answer	Additional guidance	Mark												
(a)	<table><tr><th>Name</th><th>Role</th><th>Property</th></tr><tr><td>thromboplastin</td><td>(catalyses the) conversion of prothrombin into thrombin (1)</td><td>soluble</td></tr><tr><td>thrombin (1)</td><td>catalyses the conversion of fibrinogen into fibrin</td><td>soluble (1)</td></tr><tr><td>fibrin</td><td>Any two of the following points: • form a network of fibres / mesh (1) • trap (platelets / blood cells) (1) • form a scab to (seal the wound / stop bleeding) (1) • form a scab to prevent the entry of bacteria (1) </td><td>insoluble (1)</td></tr></table>	Name	Role	Property	thromboplastin	(catalyses the) conversion of prothrombin into thrombin (1)	soluble	thrombin (1)	catalyses the conversion of fibrinogen into fibrin	soluble (1)	fibrin	Any two of the following points: • form a network of fibres / mesh (1) • trap (platelets / blood cells) (1) • form a scab to (seal the wound / stop bleeding) (1) • form a scab to prevent the entry of bacteria (1)	insoluble (1)	IGNORE reference to calcium ions / vitamin K ACCEPT insoluble ACCEPT two points made in one sentence DO NOT ACCEPT completely wrong statements	(6)
Name	Role	Property													
thromboplastin	(catalyses the) conversion of prothrombin into thrombin (1)	soluble													
thrombin (1)	catalyses the conversion of fibrinogen into fibrin	soluble (1)													
fibrin	Any two of the following points: • form a network of fibres / mesh (1) • trap (platelets / blood cells) (1) • form a scab to (seal the wound / stop bleeding) (1) • form a scab to prevent the entry of bacteria (1)	insoluble (1)													

Question number	Answer	Additional guidance	Mark
(b)	An explanation that includes the following points: - because (gene / (defective) allele) located on the X chromosome (1) - because defective allele is recessive (1) - therefore, males with (defective / haemophilia) allele will only have that allele (1)	ACCEPT X-linked disease / sex-linked disease / inherited on the X chromosome ACCEPT (mutated / affected) allele / (haemophilia / disease) is recessive ACCEPT males will not carry a (healthy / normal) allele females need (both defective alleles / to be homozygous for defective alleles) to have haemophilia	(3)

Q8.

Question number	Answer	Additional guidance	Mark
(a)(i)	An answer that includes the following points: - thromboplastin (1) - active site (1) - platelets / (red / white) blood cells / erythrocytes (1)	IGNORE calcium ions / Ca⁺⁺ IGNORE clot / scab	(3)

Question number	Answer	Mark
(a)(ii)	A The only correct answer is A. <i>B is incorrect because antihypertensives are used to lower blood pressure</i> <i>C is incorrect because platelet inhibitors affect platelets</i> <i>D is incorrect because statins lower blood cholesterol</i>	(1)

Question number	Answer	Additional guidance	Mark
(b)	- tangent drawn at 2 days (1) - correct answer up to 2 decimal places and units (1)	Example of calculation: ACCEPT straight line touching outside of curve at 2 ACCEPT in range of 2.7 to 4.5 {s day⁻¹ / s per day / s/day} ACCEPT with or without a minus sign	(2)

Q9.

Question number	Answer	Additional guidance	Mark
(a)	The correct answer is C, fibrin <i>A is incorrect because cholesterol is not part of the wound</i> <i>B is incorrect because collagen is inside the artery wall</i> <i>D is incorrect because fibrinogen is soluble</i>		(1)

Question number	Answer	Additional guidance	Mark
(b)	The correct answer is A, 1 <i>B is incorrect because prothrombin is the only inactive enzyme precursor in the list</i> <i>C is incorrect because prothrombin is the only inactive enzyme precursor in the list</i> <i>D is incorrect because prothrombin is the only inactive enzyme precursor in the list</i>		(1)

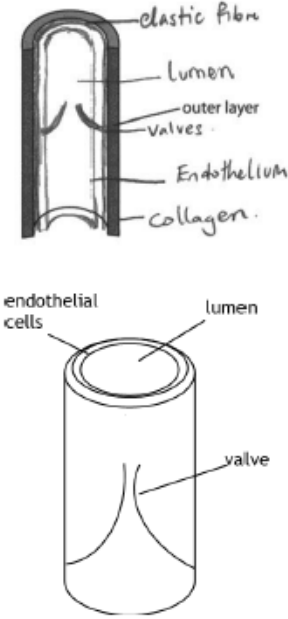
Question number	Answer	Additional guidance	Mark
(c)	The correct answer is C, 3 <i>B is incorrect because fibrin is the only insoluble molecule in the list</i> <i>C is incorrect because fibrin is the only insoluble molecule in the list</i> <i>D is incorrect because fibrin is the only insoluble molecule in the list</i>		(1)

Question number	Answer	Additional guidance	Mark
(d)	An explanation that includes three of the following points: • to keep thromboplastin separate from prothrombin (1) • so that prothrombin will not be converted into thrombin (1) • the blood clotting process will be prevented (1) • to have thromboplastin {available / released quickly} (when needed) (1)	ACCEPT other descriptions of what will not happen e.g. fibrin will not be formed ACCEPT will be at a high concentration (when needed) NB award mps if candidate clearly states what would happen if the thromboplastin was NOT inside platelets	(3)

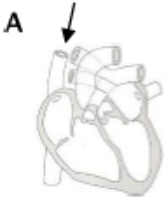
Q10.

Question number	Answer	Additional guidance	Mark
(a)	An answer that includes the following points: - number of minutes in one day calculated (1) - volume in 24 hours given in standard form (1) OR - volume in one hour calculated (1) - volume in 24 hours given in standard form (1)	$1 \times 60 \times 24 = 1440$ 7.2×10^3 (litres) $5 \times 60 = 300$ 7.2×10^3 (litres) Correct answer with no working (2) Correct answer not in standard form = 1 mark	(2)

Question number	Answer	Additional guidance	Mark
(b)	An answer that includes one similarity and one difference: Similarities: - both have walls containing {muscle cells / elastic fibres / an endothelial cell lining / an (outer) collagen layer} (1) - both have a valve (at the point they leave the heart) (1) Differences: - aorta has a {lumen with a wider diameter / thicker wall / more elastic tissue / more muscle tissue / more collagen} (1) - aorta has branches to more organs (1)		(2)

Question number	Answer	Additional guidance	Mark
(c)	An answer that includes three of the following points: • addition to diagram {additional one or two layers of wall / valves}. If valves, must be correct orientation (1) Any two from: • {endothelial cell / tunica intima} lining labelled (1) • valve labelled (1) • {(smooth) muscle / elastic fibres / tunica media} labelled (1) • lumen labelled (1)		(3)

Q11.

Question number	Answer	Mark
(a)	A  The only correct answer is A. B is incorrect because the arrow is pointing down the pulmonary vein C is incorrect because the flow of blood is in the wrong direction D is incorrect because the flow of blood is out through the pulmonary artery	(1)

Question number	Answer	Mark		
(b)	A <table><tr><td>deoxygenated blood flowing away from the heart</td><td>oxygenated blood flowing towards the heart</td></tr></table> The only correct answer is A. B is incorrect because the pulmonary artery carries blood away from the heart and the pulmonary vein carries blood towards the heart C is incorrect because the pulmonary artery carries deoxygenated blood and the pulmonary vein carries oxygenated blood D is incorrect because the pulmonary artery carries deoxygenated blood and the pulmonary vein carries oxygenated blood	deoxygenated blood flowing away from the heart	oxygenated blood flowing towards the heart	(1)
deoxygenated blood flowing away from the heart	oxygenated blood flowing towards the heart			

Question number	Answer						Mark
(c)	Stage of the cardiac cycle	AV valves open and SL valves open	AV valves open and SL valves closed	AV valves closed and SL valves open	AV valves closed and SL valves closed		(3)
	atrial systole		X				
	ventricular systole			X			
	diastole		X				

Question number	Answer	Additional guidance	Mark
(d)	A description that includes the following points: <u>cardiac cycle</u> is {shorter / faster / completed more frequently} (1) <u>ventricles</u> contract more forcefully (during ventricular systole) (1)	Answers must be comparative ACCEPT cardiac cycles happens more often ACCEPT {diastole is getting shorter / gets through diastole quicker} ACCEPT cardiac cycle occurs at a higher rate IGNORE {heart rate increases / heart pumps blood faster / heart pumps more strongly / reference to number of heart beats} IGNORE Systole {faster / shorter} ACCEPT ventricles pump blood at higher pressure	(2)

Q12.

Question number	Answer	Additional guidance	Mark
(a)(i)	An answer that includes the following points: - difference between systolic and diastolic pressure is 5.3 (kPa) (1) - person is healthy (because pulse pressure is greater than 3.75 kPa) (1)	ALLOW 35 / 35.3 ALLOW (because (35 / 35.3) % is higher than 25%) CE applied to second point and comparison adjusted accordingly	(2)

Question number	Answer	Additional guidance	Mark
(a)(ii)	An answer that includes the following points: - suitable estimated values chosen (1) - answer calculated (1)	ACCEPT values in range of (diastolic) 9.5 to 9.7 and (systolic) 14.8 to 15.0 to OR (systolic) 15 and (Diastolic) 10 11 / 11.2 / 11.3 / 11.4 / 11.5 OR 11.7 Correct answer with no working gains 2 marks	(2)

Question number	Answer	Additional guidance	Mark
(a)(III)	An explanation that includes the following points: - insufficient {oxygen / glucose} delivered to the {cells / tissues} (1) - credit an appropriate consequence (1)	ACCEPT oxygenated blood e.g. breathless, lack of energy, stroke, hypoxia, decrease in respiration, dizziness IGNORE death NB eg lack of oxygenated blood for cell respiration = 2 marks	(2)

Question number	Answer	Mark
(b)(I)	D $\frac{8 \eta \lambda}{\pi r^4}$ The only correct answer is D. <i>A is incorrect because ΔP cancels out</i> <i>B is incorrect because ΔP cancels out</i> <i>C is incorrect because the equation is upside down</i>	(1)

Question number	Answer	Mark
(b)(II)	C radius of the blood vessel lumen The only correct answer is C <i>A is incorrect because ΔP cancels out</i> <i>B is incorrect because length is only to the power 1 and radius is to the power 4 and vessels can change their diameter</i> <i>D is incorrect because the thickness of the wall is not part of the calculation.</i>	(1)

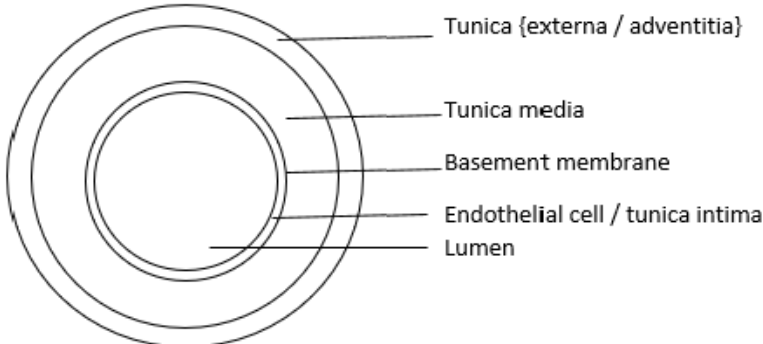
Question number	Answer	Additional guidance	Mark
(b)(III)	An explanation that includes the following points: {inside of arteries lined with layer of unfolded} {flattened / smooth} {endothelial cells / endothelium} (1) - to reduce {friction / surface in contact with blood} (1)		(2)

Question number	Answer	Additional guidance	Mark
(c)(I)	An explanation that includes the following points: - because elastic fibres { in wall of arteries} can {stretch / expand} (1) - therefore {widening the lumen / increasing the diameter (of the artery)} (1) - wall contains collagen to increase the strength (1)	IGNORE recoil DO NOT ACCEPT recoil	(2)

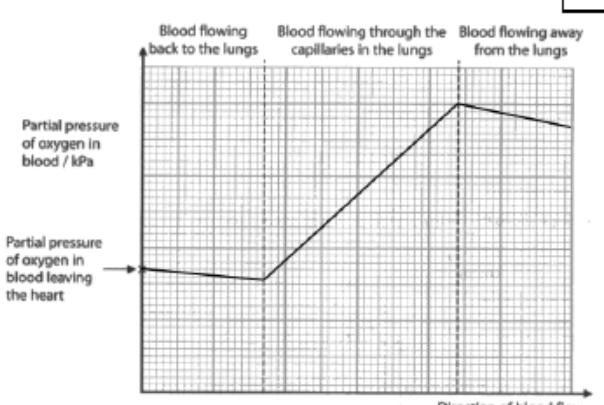
Question number	Answer	Additional guidance	Mark
(c)(II)	An explanation that includes the following points: {if compliance is reduced} damage to the endothelium lining (1) - therefore, {cholesterol / (cholesterol) plaque} can build up (1) - therefore {narrowing / blocking} the blood vessel (1) - reducing {flow of blood / oxygen} to the heart {cells / tissues / muscle} (1)	N.B A reference to an artery must be made for 3 marks to be awarded ACCEPT atheroma IGNORE by clots	(3)

Q13.

Question number	Answer	Additional guidance	Mark
(a)	A description that makes reference to the following points: - one structure (1) - linked function (1)	e.g. single layer of cells / pores / small diameter ACCEPT thin cells / walls e.g. (single layer) gas exchange / diffusion of gases (in the lungs) (pores) plasma forced out / WBC leave / molecules can leave (small diameter) all cells close to capillaries	(2)

Question number	Answer	Additional guidance	Mark
(b)	A drawing that shows the following points: - lumen + {three layers / three other layers + endothelial layer / two layers + endothelial layer} (1) - one feature correctly labelled (1) - a second feature correctly labelled (1)	 ACCEPT Epithelial {layer / lining / cells} / fenestrated membrane Tunica interna Layer of (smooth) muscle <u>and</u> elastic fibres (and collagen) for 1 layer Award marks for longitudinal section NB regards mp 2 and 3 1 right + 1 wrong label = 1 mark 2 right + 1 wrong label = 1 mark 1 right + 2 wrong labels = 0 marks	(3)

Question number	Answer	Additional guidance	Mark
(c)	An explanation that makes reference to the following points: - to prevent backflow (of blood) (1) (as blood is usually returning) {under low pressure / (often) against gravity} (1)	ACCEPT so that blood returns to the heart blood flow is in one direction	(2)

Question number	Answer	Additional guidance	Mark
(d)	A drawing that shows the following points: - pp of O₂ remaining constant as blood flows to lungs (1) - pp of O₂ rising as blood flows through the capillaries (1) - pp of O₂ remaining constant as blood flows away from lungs (1)	ACCEPT within 1 sm square of the verticals in each section ACCEPT slightly decreasing (within 1 large square) ACCEPT slightly decreasing (within 1 large square) 	(3)

Q14.

Question number	Answer	Mark
(a)(i)	A	(1)

Question number	Answer	Mark
(a)(ii)	C	(1)

Question number	Answer	Mark
(b)(i)	B at 0.4 seconds	(1)

Question number	Answer	Additional guidance	Mark
(b)(ii)	A calculation in which: • volume of blood per beat from graph = 59 cm³ (1) • heart rate calculated from graph = 75 bpm (1) • volume of blood converted into dm³ (1) Example of calculation: $(59 \times 75) \div 1000 = 4.425 \text{ dm}^3$	Accept 109 – 50 Correct answer with no working shown gains all three marks	(3)

Question number	Answer	Mark
(c)	An explanation that includes the following points: • dissociation curve for the llama is to the left of that for the human (1) • therefore llama haemoglobin has a higher affinity for oxygen (1) • llama haemoglobin will be fully saturated with oxygen at lower partial pressures (1) • this is necessary as there is less oxygen available in the atmosphere at high altitudes where llamas live (1)	(4)

Q15.

Question number	Answer	Mark
(a)(i)	B The only correct answer is B. <i>A is incorrect because fructose is a monosaccharide</i> <i>C is incorrect because both glucose and fructose are monosaccharides</i> <i>D is incorrect because fructose is a monosaccharide</i>	(1)

Question number	Answer	Mark
(a)(ii)	C peptide condensation The only correct answer is C. <i>A is incorrect because ester bonds are in lipids</i> <i>B is incorrect because ester bonds are in lipids and hydrolysis splits bonds</i> <i>D is incorrect because hydrolysis splits bonds</i>	(1)

Question number	Answer	Mark
(a)(iii)	B absent lower The only correct answer is B. <i>A is incorrect because saturated fatty acids have more hydrogens than unsaturated fatty acid of same length</i> <i>C is incorrect because there are no carbon carbon double bonds in saturated fatty acids</i> <i>D is incorrect because there are no carbon carbon double bonds in saturated fatty acids</i>	(1)

Question number	Answer	Additional guidance	Mark
(b)(i)	- volume of cylinder calculated (1) - ratio of surface area : volume to max 2 dps (1)	Example of calculation: $(3 \times 2 \times 2 \times 28 / \pi \times 2 \times 2 \times 28 / 22/7 \times 2 \times 2 \times 28) 336 / 352 \text{ (mm}^3\text{)}$ e.g 1.02 : 1 / 1.07 : 1 / 1 : 1 ACCEPT ratio given the wrong way round e.g. 1 : 09 NB ecf if {incorrect rounding from above / diameter used} for 1 mark	(2)

Question number	Answer	Additional guidance	Mark
(b)(ii)	An explanation that includes two of the following points: (because the insect is small) the cells will not be far from the {sinuses / blood} (1) (so) diffusion can supply the {oxygen / nutrients / named nutrient} (from the blood) (1) - because the insect is small it does not have {double circulation / blood vessels / closed circulatory system / complex circulatory system / high pressure} OR - because the insect has a low {metabolic rate / oxygen demand}(1) - diffusion can supply the oxygen (from blood / tracheoles) / the oxygenated and deoxygenated blood <u>does not need to be kept separate</u> (1) - because the insect is small it does not have {double circulation / blood vessels / closed circulatory system / complex circulatory system / high pressure}	IGNORE ref to surface area to volume ratio ACCEPT small diffusion distance between cells and {sinuses / blood} ACCEPT remove carbon dioxide diffusion supplies oxygen to cells from the tracheoles IGNORE has an open system because this is in the question IGNORE has an open system because this is in the question	(2)

Question number	Answer	Additional guidance	Mark
(b)(iii)	A description that includes two of the following points: - fibrous protein (1) {triple / three stranded} helix (held with hydrogen bonds) (1) (short) repeating sequences of amino acids / high {hydroxyproline / proline / glycine} content / every third amino acid is glycine(1)	IGNORE refs to secondary / tertiary / quaternary structure throughout NB piece together IGNORE alpha	(2)

Q16.

Question number	Answer	Mark		
(a)(i)	B <table><tr><td>2</td><td>3</td></tr></table> The only correct answer is B <i>A is incorrect because glucose and fructose are monosaccharides and lactose, maltose and sucrose are disaccharides</i> <i>C is incorrect because glucose and fructose are monosaccharides and lactose, maltose and sucrose are disaccharides</i> <i>D is incorrect because glucose and fructose are monosaccharides and lactose, maltose and sucrose are disaccharides</i>	2	3	(1)
2	3			

Question number	Answer	Mark
(a)(ii)	B glycosidic The only correct answer is B. <i>A is incorrect because ester bonds join organic acids and alcohols together</i> <i>C is incorrect because hydrogen bonds do not join two monosaccharides together</i> <i>D is incorrect because phosphodiester bonds join phosphate group to an organic alcohol</i>	(1)

Question number	Answer	Additional guidance	Mark
(a)(iii)	An answer that includes two of the following points: - monosaccharides are not more or less sweet than disaccharides (1) - a disaccharide is the least sweet and a monosaccharide is the sweetest (1) - sucrose is the sweetest disaccharide and fructose is the sweetest monosaccharide (1)	ACCEPT lactose is the least sweet disaccharide and glucose is the least sweet monosaccharide	(2)

Question number	Answer	Additional guidance	Mark
(a)(iv)	An answer that includes three of the following points: • {sugars / sugar solutions} are tasted (1) • sugars should be the same concentration (1) • mouth is rinsed out between each sugar (1) • the (relative) sweetness is compared to sucrose (1) OR If students describe Benedict's test, allow the following two marks: • add Benedict's solution and heat (1) • rank sugar by {described colour changes / time taken to reach specific colour} (1)	ACCEPT sampled IGNORE amount ACCEPT the sugars are {compared against each other / given a rating}	(3)

Question number	Answer	Additional guidance	Mark
(b)	An answer that includes the following points: similarities: • both (polymers) composed of a glucose (1) • both contain 1 - 4 glycosidic {bonds / links} (1) differences: • amylose has {1 - 4 glycosidic bonds (only) / no 1 - 6 glycosidic bonds} and amylopectin has {1 - 4 and 1 - 6 glycosidic bonds} (1)	DO NOT piece together unless in same sentence or two linked adjacent sentences ALLOW composed of glucose if a glycosidic bonds are given ACCEPT amylose is {a chain / helical / linear / unbranched} and amylopectin is branched NB 'amylose has 1 - 4 glycosidic bonds and amylopectin has 1 - 4 and 1 - 6 glycosidic bonds' scores mark points 2 and 3	(3)

Q17.

Question number	Answer	Mark		
(a)(i)	The only correct answer is B <table><tr><td>contracted</td><td>relaxed</td></tr></table> <i>A is incorrect because the ventricles are relaxed</i> <i>C is incorrect because the atria are contracted and the ventricles are relaxed</i> <i>D is incorrect because the atria are contracted</i>	contracted	relaxed	(1)
contracted	relaxed			

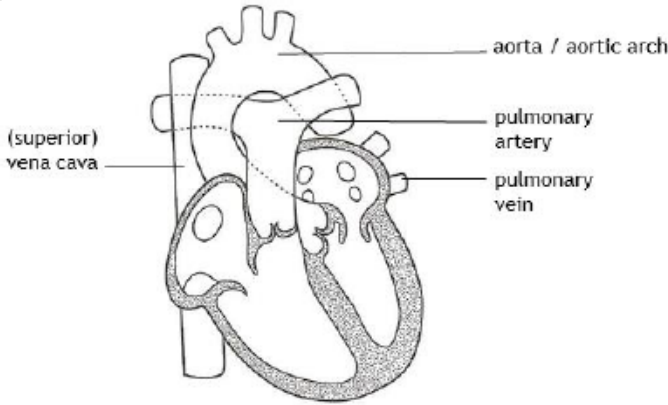
Question number	Answer	Additional guidance	Mark
(a)(ii)	An explanation that includes the following points: - because the atrioventricular valves have to close (before the ventricles contract) (1) - to prevent backflow of blood into the atria (1)	ACCEPT {bicuspid / mitral} valve and tricuspid valve DO NOT ACCEPT valves close during ventricular systole	(2)

Question number	Answer	Additional guidance	Mark
(a)(iii)	- cardiac cycle time multiplied by proportion of cycle spent in ventricular systole (1) $3.2 \times 10^2 / 3.23 \times 10^2$ (1)	Example of calculation: $0.86 \times \frac{3}{8} / 0.3225 / 0.32 / 0.323$ Correct answer with no working gains 2 marks	(2)

Question number	Answer	Additional guidance	Mark
(a)(iv)	63% / 5/8 / 0.63	ACCEPT 0.625 / 62.5% / 5 out of 8	(1)

Question number	Answer	Additional guidance	Mark
(b)	- heart rate if cardiac cycle lasts 0.86 seconds (1) - heart rate if cardiac cycle last 0.46 seconds (1) - increase in heart rate = 60 / 61 beats per minute (1)	Example of calculation: $60 \div 0.86 = 69.76744186046512$ $60 \div 0.46 = 130.4347826$ Answer in range of 60.2 to 60.7 gains 2 marks CE from calculations of heart rate Correct answer alone gains 3 marks	(3)

Q18.

Question number	Answer	Additional guidance	Mark
(a)	 Diagram of the human heart showing the following structures labeled: - aorta / aortic arch - pulmonary artery - pulmonary vein (superior) vena cava	IGNORE ascending / descending DO NOT ACCEPT inferior All 4 correct for 3marks 3 correct for 2 marks 1 or 2 correct for 1 mark	(3)

Question number	Answer					Mark
(b)	Structures	Present in arteries only	Present in capillaries only	Present in veins only	Present in arteries, capillaries and veins	(3)
	Lining of endothelial cells				X	
	Valves along the length of the blood vessel			X		
	Wall only one cell thick		X			

Question number	Answer	Additional guidance	Mark
(c)	An answer that includes the following points: • {velocity / (blood) flow} decreases as blood flows through the arterioles (1) • {velocity / (blood) flow} low as blood flows through the capillaries (1) • {velocity / (blood) flow} increases as blood flows through the venules (1)	NB penalise ref to blood pressure instead of blood flow once ACCEPT from arteries to capillaries IGNORE descriptions of what happens in arteries ACCEPT slight increase IGNORE constant ACCEPT from capillaries to veins IGNORE descriptions of what happens in veins	(3)

Q19.

Question number	Answer	Mark
(a)(i)	The only correct answer is A <i>B is incorrect because a person can modify their alcohol intake</i> <i>C is incorrect because a person can modify their blood pressure</i> <i>D is incorrect because a person can change their level of activity</i>	(1)

Question number	Answer	Additional guidance	Mark
(a)(ii)	An explanation that includes the following points: • because many factors cause CVD (1) • different drugs treat different conditions (1)	ACCEPT two named drugs and what they treat IGNORE wrong drugs	(2)

Question number	Answer	Additional guidance	Mark
(b)(i)	An explanation that includes the following points: - because antioxidants reduce free radicals (1) - therefore {cell damage / damage to lining of blood vessels / oxidative stress} will be reduced (1) - therefore reducing {plaque / atheroma} formation (due to decreased free radicals) (1)	ACCEPT neutralise / donate electrons to / break down / stabilise IGNORE incorrect consequences	(3)

Question number	Answer	Additional guidance	Mark
(b)(ii)	An explanation that includes the following points: {study / data} will not be valid (1) - diet has an impact on CVD (1) - credit an example explained (1)	IGNORE non-dietary factors IGNORE reliability / accuracy ACCEPT {increase risk / decrease risk} in correct context e.g. high salt causes high blood pressure high fibre reduces cholesterol absorption	(3)

Question number	Answer	Additional guidance	Mark
(b)(iii)	An explanation that includes the following points: • because diet affects a number of risk factors (1) • credit example of change in diet and the risk factor it reduces (1) • credit a second example of change in diet and the risk factor it reduces (1)	IGNORE non-dietary examples e.g. salt intake can be reduced to lower blood pressure {saturated / animal} fats can be reduced to reduce {cholesterol levels / atheroma formation} unsaturated fats can be increased to reduce {cholesterol levels / atheroma formation}	(2)

Q20.

Question number	Answer	Additional guidance	Mark
(a)(i)	An answer that includes three of the following points: • (in general) people's perceptions of risks are lower than the actual risks (except being overweight) (1) • people seem to have a realistic perception of the risk of {smoking / being overweight} (1) • overweight is the most common risk factor / smoking is the least common risk factor (1)	ACCEPT converse that actual risks are higher (in general) (in general) people underestimate their risks ACCEPT perception and actual risks are very close IGNORE perceived risk is lower than actual risk for overweight ACCEPT actual risk of high blood pressure and cholesterol are the same IGNORE the most number of people are overweight / least number of people smoke	(2)

Question number	Answer	Additional guidance	Mark
(a)(ii)	An explanation that includes three of the following points: • large group of people (1) • sample size is large for {repeatability / reproducibility} (1) • people should not know if they have underlying health risks (before being interviewed) (1) • no known health risks for validity / otherwise it is not a perception that is being studied (1)	NB mp 2, 4 and 6 can only be awarded if mp 1, 3 and 5 have been awarded, respectively ACCEPT large sample size / more people ACCEPT to allow for a statistical analysis / description of statistical analysis e.g. SD calculated IGNORE accurate / precise / valid / reliable ACCEPT named example e.g. family history should not be on medication for CVD	(3)

	• people should have some knowledge of CVD (1) • some knowledge for validity / to reduce the number of guesses / to make an informed decision (1)		
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Question number	Answer	Additional guidance	Mark
(a)(iii)	An explanation that includes three of the following points: - lifestyle can be modified (to reduce the risk / slow down progression) (1) - they could have a {blood / health} test (to assess the risk / check on the progression) (1) - medication can be {prescribed / taken} (to reduce the risk / slow down progression) (1) - if perception is greater than actual, an unnecessary change may be made (1)	ACCEPT converse i.e. what a person would not do if they underestimated the risk for mp 1, 2 and 3 ACCEPT if people know they are at risk then they can do something about it ACCEPT a described change in a named example ACCEPT named example ACCEPT named example of a change may cause stress	(3)

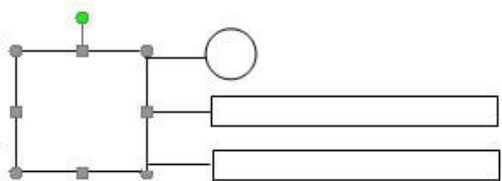
Question number	Answer	Additional guidance	Mark
(b)(i)	- points added up (1) 8 (%) (1)	$(-3 + 11 + 9 + 2) 19$ Bald answer = 2 marks $(11+9+ 2=22) 17(\%) = 1 \text{ mark}$	(2)

Question number	Answer	Additional guidance	Mark
(b)(ii)	An explanation that includes two of the following points: - stop smoking as this would reduce {damage to the endothelial lining / lower blood pressure} (1) - reduce {cholesterol / saturated fats} in the diet so less to build up the {plaque / atheroma} (in the arteries) (1) - reduce {salt intake / stressful activities} as this would lower blood pressure (1)	ACCEPT the converse throughout for what would happen if the changes were not made ACCEPT increase antioxidants to reduce free radicals generated by smoking ACCEPT atherosclerosis increase in fibre to reduce absorption of cholesterol ACCEPT <u>increase</u> exercise / consume less caffeine	(2)

Question number	Answer	Mark
(b)(iii)	The only correct answer is D, antihypertensives and statins <i>A is incorrect because anticoagulants do not reduce blood pressure or blood cholesterol levels</i> <i>B is incorrect because anticoagulants do not reduce blood pressure or blood cholesterol levels</i> <i>C is incorrect because platelet inhibitors do not reduce blood pressure or blood cholesterol levels</i>	(1)

Question number	Answer	Additional guidance	Mark
(b)(iv)	An answer that includes two of the following points: - other factors are risk factors that have not been included (1) - the {cholesterol levels / blood pressure} may have to be estimated (1) - does not include {the number of cigarettes smoked / ex smoker} (1)	ACCEPT named factor e.g. body mass, activity levels, diabetic, genetic predisposition, passive smoking IGNORE sex / gender ACCEPT does not include {HDL / LDL:HDL} / diastolic B P IGNORE not accurate IGNORE under estimates / lying / passive smoking	(2)

Q21.

Question number	Answer	Additional guidance	Mark
(a)(i)	A diagram that makes reference to the following points: - one glycerol (squarish / labelled), two fatty acids (rectangular / labelled), one phosphate and three bonds shown (1) - all components drawn together correctly (1)	 ecf if: {one / three} fatty acids drawn attached to glycerol but rest correct glycerol missing but two fatty acids attached to head with bonds bonds missing but all four components are touching correctly	(2)

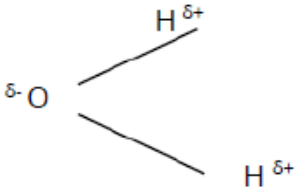
Question number	Answer	Mark
(a)(ii)	The only correct answer is A (ester) B is incorrect because glycosidic bonds are found in carbohydrates C is incorrect because there are no hydrogen bonds in phospholipids D is incorrect because peptide bonds are found in proteins	(1)

Question number	Answer	Mark
(b)(i)	The only correct answer is B (by diffusion) A is incorrect because active transport moves polar molecules C is incorrect because nonpolar molecules can diffuse through the nonpolar fatty acids D is incorrect because only water moves by osmosis	(1)

Question number	Answer	Mark
(b)(ii)	The only correct answer is B (one) A is incorrect because the second statement is the only correct one C is incorrect because the second statement is the only correct one D is incorrect because the second statement is the only correct one	(1)

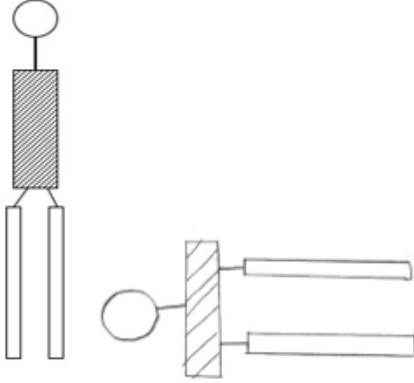
Question number	Answer	Additional guidance	Mark
(a)	An explanation that includes the following points: - because it shows that it is {made of two layers of phospholipid / bilayer} (1) - the size of a phospholipid is in the range 2.05 nm to 2.65 nm (1) - therefore the width of the membrane (5 nm) is within a bilayer range (of 4.1 nm to 5.3 nm) (1)	Accept it shows two layers of phosphate heads separated by a band of lipids	(3)

Question number	Answer	Additional guidance	Mark
(b)	An explanation that includes three of the following points: - cholesterol is a non-polar molecule (1) - fatty acid tails are non-polar (1) - cholesterol will be located within the {fatty acid tails / non-polar part} of membrane (1) - OH group will be located near the phosphate heads (1)	Accept hydrophobic for non-polar in all points Accept {hydrocarbon tail / hydrocarbon rings} are non-polar	(3)

Question number	Answer	Additional guidance	Mark
(c)(i)	A description that includes the following points: {small / weak / delta / partial} positive charge on hydrogen (1) {small / weak / delta / partial} negative charge on oxygen (1)	Accept both points from a diagram 	(2)

Question number	Answer	Additional guidance	Mark
(c)(ii)	An explanation that includes the following points: • water is small enough to move by {osmosis / diffusion} (betweenthe phospholipids) (1) • steroid (is non-polar so) can diffuse through the {membrane / phospholipids} (1) • glucose (is polar so) passes through {protein channels / carrierproteins / by facilitated diffusion} (1) • ions (are polar so) pass through {protein channels / carrier proteins / by facilitated diffusion / active transport} (1)	Accept description of water movingthrough {protein channels / aquaporins} Accept steroid is not repelled by fattyacid tails Accept movement by active transport Accept ions are repelled by fatty acidtails so cannot get through membrane	(4)

Q23.

Question number	Answer	Additional guidance	Mark
(a)(i)	A diagram that includes the following points: • one glycerol (shaded / labelled), two fatty acids (not shaded / labelled), one phosphate and three bonds shown (1) • all components drawn together correctly (1)	 ecf if: {one / three} fatty acids drawn attached to glycerol but rest correct glycerol missing but fatty acids attached to head with bonds bonds missing but all four components are touching correctly {all shaded / nothing shaded} with no labels	(2)

Question number	Answer	Additional guidance	Mark
(b)(iii)	An explanation that includes the following points: - cholesterol interacts with {phospholipids / fatty acids} (1) (if less cholesterol) movement of <u>phospholipids</u> no longer restricted (by interaction with cholesterol) (1)	NB we are not looking for the idea that cholesterol is acting as a barrier or taking up space ACCEPT bonds ACCEPT so <u>phospholipids</u> can move around more	(2)

Question number	Answer	Additional guidance	Mark
(b)(iv)	will require less (kinetic) energy to move / because there are fewer interactions (with {other fatty acids / phospholipids / cholesterol}) (1)	ACCEPT bonds converse for longer chains	(1)

Question number	Answer	Additional guidance	Mark
(c)(i)	An answer that includes the following points: - convert saturated fatty acids into unsaturated fatty acids (1) - convert long side chains into shorter ones (1)	ACCEPT become unsaturated / increase in unsaturated / decrease in saturated fats ACCEPT become shorter	(2)

Question number	Answer	Additional guidance	Mark
(c)(ii)	An answer that includes two of the following points: • to maintain the fluidity of the membrane (1) • so that membrane can change shape (1) • so that fusion of membranes can occur (1) • so that substances can continue to move across membrane (1)	ACCEPT otherwise the fluidity will decrease ACCEPT named example e.g. phagocytosis, endocytosis, exocytosis, red blood cells, formation of vesicles ACCEPT named example e.g. of nuclei (during fertilisation) fusion of vesicles ACCEPT named substance	(2)

Q24.

Question number	Answer	Additional guidance	Mark
(a)(i)	A description that includes three of the following points: • fibrous protein (1) • (protein) composed of {three polypeptide chains / three-stranded / triple} <u>helix</u> (1) • held by hydrogen bonds (between the chains) (1) • credit details of the chains (1)	e.g every third amino acid is a glycine, repeating sequences of amino acids, high content of {glycine / proline / hydroxyproline}	(3)

Question number	Answer	Additional guidance	Mark
(a)(ii)	An explanation that includes the following points: - gives (the wall) (tensile) strength (1) - so that the aorta {does not get damaged by / can withstand} pressure (of the blood leaving the heart) (1)	IGNORE refs to elastic properties and recoil IGNORE prevents aorta from collapsing	(2)

Question number	Answer	Additional guidance	Mark
* (b)	Indicative content: Graph 1 - older male monkeys have more stiffness than younger males (D) - older female monkeys have more stiffness than younger females (D) - older males have more stiffness than older females (D) - probably significant as error bars do not overlap (C) - not much difference in stiffness between younger males and females (D) - as error bars overlap (C) - age increases aortic stiffness in both males and females (C) - age has a greater effect on aortic stiffness in males than females (C) Graph 2 - density of collagen decreases slightly with age (D) - males of all ages have (slightly) more collagen than females (C) - probably not significant as error bars overlap (C) - neither age nor sex affects density of collagen (C) - changes in stiffness do not appear to be related to the density of collagen (C) Graph 3 - higher type 1 in younger monkeys than older ones (D)	Level 1 1 mark = description made from one graph (D) Level 2 2 marks = descriptions made from two graphs (D) 3 marks = plus one conclusion made (C) 4 marks = plus two conclusions made (C) Level 3 5 marks = two conclusions and comments on the other two graphs 6 marks = three conclusions that includes the asterisked conclusion (C*) and comments on the other two graphs Description = comparison of one variable Conclusion = summary statement that includes both age and sex	(6)

	- more type 1 in females than males at each age (D) - no error bars shown to judge significance (C) Graph 4 - more type 8 in older male monkeys (D) - may not be a difference in type 8 between older and younger females (D) • no error bars to judge significance (C) - the type of collagen appears to determine stiffness (C) - stiffness associated with decrease in type 1 and increase in type 8 (C*)	interpretation of error bar and significance of data – not reliability links between 2 graphs	
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Q25.

Question number	Answer	Additional guidance	Mark
(a)	A calculation in which: - actual height of elephant - how many times taller the elephant is than the mouse	Example of calculation: $4.5 \div 0.02 = 225 / 230 / 235 \text{ (cm)}$ 75 / 76.67 / 76.7 / 77 / 78 / 78.3 / 78.33 IGNORE units	(2)

Question number	Answer	Additional guidance	Mark
(b)	A description that includes the following points: - attachment of lungs to {chest cavity / diaphragm} {increases volume / decreases pressure} (1) Any two from: <u>alveoli</u> provide a large surface area for faster diffusion (1)	ACCEPT to {take in / hold} large volume of air ACCEPT thin walls	(3)

	<u>alveoli</u> formed from {one cell layer / flattened / squamous} epithelial cells for small diffusion distance (1) - concentration gradient maintained by {ventilation / blood flow / good blood supply} (1)	ACCEPT large network of capillaries	
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Question number	Answer	Mark
* (c)	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material indicated as relevant. Additional content included in the response must be scientific and relevant. Indicative content - oxygen dissociation curve for the mouse is shifted to the right - mouse haemoglobin has a lower affinity for oxygen than the elephant haemoglobin - therefore haemoglobin can supply oxygen to the tissues at lower pp of oxygen - because the rate of respiration in the mouse is higher - a mouse has a higher mass-specific metabolic rate than the elephant - because the mouse loses more body heat - because it has a larger surface area to volume ratio - because the mouse is more active - because it has to escape predators - the rate of respiration of the mouse is going to be	(6)

	greater than the elephant • therefore pp of oxygen in mouse tissues will be lower • therefore haemoglobin needs to be releasing oxygen • when blood cannot supply oxygen at a fast enough rate	
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Level	Marks	
	0	No awardable content.
1	1-2	An explanation may be attempted but with limited interpretation or analysis of the scientific information and with a focus on mainly just one piece of scientific information. The explanation will contain basic information, with some attempt made to link knowledge and understanding to the given context.
2	3-4	An explanation will be given, with occasional evidence of analysis, interpretation and/or evaluation of both pieces of scientific information. The explanation shows some linkages and lines of scientific reasoning with some structure.
3	5-6	An explanation is made that is supported throughout by sustained application of relevant evidence of analysis, interpretation and/or evaluation of both pieces of scientific information. The explanation shows a well-developed and sustained line of scientific reasoning, which is clear and logically structured.

Q26.

Question number	Answer				Additional guidance	Mark
(a)	Polymer	Monomer	Elements in monomer	Type of bond	ACCEPT chemical symbols C, H, O	(4)
	Carbohydrates	monosaccharide	carbon, hydrogen and oxygen	glycosidic		
	Nucleic acids	(mono)nucleotide	carbon, hydrogen, oxygen, phosphorus and nitrogen	phosphodiester		
	Proteins	amino acid	carbon, hydrogen, oxygen, (sulfur) and nitrogen	peptide		
					ACCEPT chemical symbols C, H, O, N, S	

Question number	Answer	Additional guidance	Mark
(b)	A description that includes three of the following points: TWO FROM • (one) glycerol and three fatty acids (1) • joined by {condensation reaction / ester bond} (1) • by enzymes (1) AND • (at least) one fatty acid is {unsaturated / has a CC double bond}(1)		(3)

Question number	Answer	Additional guidance	Mark
(a)	An answer that includes the following points: • high salt intake increases the {hazard ratio / risk of death} for all causes of death (1) • high salt intake increases the {hazard ratio / risk of death} the most for CAD (1)	Allow piecing together for mp1 Allow CHD for CAD throughout Both marking points must be about increased {risk of death / hazard ratio} not increased risk of getting disease ACCEPT a description for all causes of death eg CAD, CVD and all other causes ACCEPT from a comparative calculation. ACCEPT high salt intake has the {hazard ratio / <u>risk of death</u>} for CAD	(2)

Question number	Answer	Additional guidance	Mark
(b)(i)	An explanation that includes the following points: • age and smoking both increase the {risk of death / hazard ratio} (1) • credit an explained example (1) • the study would not be {valid / reproducible / repeatable} if either or both of these factors were not controlled (1)	Piece together for mp1 This can be for either factor e.g. smoking increases blood pressure, with increasing age arteries lose elasticity IGNORE references to reliability	(3)

Question number	Answer	Additional guidance	Mark
(b)(ii)	An answer that includes two of the following points: • gender / sex (1) • blood pressure (1) • blood cholesterol levels (1) • level of exercise / activity (1)	ACCEPT; Obesity / BMI Level of {fat / cholesterol / sugar} in diet Type 2 diabetes Stress levels Ratio of LDL to HDL Genetic factors Level of alcohol consumption IGNORE: diet / unhealthy diet (unqualified) / lifestyle / exercise (unqualified) / level of salt in diet	(2)

Question number	Answer	Additional guidance	Mark
(c)	An answer that includes the following points: • needed a means of comparison (1) • the (increased) risk of death due to high salt intake is compared to the risk of death (from a low salt intake) (1)	Accept reference point / baseline IGNORE control If they get MP 2 will also get MP 1 Risk of death is eq. to hazard ratio	(2)

Question number	Answer	Additional guidance	Mark
(d)(i)	• A measure of the (linear) relationship between 2 (quantitative) {variables / factors} (1)	ACCEPT a change in one variable is reflected by a change in another variable ACCEPT link between two variables ACCEPT a technique to show {if / how strongly} pairs of variables are related ACCEPT positive / negative correlation described eg as one variable increases another increases, or an example of this DO NOT ACCEPT {causes / is caused by / leads to}	(1)

Question number	Answer	Additional guidance	Mark
(d)(ii)	An answer that includes the following points: • {difficult/impossible} to control all the {variables/risk factors} (1) • unreliable estimate of risk factors e.g. number of cigarettes smoked (1)	ACCEPT too many {factors / variables} to control IGNORE examples of variables ACCEPT no clear definition of {low / high} salt intake ACCEPT people may lie about data/self-reporting not reliable IGNORE reference to low sample size	(2)

Q28.

Question number	Answer	Additional guidance	Mark
* (a)	Indicative content: Graph: - HDL involved in removal of LDL from blood by liver (SE) - not just level of HDL that influences risk (D) - higher levels of LDL increase risk (D) - risk decreases with increase in HDL (D) - HDL results in uptake of cholesterol by liver (SE) - LDL forms the plaque (SE) - risk is a {combination / ratio} of HDL and LDL levels (SE) - the higher the HDL:LDL ratio the lower the risk (SE) Other risk factors: - the more cholesterol in the blood the more cholesterol to build up the atheroma (SE) - high blood pressure increases chance of damage to endothelial cell layer (SE) - smoking causes high blood pressure (SE) - smoking produces CO that binds to haemoglobin putting strain on heart (SE) - high salt in diet causes high blood pressure (SE) - obesity increases risk because of strain put on heart (SE) - age increases risk because affects heart muscle (SE) - genetic predisposition affects risk (SE) Extended explanation: - damage to the endothelial layer results in an inflammatory response - damage to the endothelial layer	Level 1: 1 mark = 1 {risk factor named / comment on graph} 2 marks = 2 {risk factor named / comment on graph} Or outline of how cholesterol causes CVD i.e. recall of the story Level 2: 3 marks = 2 simple explanations 4 marks = 3 simple explanations Level 3: 5 marks = as for 4 marks + 1 point from extended explanation 6 marks = as for 5 marks + 2 points from extended explanation	(6)

	causes {build up of cholesterol / plaque} - plaque causes {more cholesterol to build up / blood clot to form} <u>coronary artery</u> becomes blocked - resulting in less oxygen reaching <u>heart</u> {cells / tissues} - heart attack results as <u>heart cells</u> cannot respire		
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Question number	Answer	Additional guidance	Mark
(b)(i)	An answer that includes three of the following points, one of which must be a similarity for full marks: Similarities • both contain ApoA-1 (1) • both contain a phospholipid layer (1) Differences • altered HDL is larger (1) • altered HDL has more CE (1) • altered HDL has fewer (long-chain polyunsaturated) PC (1)	ACCEPT converse throughout DO NOT PIECE TOGETHER ACCEPT altered HDL has no {ApoM / S1P / RBP4/ CRABP1}	(3)

Question number	Answer	Additional guidance	Mark
(b)(ii)	An explanation that includes the following points: • less reduction (in the number) of free radicals (1) • therefore {cell damage / damage to lining of blood vessels / oxidative stress} will not be reduced (1) • therefore formation of {plaque / atheroma} will not be reduced (1)	ACCEPT free radicals will not be {reduced / neutralised} IGNORE free radicals won't increase ACCEPT {cell damage / oxidative stress} will occur ACCEPT more plaques NB max 1 mark if not in context of reduced antioxidant properties	(3)

Q29.

Question number	Answer	Additional guidance	Mark
(a)(i)	• 9 : 1	ACCEPT 6 : 1 / 5 : 1	(1)

Question number	Answer	Additional guidance	Mark
(a)(ii)	A description that includes the following points: - will not have any effect on the total membrane phospholipids (1) - the inner layer will have a relatively higher content of the other phospholipids / the outer layer will have a relatively lower content of the other phospholipids (1)	ACCEPT increase phospholipid content in outer layer and decrease content in inner layer	(2)

Question number	Answer	Additional guidance	Mark
(a)(iii)	A description that includes the following points: - will alter membrane {properties / permeability / fluidity} (1) - so that platelets will release thromboplastin (1) - thromboplastin is {an enzyme / a catalyst} (1) - that converts prothrombin into thrombin (1)	NB thromboplastin catalyses prothrombin into thrombin = 2 marks	(4)

Question number	Answer	Additional guidance	Mark
(b)	An explanation that includes the following points: - thrombin is an <u>enzyme</u> (1) - because the inhibitor will change the shape of the active site (of thrombin) (1) - therefore thrombin cannot bind to fibrinogen (1) - therefore {less / no} fibrinogen will be converted into fibrin (1) - therefore there is {less / no} {mesh / fibrin / fibres} to trap {blood cells / platelets} (1)	ACCEPT inhibitor blocks the active site / fewer active sites available ACCEPT {less / no} thrombin to bind to fibrinogen / fewer collisions / fewer enzyme substrate complexes formed ACCEPT slower conversion	(4)

Q30.

Question number	Answer	Additional guidance	Mark
(a)(i)	An answer that includes two of the following points: (46 / 48 / 94 patients is) not a very large sample size (1) {18 countries / variety of people} probably means that other variables not taken into account (1) - but AHP is a very rare disorder so not many patients available (1)	IGNORE refs to reliability, validity ACCEPT in the context of 'these' people named variable e.g. lifestyle, diet, other diseases IGNORE sex / age	(2)

Question number	Answer	Additional guidance	Mark
(a)(ii)	- mass of drug needed for that patient (1) {0.8 / 0.85 / 0.847} cm³ (1) OR - volume of drug to give 2.5 mg (1) {0.8 / 0.85 / 0.847} cm³ (1)	Example of calculation: $64 \times 2.5 / 160$ IGNORE units ACCEPT cc / mls $2.5 \div 189 / 0.0132275$ ACCEPT cc / mls NB Bald answer of {0.8 / 0.85 / 0.847} cm³ = 2 marks Bald answer of {160 / 0.01 / 0.013 / 0.132} = 1 mark	(2)

Question number	Answer	Additional guidance	Mark
(a)(iii)	27% of 48 calculated (1) 12 / 13 (1)	Example of calculation: $27 \times 48 \div 100 / 12.96$ ACCEPT 25 as an ecf for 1 mark (27% of 94)	(2)

Question number	Answer	Additional guidance	Mark
(b)(i)	G U C U U U C	All correct = 2 marks One wrong base given OR one wrong base given consistently = 1 mark	(2)

Question number	Answer	Additional guidance	Mark
(b)(ii)	A description that includes three of the following points: - phosphodiester bonds between (adjacent) {ribose and phosphate / (mono)nucleotides} (in each strand) (1) - covalent bonds attaching base to a {ribose (sugar) / sugar} (1) {hydrogen / H} bonds between (complementary) bases (holding two strands together) (1) {hydrogen / H} bonds holding double helix together (1)	ACCEPT sugar DO NOT ACCEPT deoxyribose ACCEPT between {C and G / U and A} DO NOT ACCEPT between {T and A / other incorrect base pairs} IGNORE incorrect number of H bonds	(3)

Question number	Answer	Additional guidance	Mark
(b)(iii)	An answer that includes three of the following points: {no / less / affected} translation of the mRNA (1) (altered mRNA) affects shape of {protein / active site} (1) {no / less / slower} haem production (1) {no / less} (toxic) porphyrin (1)	ACCEPT a description of translation DO NOT ACCEPT transcription / description of transcription ACCEPT no {protein / enzyme} formed	(3)

Q31.

Question number	Answer	Additional guidance	Mark
(a)	An explanation that includes the following points: - because (X / coronary artery) carries {oxygen / oxygenated blood} to the heart {cells / muscle / tissue} (1) - for {(aerobic) respiration / metabolism} (in the heart) (1) - aorta is closest blood vessel carrying oxygenated blood (1)	IGNORE glucose / nutrients ACCEPT aorta supplies X blood with <u>high levels of</u> oxygen	(3)

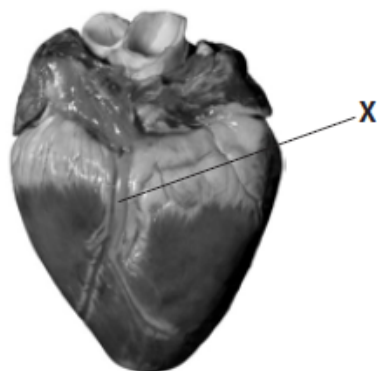
Question number	Answer	Additional guidance	Mark
(b)(i)	An explanation that includes the following points: • diastole / atrial systole / ventricular diastole (1) • because the {atrioventricular / AV / bicuspid / tricuspid} valves are open (1)	ACCEPT semi lunar valves are closed	(2)

Question number	Answer	Additional guidance	Mark
(b)(ii)	An answer that includes the following points: • arrows shown on left-hand side of heart (only) (1) • arrows pointing in correct direction (1) • arrows shown entering atrium through pulmonary vein and leaving through the aorta (1)	<u>example of diagram</u> 	(3)

Question number	Answer	Additional guidance	Mark
(c)	An explanation that includes the following points: • increase in diameter due to {high pressure / large volume / surge} of blood (leaving the left ventricle) (1) • therefore expansion of elastic fibres (1) • decrease in diameter due to recoil (of elastic fibres) (1)	ACCEPT to reduce pressure of blood	(3)

Q1.

The photograph shows a mammalian heart.



The blood vessel labelled **X** is a branch from the aorta.

The aorta is one of the major blood vessels of the heart.

(a) Explain why it is important that blood vessel **X** branches directly from the aorta.

(3)

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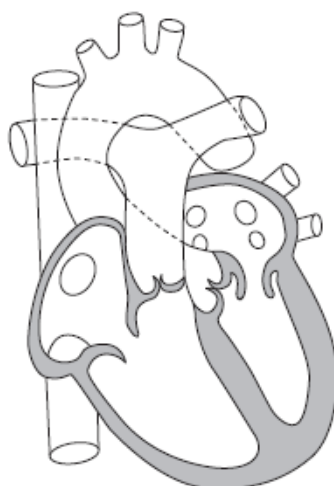
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(b) The diagram shows the internal structure of a mammalian heart.



(i) Explain which stage of the cardiac cycle is shown in this diagram.

(2)

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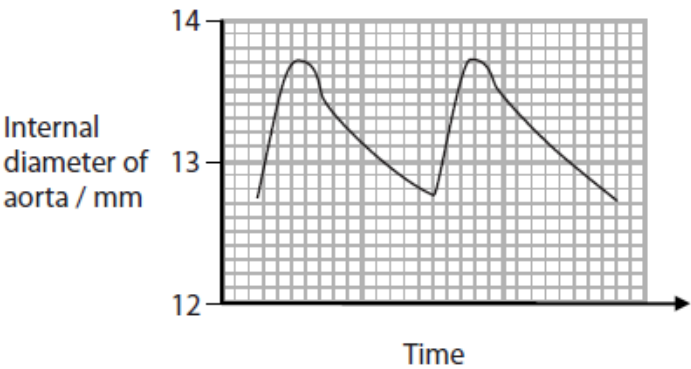
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(ii) Draw arrows on the diagram to show the flow of blood through the left side of the heart and into the aorta.

(3)

(c) The graph shows the changes in the internal diameter of the aorta during two cardiac cycles.



Explain the changes in the internal diameter of the aorta.

(3)

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Q2.

Answer the question with a cross in the box you think is correct ☐ . If you change your mind about an answer, put a line through the box ☐ and then mark your new answer with a cross ☐ .

Humans store energy as glycogen.

(a) (i) Which is the correct statement about the formation of glycogen?

(1)

- ☐ **A** α glucose molecules join together by a condensation reaction
- ☐ **B** α glucose molecules join together by a hydrolysis reaction
- ☐ **C** β glucose molecules join together by a condensation reaction
- ☐ **D** β glucose molecules join together by a hydrolysis reaction

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

(1)

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(iii) Explain how the structure of glycogen relates to its role as an energy storage molecule.

(3)

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(b) Von Gierke disease is one type of glycogen storage disease (GSD).

(i) Between one in 20 000 and one in 25 000 babies are born with GSD.

About 25% of patients with GSD are thought to have Von Gierke disease.

In one country, 3.8 million babies were born in one year.

Estimate the number of babies born each year with Von Gierke disease in this country.

(2)

Answer

(ii) Von Gierke disease is an inherited disease.

Suggest why the majority of these babies are born to parents who are not affected by Von Gierke disease.

(2)

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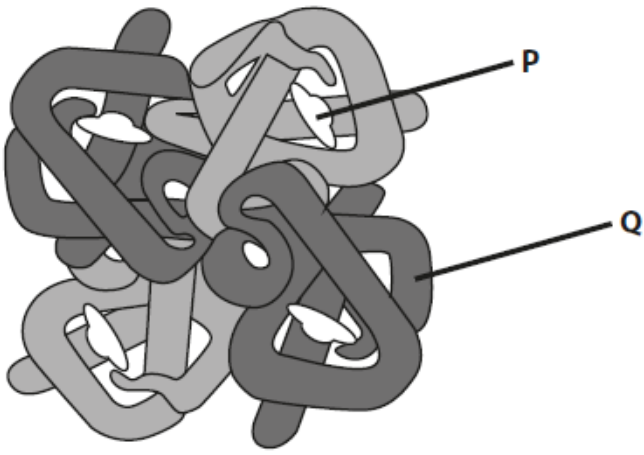
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(Total for question = 9 marks)

Q3.

The role of haemoglobin is to transport oxygen and carbon dioxide in the blood.

The diagram shows the structure of adult haemoglobin



(a) (i) State the role of the structure labelled **P**.

(1)

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(ii) Explain the properties of amino acids located on the outer surface of the haemoglobin, for example at position **Q**.

(2)

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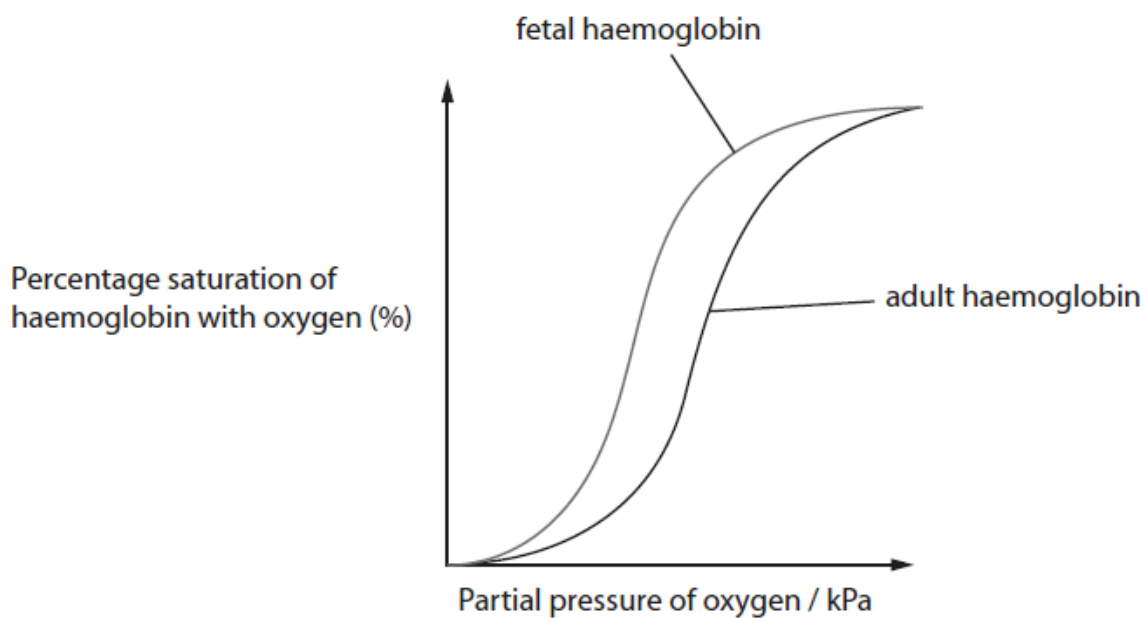
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(b) The graph shows the oxygen dissociation curves of adult and fetal haemoglobin.



(i) Explain why the oxygen dissociation curve of adult haemoglobin is different from that of fetal haemoglobin.

(2)

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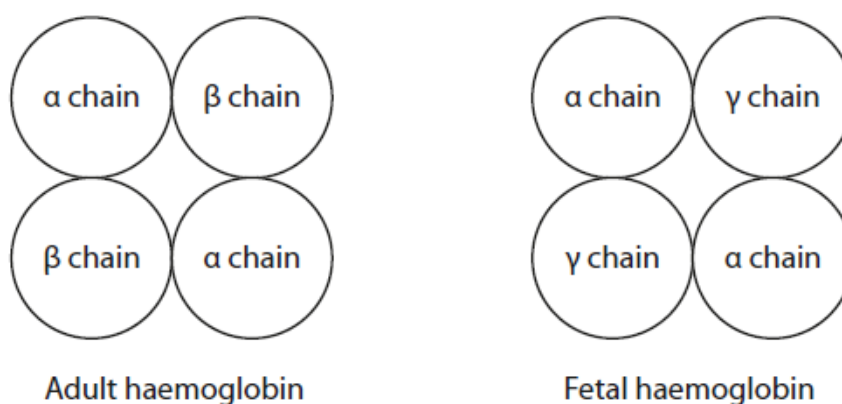
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(ii) The structures of adult and fetal haemoglobin are different.

The diagram shows the structure of adult and fetal haemoglobin.



The table shows the number of amino acids in each type of chain.

Type of chain	Number of amino acids
α	141
β	146
γ	146

The amino acids in the α chains are the same in adult and fetal haemoglobin.
The β and γ chains differ in 39 of their amino acids.

Calculate the percentage of amino acids that are different in adult and fetal haemoglobin.

(2)

Answer %

(Total for question = 7 marks)

Q4.

Carbohydrates are one of the main types of nutrient. They include polysaccharides, disaccharides and monosaccharides.

(a) (i) Which formula is correct for a monosaccharide?

(1)

- ☐ **A** $C_nH_nO_{2n}$
- ☐ **B** $C_nH_{2n}O_n$
- ☐ **C** $C_{2n}H_nO_n$
- ☐ **D** $C_{2n}H_{2n}O_n$

(ii) Name the reaction that joins two monosaccharides together to form a disaccharide.

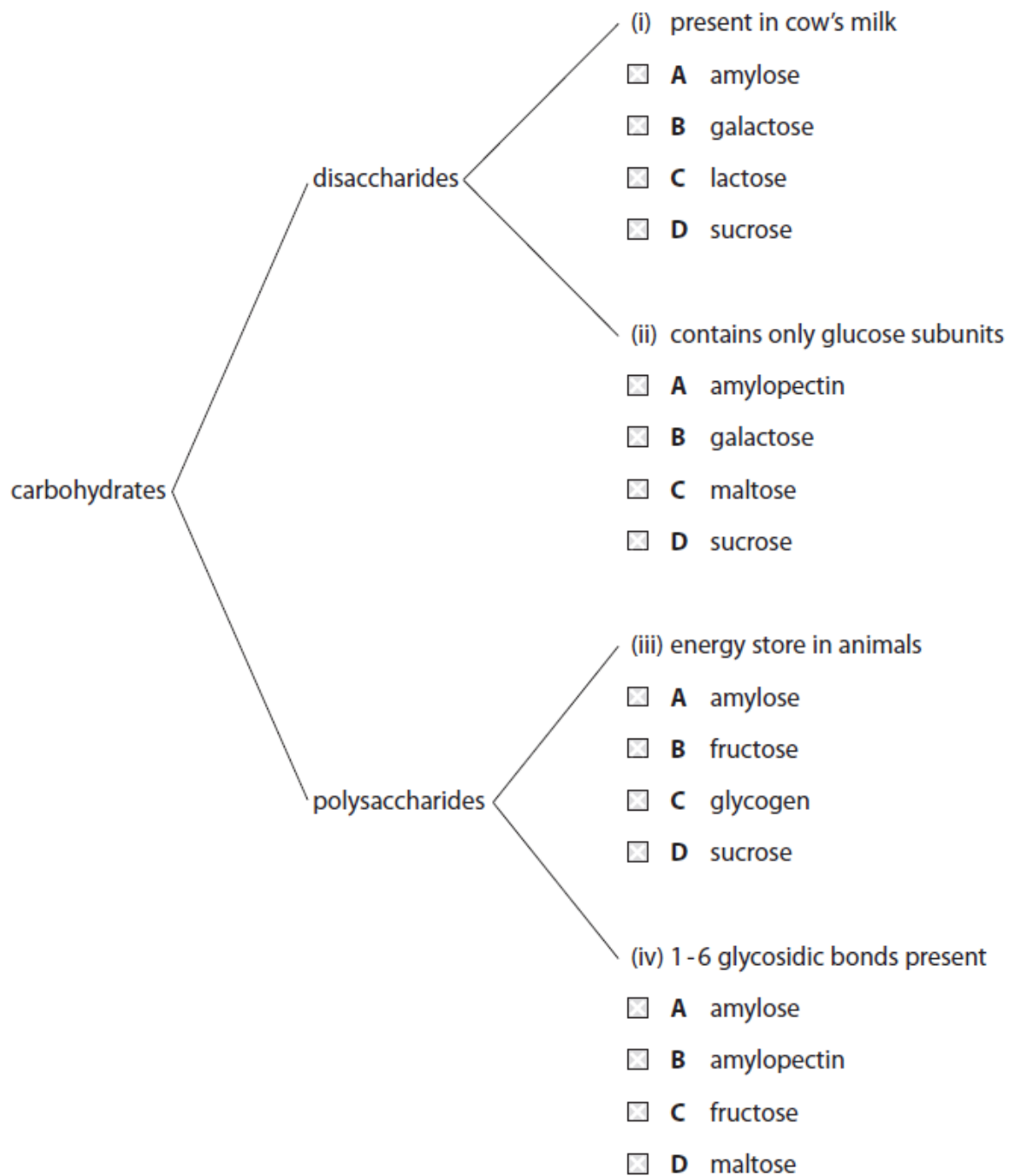
(1)

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(b) The diagram shows some information about carbohydrates.

Which carbohydrate is being described in each of (i) to (iv)?

(4)



(Total for question = 6 marks)

Q5.

The diagram shows a coronary heart disease (CHD) risk calculator.

Coronary Heart Disease Risk Calculator

Sex:
 Ethnicity:
 Age:
 Total Cholesterol: mg/dL
 HDL Cholesterol: mg/dL
 Systolic BP: mmHg
 Patient taking blood pressure medication: ☒
 Patient has diabetes: ☒
 Patient smokes: ☐

10 Year CHD Risk: 6.62%
Calculate

(a) Which of the following is a medication to control blood pressure?

(1)

- ☒ **A** anticoagulant
- ☒ **B** antihypertensive
- ☒ **C** platelet inhibitor
- ☒ **D** statin

(b) Explain why the risk calculator takes into account total cholesterol and HDL cholesterol levels.

(2)

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(c) Explain why the 10 Year CHD Risk would change if this person ticked the box next to the 'Patient smokes' on the risk calculator.

(3)

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(d) (i) State one other factor that the risk calculator should include to improve the accuracy of the value for the 10 Year CHD Risk.

(1)

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(ii) Predict the effect that taking this factor into account would have on the value for the 10 Year CHD Risk.

(1)

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(iii) A person used this risk calculator.

Explain why the value obtained for the 10 Year CHD Risk may be an underestimate.

(2)

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(Total for question = 10 marks)

Q6.

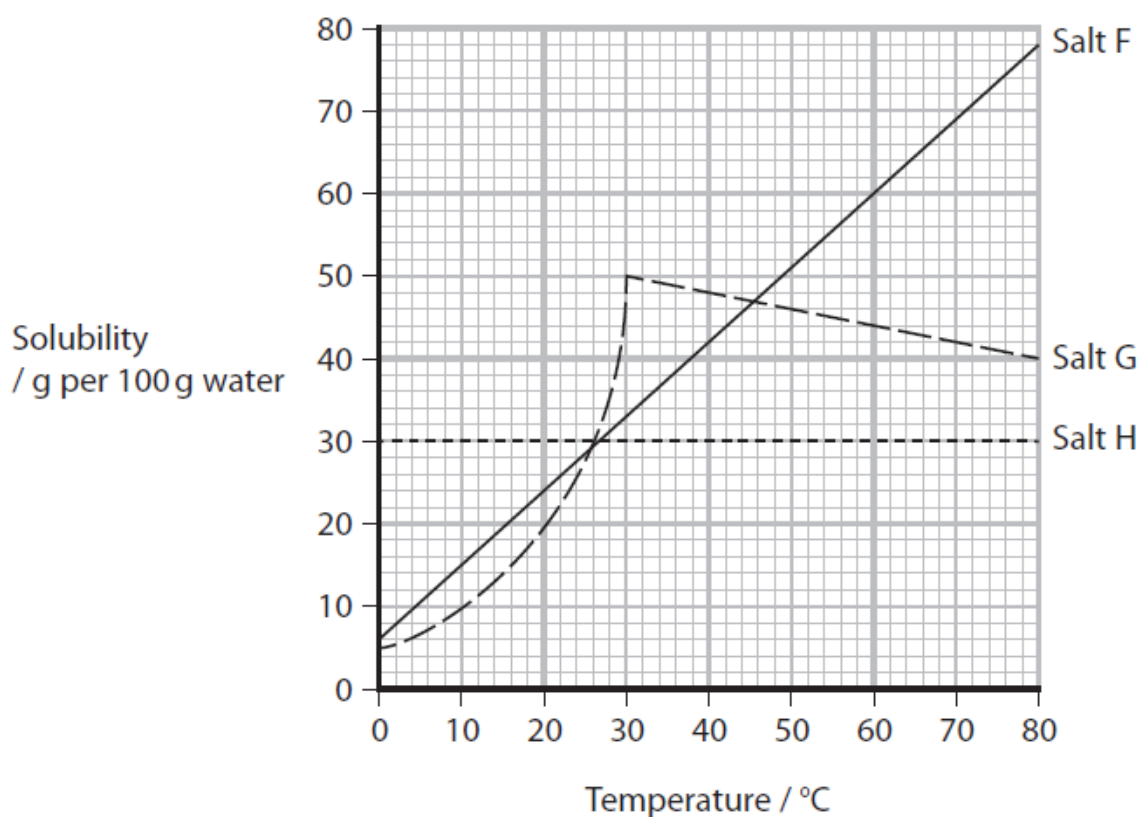
Answer the question with a cross in the box you think is correct ☐. If you change your mind about an answer, put a line through the box ☐ and then mark your new answer with a cross ☐.

Water is important as a solvent for transport in living organisms.

(a) Draw a diagram of a water molecule to show its dipole nature.

(2)

(b) The graph shows the effect of temperature on the solubility in water of three salts, F, G and H, in the human diet.



(i) Describe the effect of temperature on the solubility of these three salts.

(3)

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(ii) How many times more soluble is salt G than salt H at 30 °C?

(1)

☐ **A** 15.00

☐ **B** 1.67

☐ **C** 1.50

☐ **D** 0.60

(Total for question = 6 marks)

Q7.

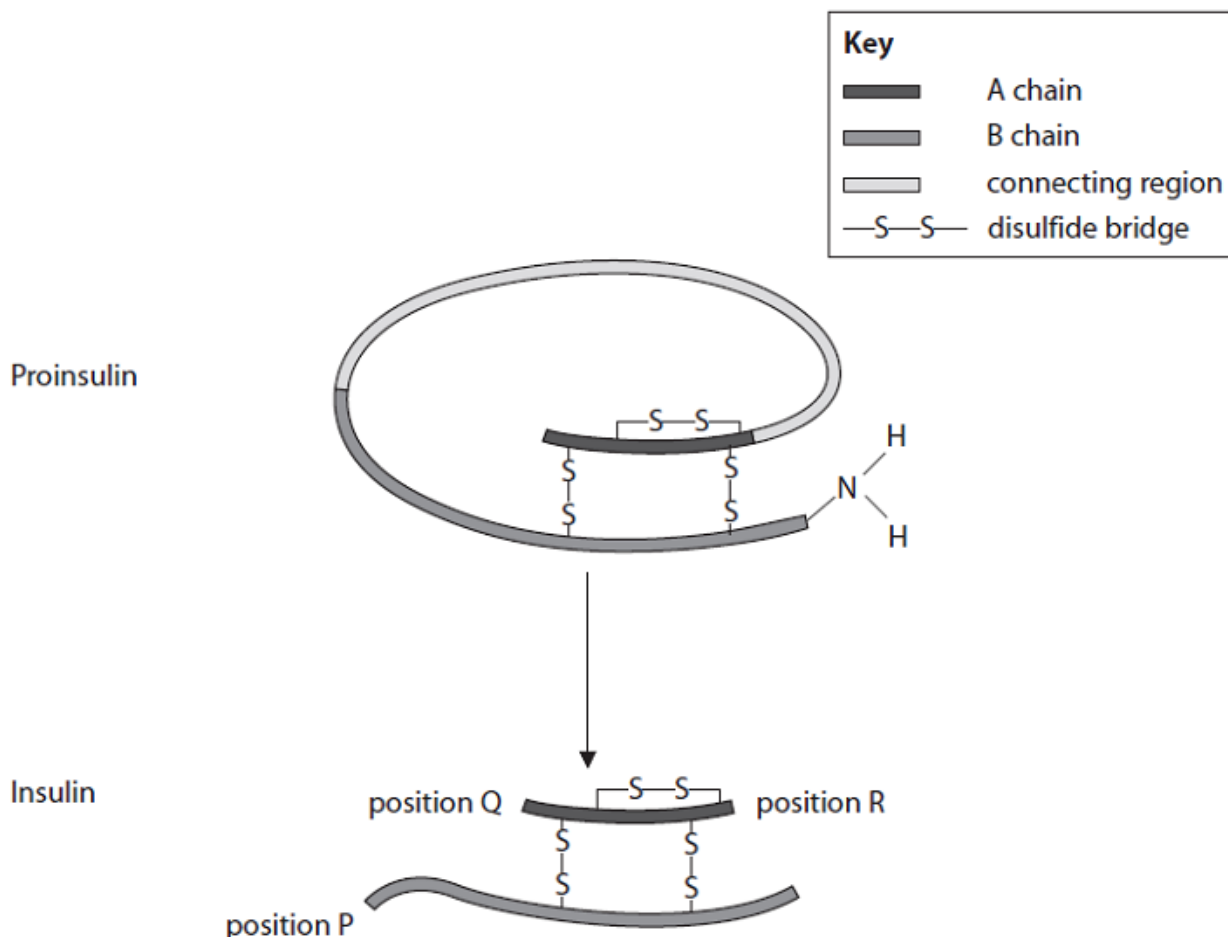
Answer the question with a cross in the box you think is correct ☐. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☐.

Insulin is a small protein composed of two peptide chains, the A chain and the B chain.

Insulin is made from the protein proinsulin.

Proinsulin is composed of the A chain and the B chain joined by a sequence of amino acids called the connecting region.

The diagram shows how insulin is formed from proinsulin.



(a) The connecting region is removed from proinsulin, leaving the A chain connected to the B chain by disulfide bridges (—S—S—).

Which row of the table shows the position of an amino group (NH₂) and a carboxyl group (COOH)?

(1)

	Amino group	Carboxyl group
☒ A	position R	position P
☒ B	position P	position R
☒ C	position Q	position R
☒ D	position Q	position P

(b) Proinsulin is composed of 84 amino acids.

Insulin is composed of 51 amino acids.

(i) What percentage of proinsulin is the connecting region?

(1)

Answer %

(ii) There are three disulfide bridges in insulin. Each disulfide bridge is formed between the R groups of two cysteine amino acids.

Give the ratio of amino acids forming disulfide bridges in insulin to those not forming disulfide bridges in insulin.

(1)

Answer

(c) Suggest how insulin is synthesised from proinsulin.

Use the information in the diagram to support your answer.

(2)

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(d) Insulin lowers the levels of glucose in the blood. This glucose is taken up by the liver and stored as glycogen.

Compare and contrast the structure of glucose with the structure of glycogen.

(3)

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*(e) Type 2 diabetes is a disorder that can result from ineffective or insufficient insulin. It is a risk factor for cardiovascular disease (CVD).

Cinnamon is a spice that has been shown to:

- increase the uptake of glucose from the blood into the liver

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(Total for question = 14 marks)

Q8.

Genetic screening can be used to test for aneuploidy.

Aneuploidy is the presence of an abnormal number of chromosomes in a cell.

Aneuploidy can affect the miscarriage rate of implanted embryos.

Following screening, only embryos with the correct number of chromosomes are implanted into the female.

The table shows the miscarriage rate of two groups of implanted embryos:

- embryos not screened for aneuploidy
- embryos screened and shown not to have aneuploidy.

Age range of women at implantation / years	Miscarriage rate (%)	
	Implanted embryos not screened for aneuploidy	Implanted embryos screened and shown not to have aneuploidy
<35	12.0	11.2
35 to 37	16.8	13.0
38 to 40	25.0	13.6
41 to 42	37.9	16.3
>42	58.8	17.2

(a) Explain how this data shows that there is a correlation between the age of the women and the miscarriage rate.

(2)

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(b) (i) Explain the conclusions that can be made from these data about the causes of miscarriage.

(2)

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(ii) Explain why conclusions made using these data may not be valid.

(3)

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(c) Discuss the implications of screening embryos for aneuploidy before implantation.

(3)

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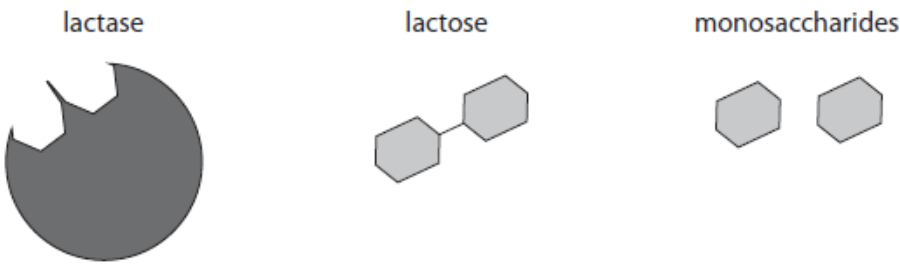
(Total for question = 10 marks)

Q9.

Answer the question with a cross in the boxes you think are correct ☐. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☐.

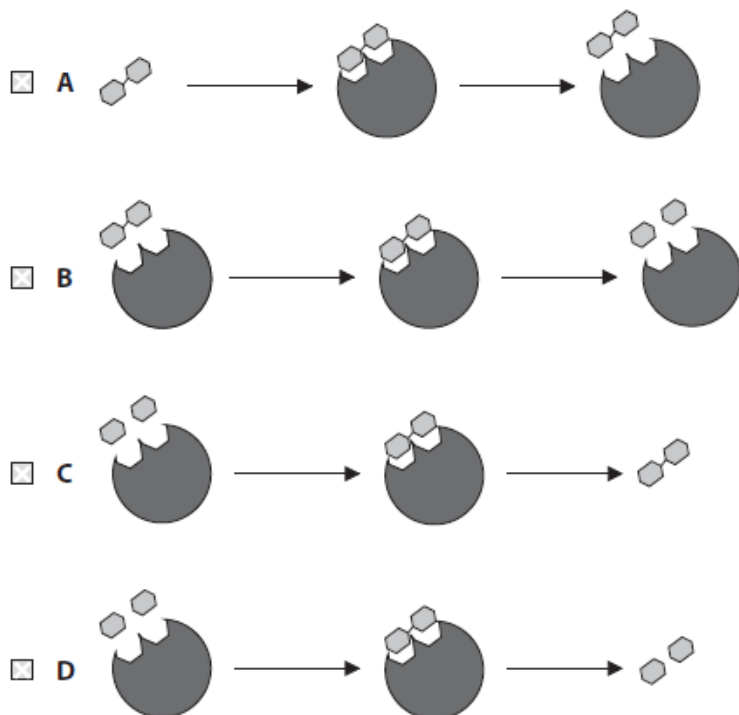
Lactase is an enzyme that catalyses the hydrolysis of lactose.

(a) (i) The diagrams show symbols for lactase, lactose and the monosaccharides of lactose.



Which diagram shows the sequence of events for the hydrolysis of lactose?

(1)

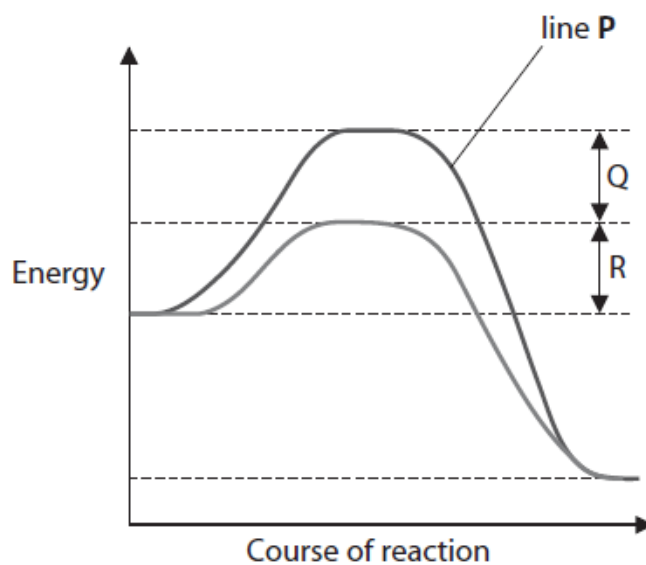


(ii) Which of the following are the monosaccharides present in lactose?

(1)

- ☐ **A** fructose and sucrose
- ☐ **B** galactose and glucose
- ☐ **C** glucose and fructose
- ☐ **D** sucrose and galactose

(b) The graph shows the energy changes for the hydrolysis of lactose, with and without lactase.

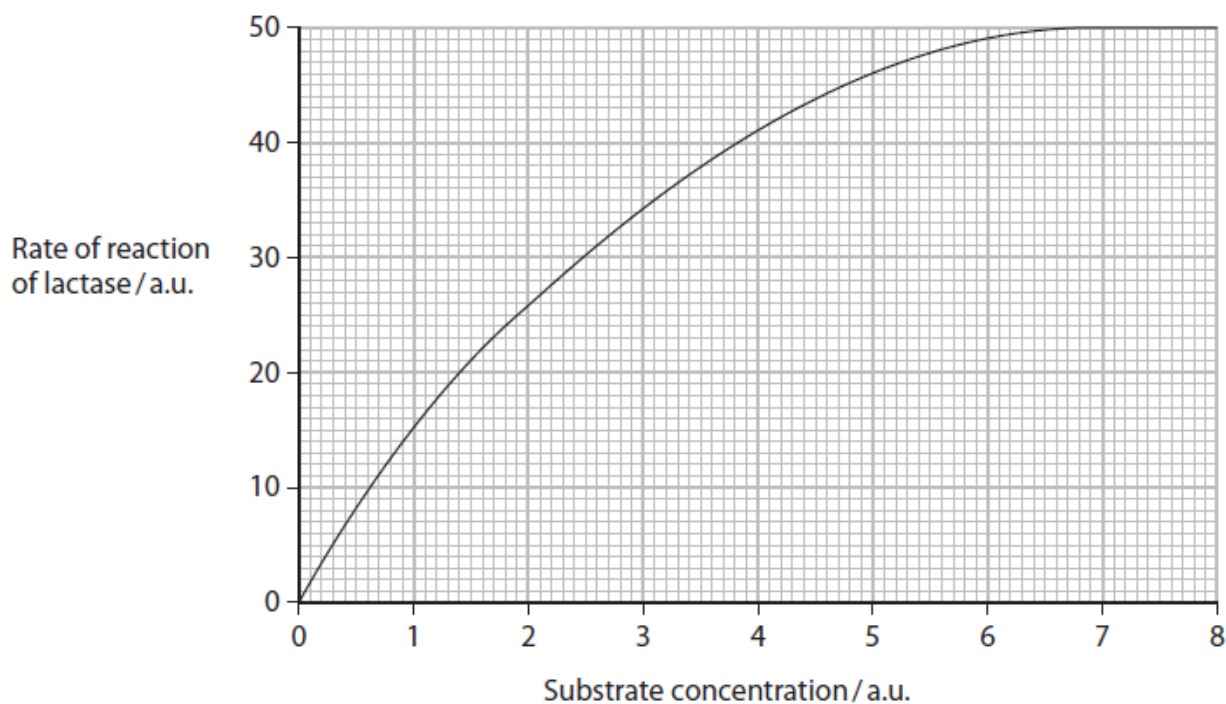


Which row in the table describes line **P** and identifies the letter that shows the decrease in activation energy due to lactase?

(1)

	Line P	Decrease in activation energy due to lactase
☐ A	reaction with enzyme	Q
☐ B	reaction with enzyme	R
☐ C	reaction without enzyme	Q
☐ D	reaction without enzyme	R

(c) The graph shows the relationship between substrate concentration and the rate of reaction of lactase.



(i) Explain why substrate concentration affects the rate of reaction.

(2)

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(ii) The reaction rate (V) at each substrate concentration can be calculated using the formula

$$V = \frac{V_{\max} \times S}{K + S}$$

$V_{\max}$ is the maximum rate of reaction

K is the substrate concentration when the rate of reaction is half the rate of $V^{\max}$

S is the substrate concentration.

Calculate the reaction rate (V) at a substrate concentration of 4 a.u.

(2)

Answer

(Total for question = 7 marks)

Q10.

Answer the question with a cross in the box you think is correct ☒ . If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒ .

People with lactose intolerance cannot digest lactose.

Lactose intolerance is due to a lack of the enzyme lactase.

(a) (i) Which are the products of lactose digestion?

(1)

- ☐ **A** fructose and galactose
- ☐ **B** fructose and glucose
- ☐ **C** galactose and glucose
- ☐ **D** glucose and glucose

(ii) Explain how the three-dimensional structure of lactase affects the mechanism of action of this enzyme.

(3)

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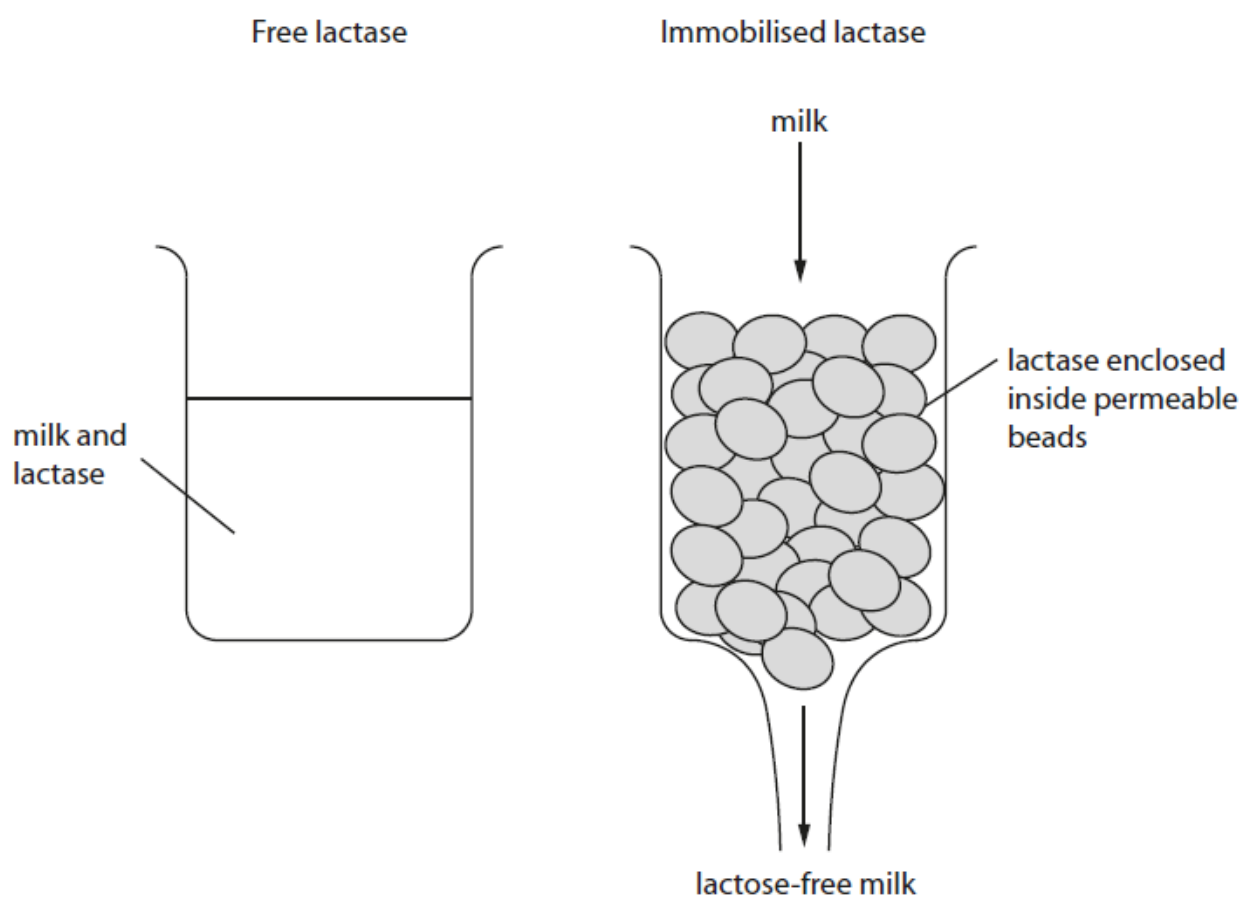
(b) People with lactose intolerance can drink lactose-free milk.

Lactose-free milk is produced by treating milk with lactase.

There are two ways of removing lactose from milk:

- mixing a solution of lactase with the milk (free lactase)
- enclosing the lactase inside permeable beads and pouring the milk over them (immobilised lactase).

The diagrams show these two methods.



(i) Suggest **one** advantage of using immobilised lactase.

(1)

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(ii) The table shows the effect of pH on the activity of free lactase and immobilised lactase.

pH	Activity of free lactase / a.u.	Activity of immobilised lactase / a.u.
2	0	0
3	0	38
4	75	75
5	94	98
6	63	76
7	56	63
8	28	35

Explain the effects of pH on the activity of these two enzymes.

(4)

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(iii) Suggest how the rate of activity of the lactase could be measured.

Include appropriate units in your answer.

(2)

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(c) Congenital lactose intolerance (CLI) is an extremely rare genetic disorder.

Most people with CLI are found in one country.

Suggest why most people with CLI are found in one country.

(2)

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(Total for question = 13 marks)

Q11.

Lipids and carbohydrates can be used as energy storage molecules.

(a) Lactose is an important energy source in milk.

(i) What type of chemical reaction is involved in breaking a lactose molecule into two monosaccharides?

(1)

- ☐ **A** condensation
- ☐ **B** esterification
- ☐ **C** hydrogen bonding
- ☐ **D** hydrolysis

(ii) Milk contains 4.9 g of lactose per 100 g of milk.

Each gram of lactose provides 16 kJ of energy.

Calculate the energy available from the lactose in 200 g of milk.

(1)

Answer kJ

(b) Carbohydrates used as energy storage molecules include glycogen and starch.

Compare and contrast the structures of glycogen and starch.

(4)

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(c) (i) State one difference between the structure of a saturated lipid and an unsaturated lipid.

(1)

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(ii) Describe how a triglyceride is synthesised.

(3)

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(Total for question = 10 marks)

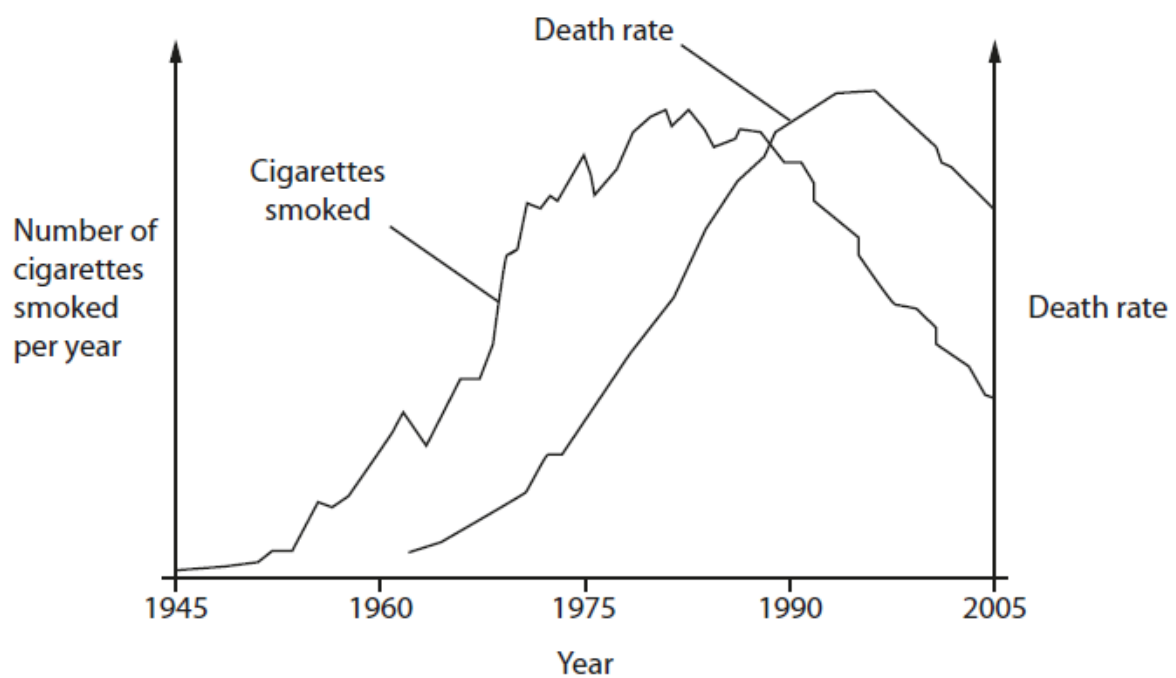
Q12.

Gas exchange surfaces have specific adaptations.

(a) Lungs contain the gas exchange surfaces of humans.

Smoking causes lung damage.

(i) The graph shows that there is a correlation between smoking and death rate from lung cancer in men.



Explain how this graph shows that there is a correlation between smoking and death rate from lung cancer in men.

(2)

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(ii) Smoking is a cause of emphysema.

People with emphysema have weakened alveoli that can collapse, creating fewer but larger alveoli.

Explain how this will affect gas exchange in people with emphysema.

(2)

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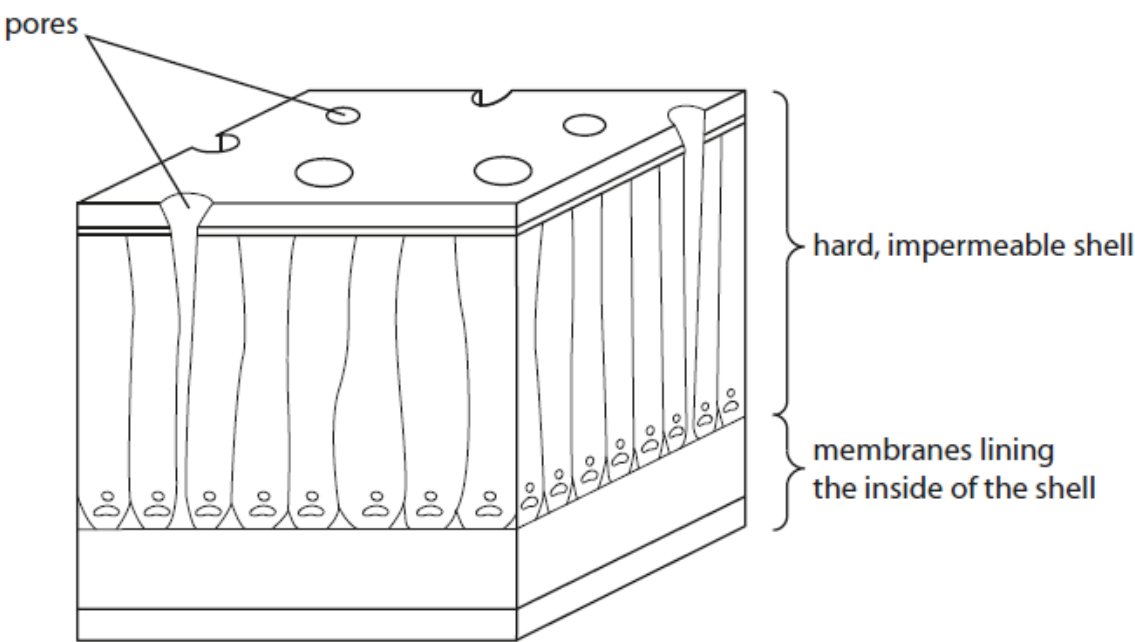
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(b) Bird embryos develop inside hard-shelled eggs.

Gas exchange occurs across the shell of the egg. The oxygen diffuses into the bloodstream of the developing embryo and carbon dioxide diffuses back out.

The diagram shows a section through the shell of an egg.



The thickness of the egg shell is 0.5 mm. The density of the pores in the shell varies from 40 to 400 per cm².

Explain the factors that would determine the rate of diffusion of gases between the air and the tissues of the embryo.

Use the information in the diagram, the question and your own knowledge to support your answer.

(6)

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(Total for question = 10 marks)

Q13.

Obesity increases the risk of cardiovascular disease (CVD).

One way to reduce obesity is to lose weight by changing eating habits.

(a) Name **two** obesity indicators used by scientists.

(1)

1

2

(b) Glucomannan is a dietary supplement claimed to aid weight loss.

Glucomannan is a branched polysaccharide similar in structure to amylopectin.

(i) Which glycosidic bonds are responsible for the branching in glucomannan?

(1)

☐ **A** 1-4 only

☐ **B** 1-6 only

☐ **C** both 1-4 and 1-6

☐ **D** neither 1-4 nor 1-6

(ii) In the presence of water, glucomannan swells to form a semi-solid gel.

The diagram shows a stomach with glucomannan present and a stomach without glucomannan.



Suggest how glucomannan aids weight loss.

(1)

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(iii) If glucomannan could be digested it would cause a gain in weight.

Explain why glucomannan could cause a gain in weight.

(2)

(c) A study compared weight loss in two groups of women.

One group of women had a low-fat diet and the other group of women had a very low-carbohydrate diet.

(i) The table shows the results of this study.

Number of weeks on the diet	Mean body mass of the group of women / kg	
	Group on the low-fat diet	Group on the very low-carbohydrate diet
0	92.5	91.1
2	90.6	88.3
4	89.9	87.5
6	89.0	85.6
8	88.8	84.5
10	88.3	84.1
12	88.2	83.0

Many studies claim that a low-carbohydrate diet can result in two to three times as much weight loss as a low-fat diet.

Determine the extent to which this study supports this claim.

(3)

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(ii) Very low-carbohydrate diets may increase cardiovascular risk factors.

Give **two** factors, other than weight loss, that should have been monitored in this study.

(2)

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2

(Total for question = 10 marks)

Q14.

Answer the questions with a cross in the boxes you think are correct ☒. If you change your mind about an answer, put a line through the box ~~☒~~ and then mark your new answer with a cross ☒.

(a) (i) Which row of the table shows which of these sugars are monosaccharides and which are disaccharides?

(1)

	Monosaccharides	Disaccharides
☒ A	fructose only	glucose and sucrose
☒ B	glucose only	fructose and sucrose
☒ C	fructose and glucose	sucrose only
☒ D	glucose and sucrose	fructose only

(ii) Which type of bond joins two monosaccharides together to form a disaccharide?

(1)

☒ A ester

- ☒ **B** glycosidic
- ☒ **C** peptide
- ☒ **D** phosphodiester

(b) The table shows the concentration of these sugars in three pineapples.

Sugar	Concentration of sugar / g cm ⁻³		
	Pineapple 1	Pineapple 2	Pineapple 3
fructose	1.71	1.44	1.41
glucose	1.22	1.02	1.00
sucrose	9.08	7.77	8.81

(i) Calculate the mean concentration of glucose in these three pineapples.

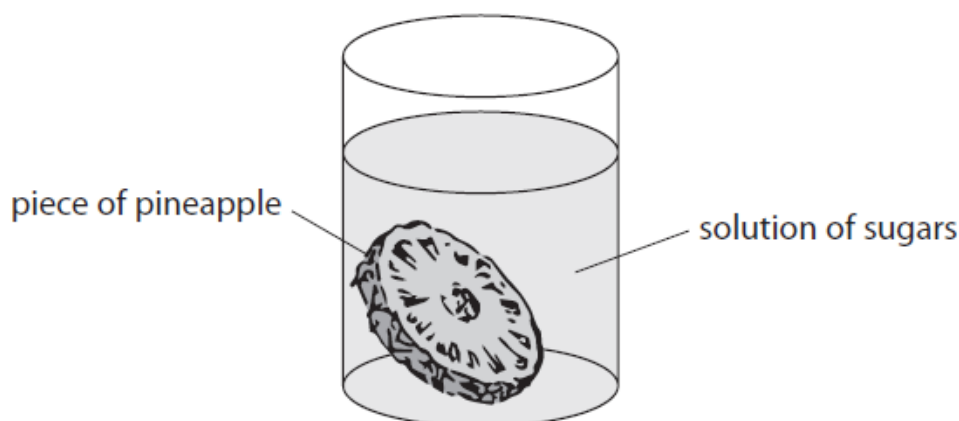
Give your answer in **g dm⁻³**.

(2)

Answer g dm⁻³

* (ii) Pineapples can be preserved by a process called osmotic dehydration in which pieces of pineapple are submerged in a solution of sugars.

The diagram shows how this process can be carried out.



Osmotic dehydration helps to preserve the pineapple by reducing the water content.

Osmotic dehydration also ensures that the concentration of each sugar in the pineapple does not change. This preserves the sweet taste of the pineapple.

Explain what the solution of sugars should contain to preserve pineapples. Use the information in the table to support your answer.

(6)

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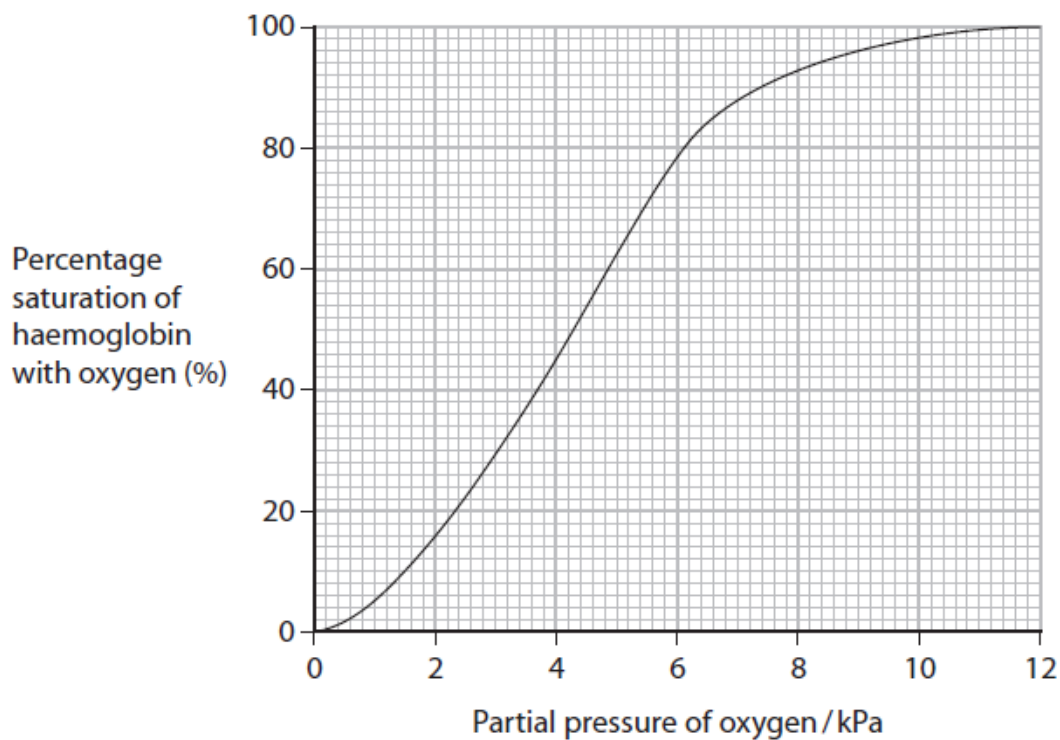
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(Total for question = 10 marks)

Q15.

One role of haemoglobin is to transport oxygen.

The graph shows an oxygen dissociation curve of haemoglobin.



(a) (i) State what is meant by the term partial pressure.

(1)

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(ii) Explain how the structure of haemoglobin causes the oxygen dissociation curve of haemoglobin to be this sigmoidal (S) shape.

(3)

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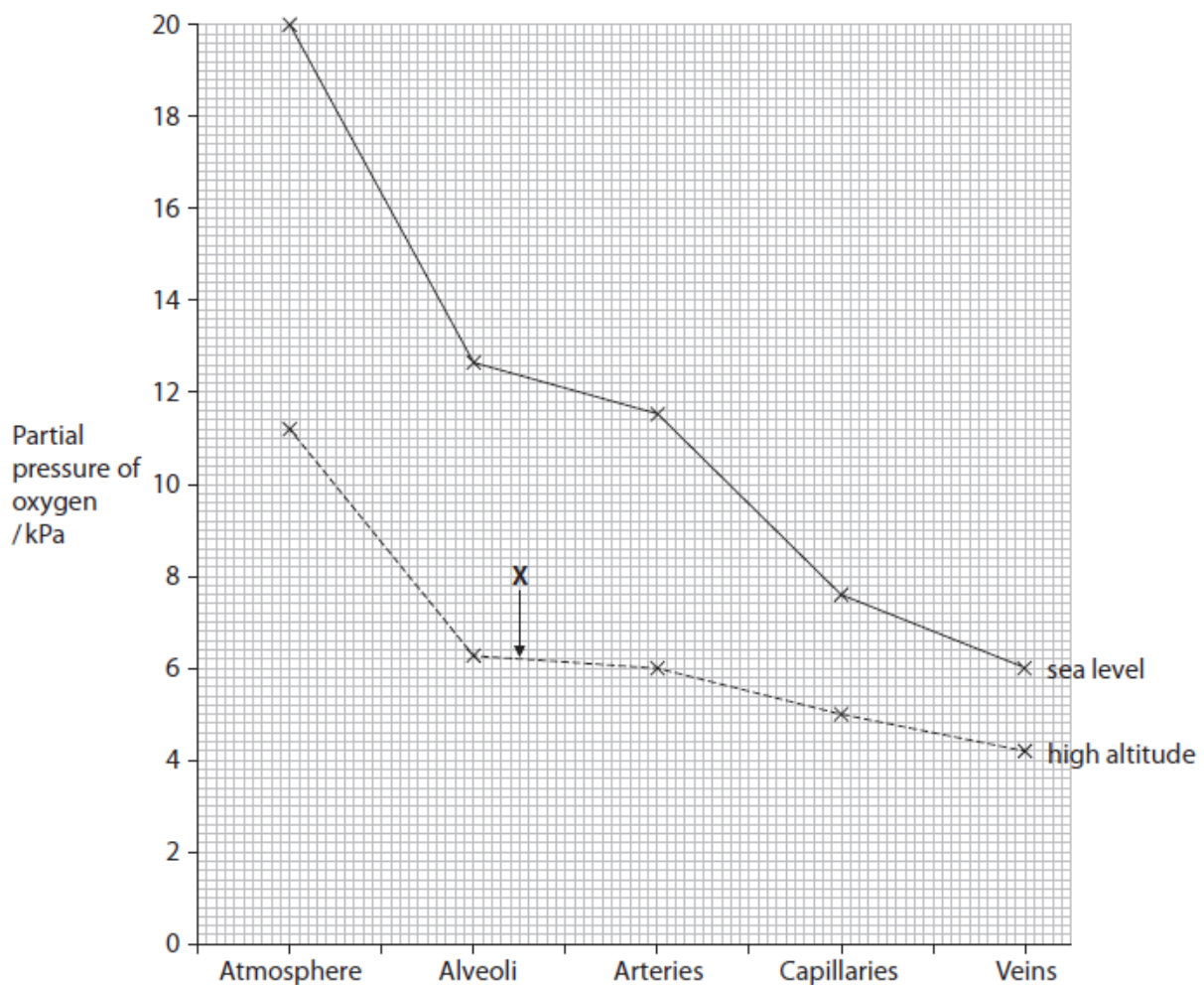
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(b) The oxygen cascade describes the differences in the partial pressure of oxygen between different blood vessels and the external atmosphere.

The graph shows the partial pressures of oxygen for a person at sea level and a person at high altitude.



(i) Suggest why the partial pressure of oxygen in the air in the alveoli is lower than in the atmosphere.

(1)

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(ii) Explain why the partial pressure of oxygen decreases as the blood flows through the arteries and into the veins.

(3)

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(iii) Determine the percentage saturation of haemoglobin in the blood as it leaves the lungs of the person at high altitude.

Use the point marked **X** on the graph and the oxygen dissociation curve of haemoglobin.

(1)

Answer %

(iv) Explain why the percentage saturation of haemoglobin in a person at high altitude is much lower than in a person at sea level.

(4)

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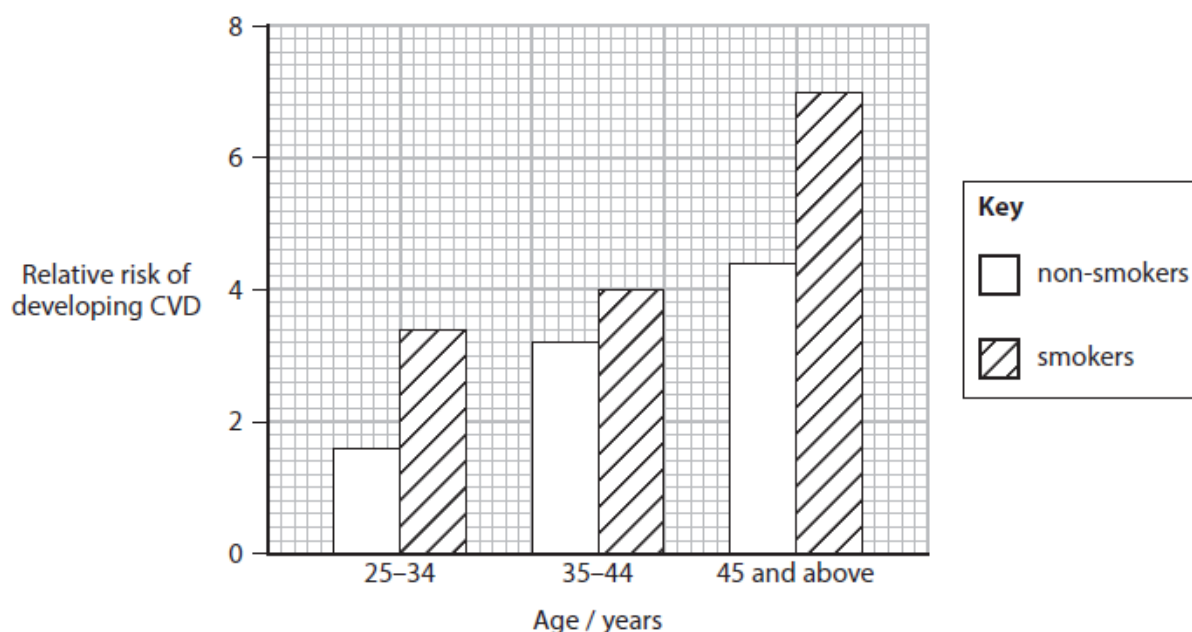
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(Total for question = 13 marks)

Q16.

The graph shows the relative risk of developing cardiovascular disease (CVD) for non-smokers and for smokers.



(a) (i) Describe the conclusions that can be made about the risk factors for CVD.

Use the information in the graph to support your answer.

(2)

(ii) The information shown in this graph was collected more than 25 years ago.

Explain how this graph might appear if it showed data collected last year.

(2)

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(b) The number of people in the world who die from CVD each year is 17.7 million.

This is 31% of all total deaths.

How many deaths are there in the world each year?

(1)

- ☐ **A** 0.571×10^6
- ☐ **B** 5.71×10^6
- ☐ **C** 57.1×10^6
- ☐ **D** 571.00×10^6

(Total for question = 5 marks)

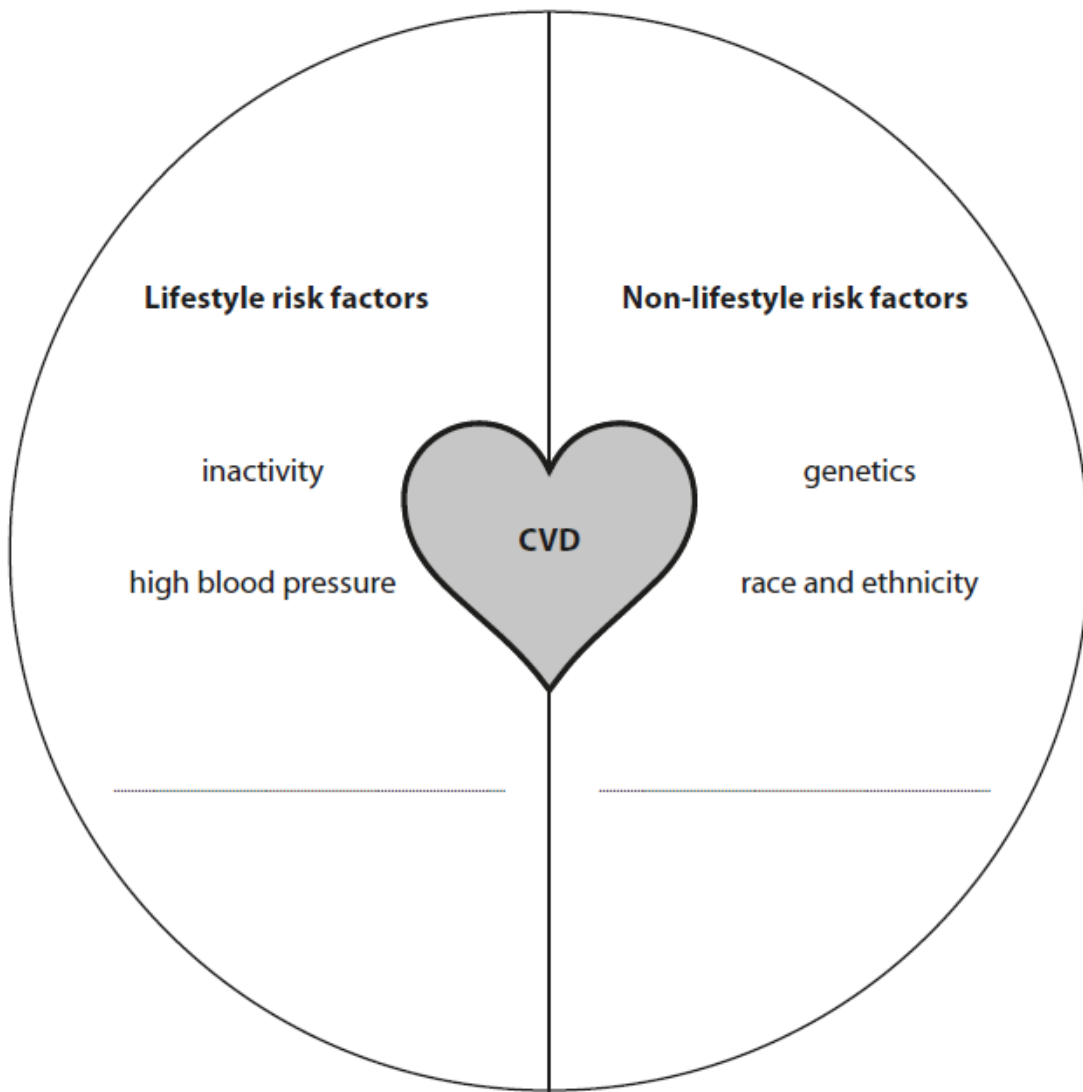
Q17.

Several factors increase the risk of cardiovascular disease (CVD).

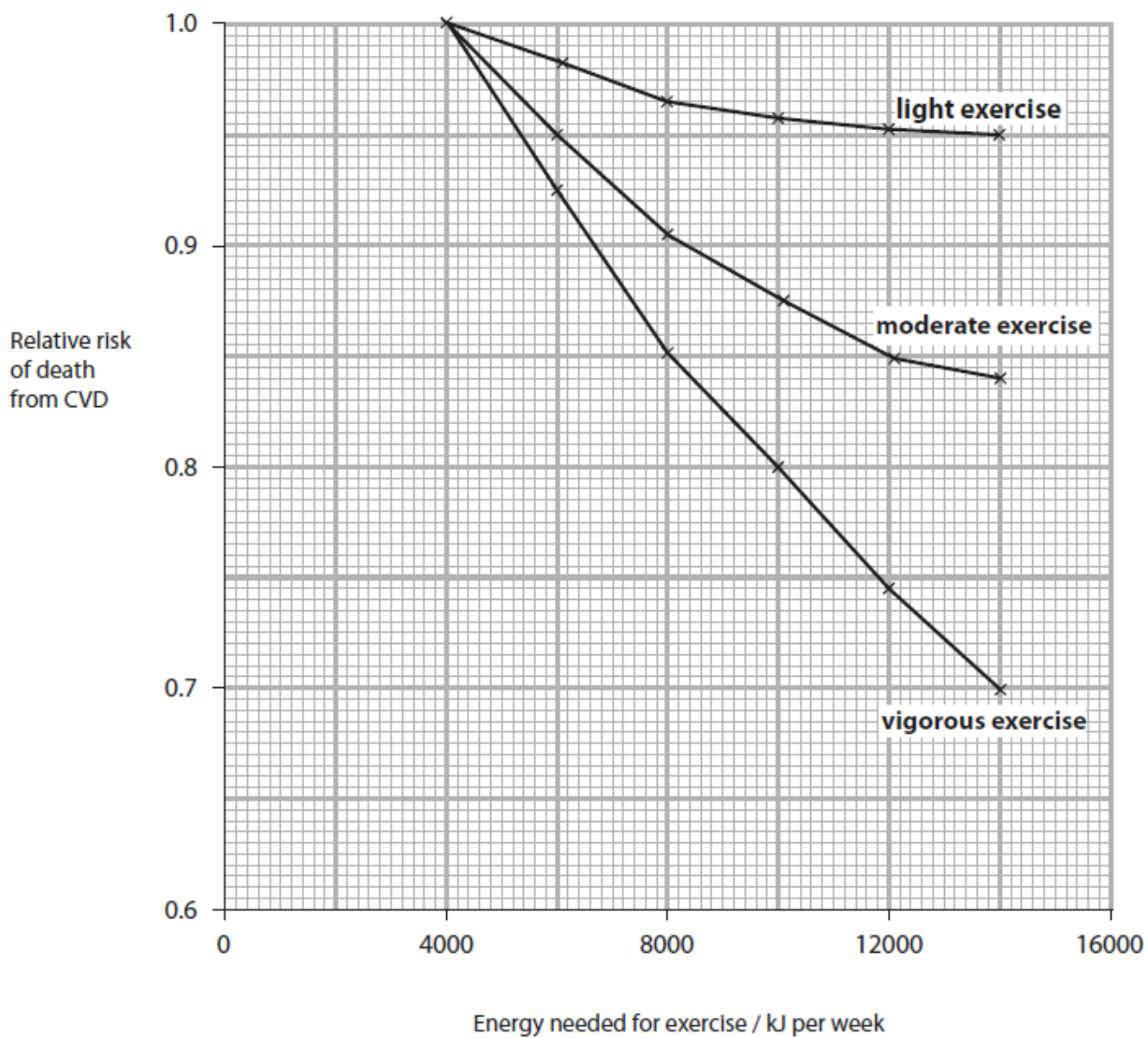
(a) The diagram shows some factors that increase the risk of CVD.

Complete the diagram with **one** lifestyle risk factor and **one** non-lifestyle risk factor.

(1)



(b) The graph shows the effect of exercise on the relative risk of death from CVD.



Describe the conclusions that can be made from the information shown in this graph.

(2)

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(c) Dietary antioxidants may reduce the risk of CVD.

(i) Explain how dietary antioxidants reduce the risk of CVD.

(3)

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(ii) Devise a study to confirm that antioxidants reduce the risk of CVD.

(3)

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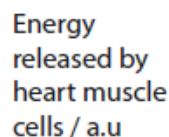
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*(d) The coronary artery may become completely blocked in people with CVD.

The graph shows how the energy released by heart muscle cells changes after the coronary artery becomes completely blocked.



The heart muscle cells begin to die 20 minutes after the coronary artery becomes completely blocked.

Use the information shown in the graph and your own knowledge to support your answer.

(6)

This image shows a single sheet of white paper with horizontal blue ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

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(Total for question = 15 marks)

Q18.

Sickle cell disease is caused by a gene mutation affecting the β -globin chain of haemoglobin.

(a) The mutation occurs in the seventh triplet code of this gene.

This mutation results in the amino acid Glu being replaced with the amino acid Val.

The table shows the sequence of bases in the first part of the DNA in a person who does not have sickle cell disease. It also shows the corresponding sequence of amino acids in the β -globin chain.

Position of triplet code	first	second	third	fourth	fifth	sixth	seventh	eighth	ninth
DNA	AUG	GUG	CAC	CUG	ACU	CCU	GAG	GAG	AAG
β -globin chain	(start)	Val	His	Leu	Thr	Pro	Glu	Glu	Lys

(i) Give the seventh triplet code in the gene for the β -globin chain in a person who has sickle cell disease.

(1)

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(ii) Name the type of mutation that causes sickle cell disease.

(1)

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(iii) The amino acid Glu is hydrophilic (polar) and the amino acid Val is hydrophobic (non-polar). Suggest why this mutation causes haemoglobin molecules to stick together.

(3)

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(b) In 2020, about 140 million babies were born in the world.

About 305 800 babies are born with sickle cell disease each year.

Estimate the ratio of babies born with the disease to babies not born with the disease.

(2)

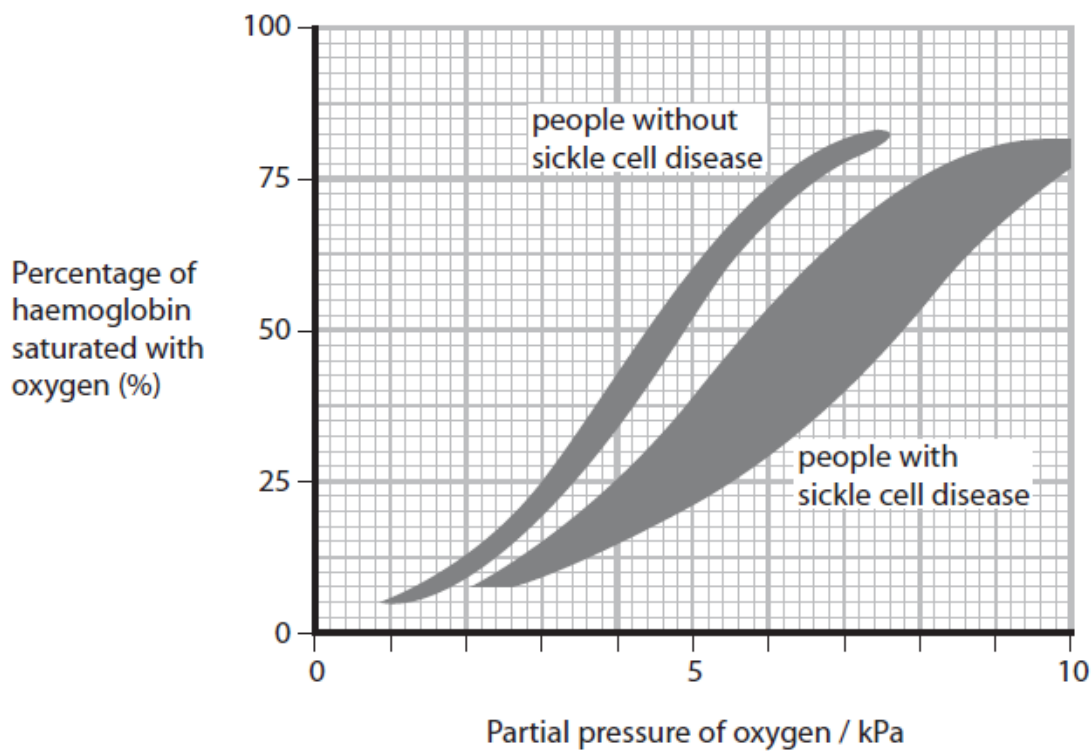
Answer

(c) The red blood cells in a person with sickle cell disease are sickle shaped and less elastic. They also have a shorter lifespan than healthy red blood cells.

These sickle shaped red blood cells cannot carry as much oxygen as healthy red blood cells and they get stuck in the capillaries.

The graph shows oxygen dissociation curves for groups of people with sickle cell disease and those without the disease.

The shaded areas represent the range of values for each group of people.



(i) A p50 value is the partial pressure of oxygen that results in 50% saturation of haemoglobin.

Calculate the largest difference in the p50 values between a person with sickle cell disease and a person without this disease.

Give your answer to an appropriate number of decimal places.

(2)

Answer kPa

(ii) Identify **two** conclusions, other than the difference in p50 values, that can be made from this graph.

(2)

Conclusion 1

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Conclusion 2

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(iii) The lifespan of a red blood cell in a person with sickle cell disease is 11 days.

This is 9.17% of the lifespan of a healthy red blood cell.

Calculate the lifespan of a healthy red blood cell.

Give your answer to the nearest day.

(1)

Answer days

(iv) Sickle cell disease can result in death.

Explain why the changes in the structure of haemoglobin and the shape of the red blood cells could result in death in a person with sickle cell disease.

(3)

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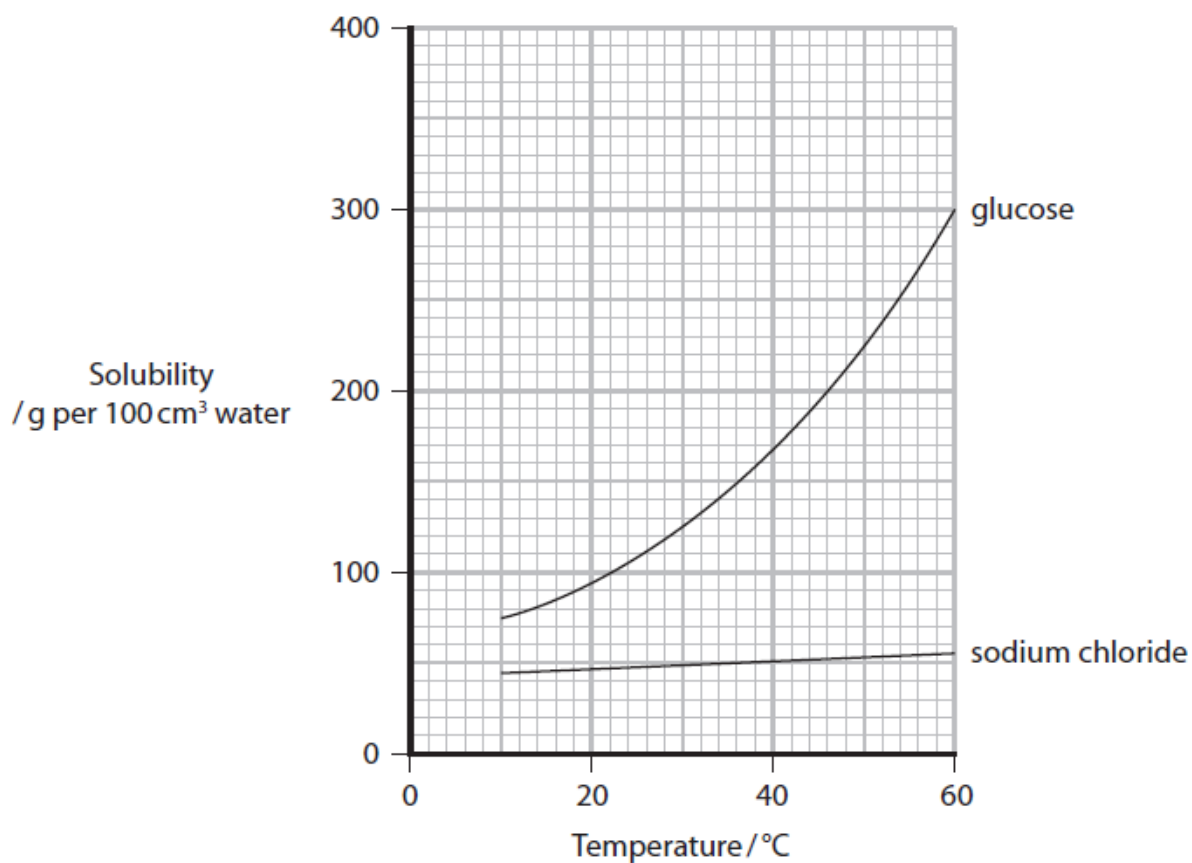
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(Total for question = 15 marks)

Q19.

Water is the solvent for the transport of sodium chloride and glucose in the blood.

(a) The graph shows the effect of temperature on the solubility of sodium chloride and glucose in water.



(i) Compare and contrast the effect of temperature on the solubilities of sodium chloride and glucose in water.

(3)

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(ii) The formula mass of sodium chloride is 58.44.

Calculate the molecular mass of glucose, using the information in the table.

(2)

Element	Atomic mass
carbon	12
hydrogen	1
oxygen	16

Answer

(iii) Calculate how many times greater the molecular mass of glucose is than the formula mass of sodium chloride.

(1)

Answer

(iv) Suggest why there is a difference in the solubility of sodium chloride and glucose in water.

(2)

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(b) Explain why fatty acids are less soluble in blood than glucose and sodium chloride.

(2)

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(Total for question = 10 marks)

Q20.

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 ☐.

The photograph shows a saffron crocus plant.



(Source: © NatureOnline / Alamy Stock Photo)

(a) This plant grows from a bulb.

The bulb contains starch as an energy storage molecule for the crocus.

How many of the following statements are correct for starch in living cells?

- starch consists of a mixture of two types of polysaccharide
- starch contains only 1-6 bonds
- starch is insoluble in water

(1)

☒ **A** none

☐ **B** one

☐ **C** two

☐ **D** three

(b) Saffron is a spice that is derived from parts of the flower of the saffron crocus.

Saffron contains a disaccharide called gentiobiose.

(i) Read through the following description of some disaccharides.

Complete the description by writing the most appropriate word on the dotted lines.

(4)

Disaccharides consist of two monosaccharides joined together by a covalent bond.

Sucrose and lactose are both disaccharides. They both contain a molecule of Sucrose also contains one molecule of and lactose also contains one molecule of

(ii) Gentiobiose is formed from two identical monosaccharides.

Name the type of reaction that joins these monosaccharides together in the formation of gentiobiose.

(1)

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(iii) The molecular mass of each of the monosaccharides in gentiobiose is 180.

The table shows the molecular mass of the elements present in the monosaccharides.

Element	Molecular mass
carbon	12
hydrogen	1
oxygen	16

Which is the molecular mass of gentiobiose?

(1)

☐ **A** 144

☐ **B** 162

☐ **C** 342

☐ **D** 360

(Total for question = 7 marks)

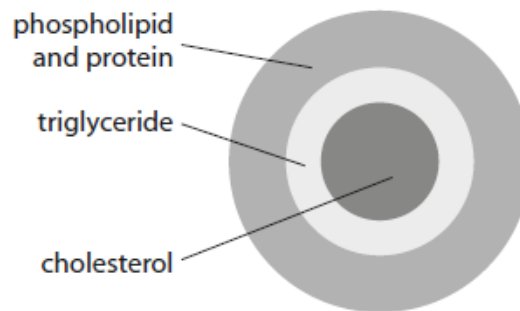
Q21.

Low-density lipoproteins (LDLs) transport lipids around the body in the blood.

Low-density lipoproteins can result in the development of atherosclerosis.

They can be absorbed into the endothelial cells lining arteries and broken down by free radicals.

The diagram shows a low-density lipoprotein containing cholesterol.



(a) Compare and contrast the structure of a triglyceride and a phospholipid.

(3)

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(b) Explain why the properties of LDLs enable cholesterol to be transported in the blood.

(3)

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(c) The diameters of LDLs range from 19 nm to 24 nm.

The table shows some information about LDLs.

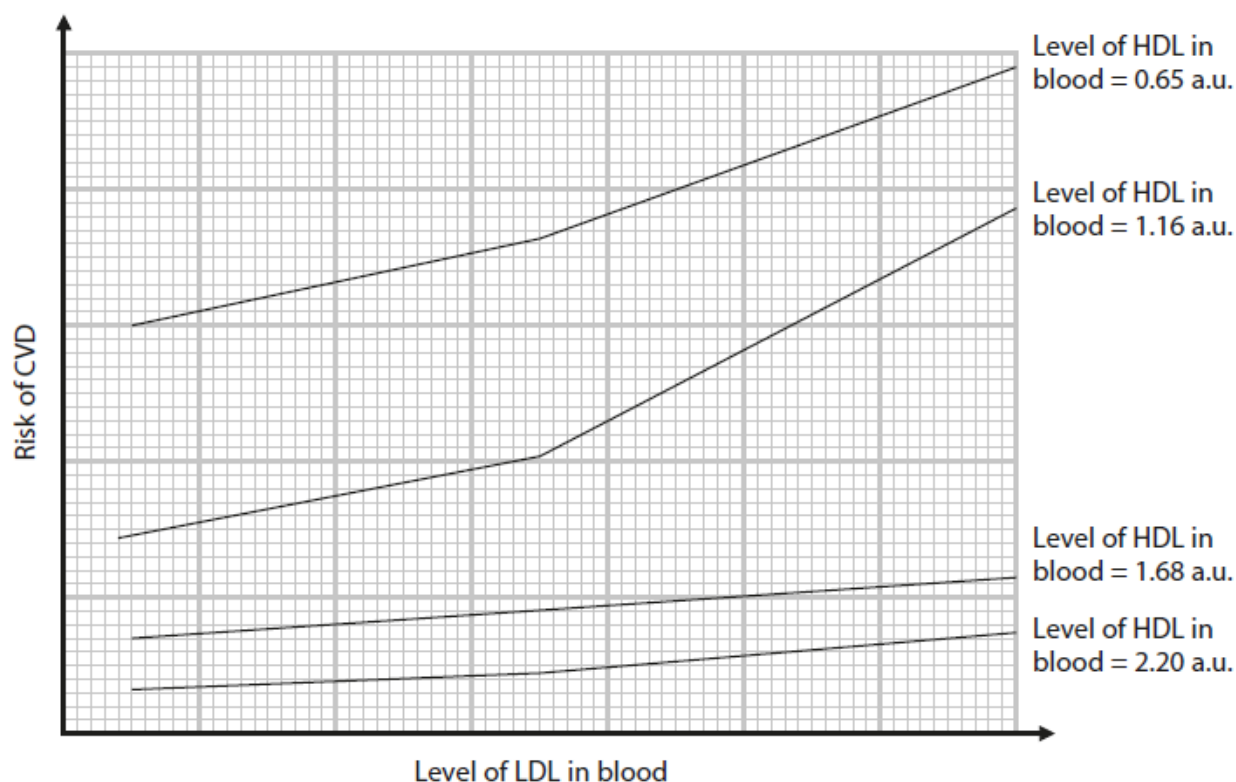
Diameter of LDL / nm	Volume of LDL / nm ³	Volume of cholesterol / nm ³	Ratio of LDL volume to cholesterol volume
19	3590	523	7:1
24		523	

(i) Complete the table by calculating the volume of LDL and the ratio of LDL volume to cholesterol volume.

Use the formula $v = \frac{4}{3}\pi r^3$

(3)

*(ii) The graph shows the relationship between LDLs, high-density lipoproteins (HDLs) and the risk of CVD.



Explain why measuring only the level of LDL in the blood is **not** a reliable predictor of CVD.

Use the graph, all the information in this question and your own knowledge to support your answer.

(6)

(Total for question = 15 marks)

Answer the questions with a cross in the boxes you think are correct ☐. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☐.

The table gives information about some blood vessels in a dog.

Blood vessel	Number in body	Diameter / cm	Length of vessel / cm	Total surface area / cm ²	Velocity of blood flow / cm s ⁻¹
aorta	1	1.0	40.0	1.3×10^2	28.0
large arteries	40	0.3	20.0	7.5×10^2	7.8
capillaries	1.2×10^9	8.0×10^{-4}	0.1	3.0×10^5	3.6×10^{-2}
large veins	40	0.6	20.0		1.9
vena cava	1	1.25		1.6×10^2	18.0

(a) Complete the table.

Use the formula:

surface area = $2\pi rl$

where r is the radius of the blood vessel and l is the length of the vessel.

(3)

(b) Explain why the velocity of blood flow in the large arteries is slower than the velocity of blood flow in the aorta.

(3)

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(c) Explain why the total surface area of the capillaries needs to be so high.

(2)

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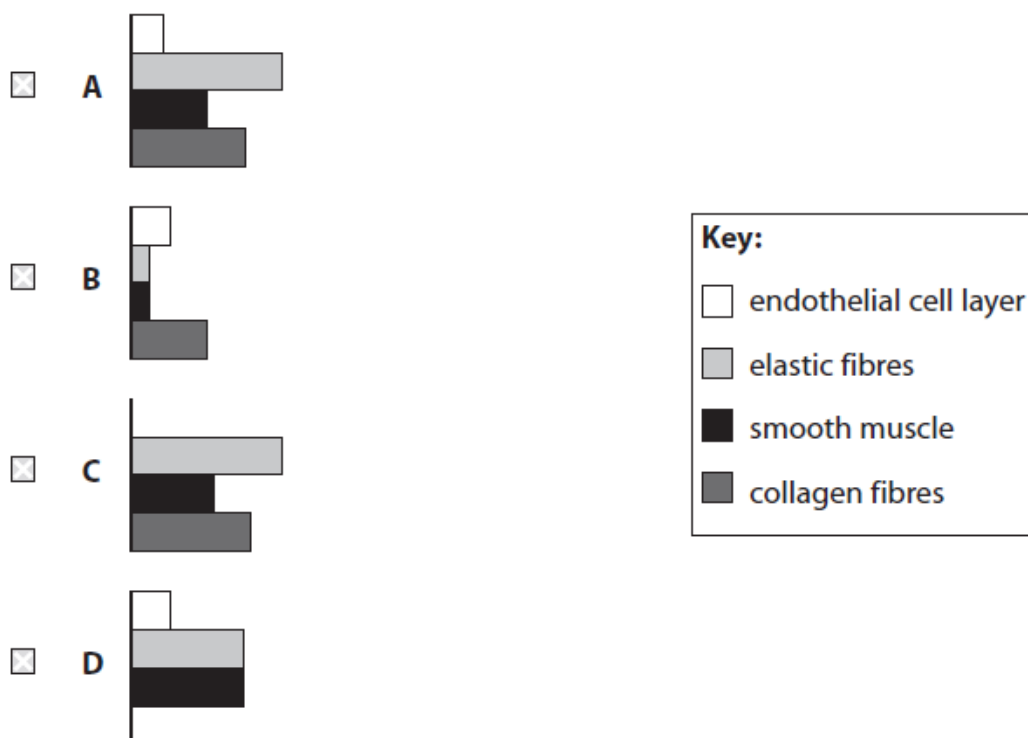
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(d) (i) The diagrams show the relative proportions of components found in blood vessel walls.

Which diagram represents the wall of a large artery?

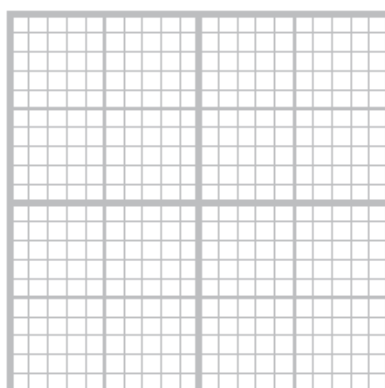
(1)

(1)



(ii) Draw a diagram, using the style above, to represent the wall of a capillary.

(1)



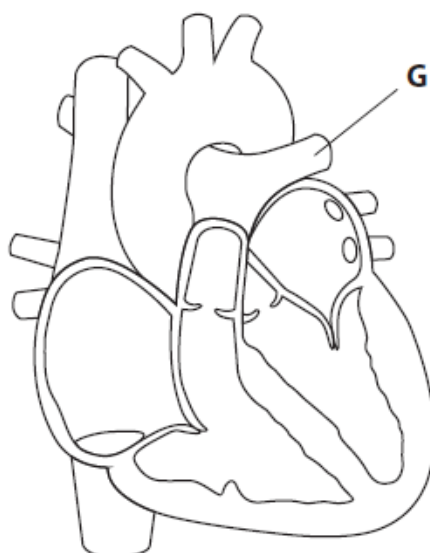
(Total for question = 10 marks)

Q23.

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

The cardiac cycle describes the events that take place in the heart during one complete heartbeat.

(a) The diagram shows a heart in one of the stages, stage **F**, of the cardiac cycle.



(i) What is the name of the blood vessel labelled **G**?

(1)

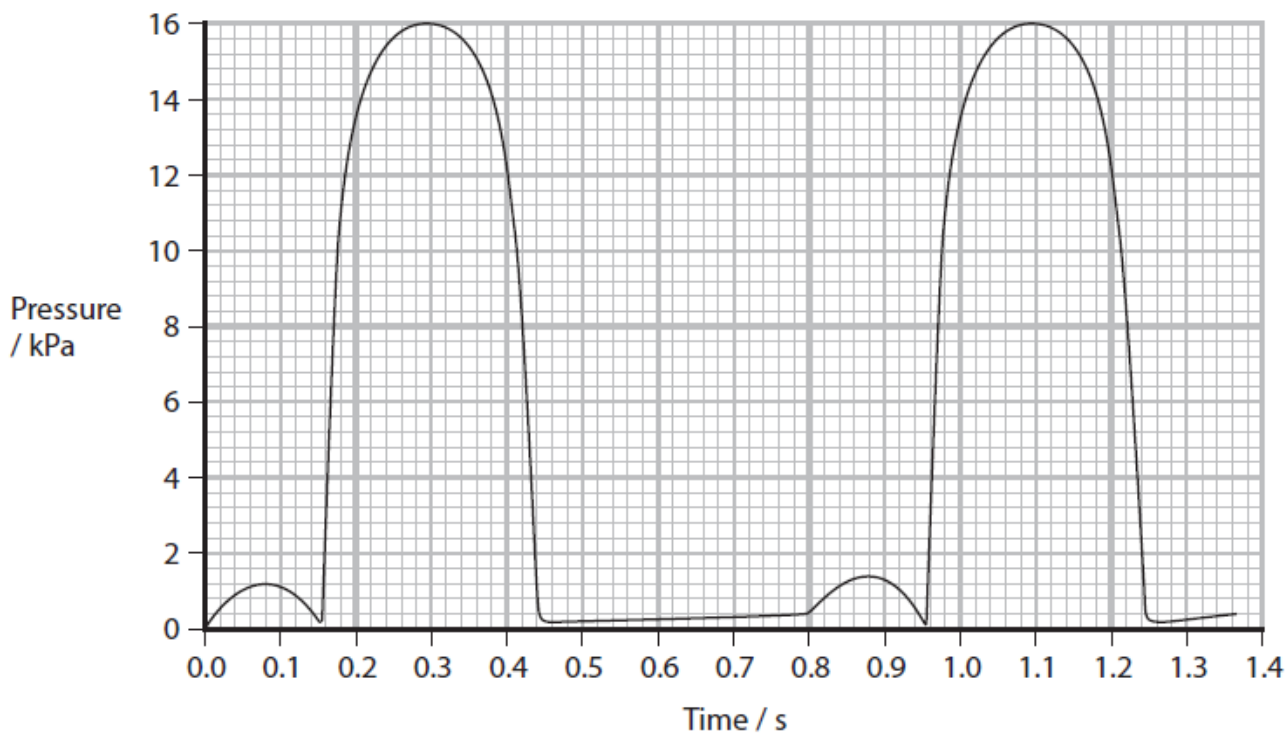
- ☒ **A** aorta
- ☒ **B** pulmonary artery
- ☐ **C** pulmonary vein
- ☐ **D** vena cava

(ii) Which row of the table identifies the stages before and after stage **F**?

(1)

	Stage before stage F	Stage after stage F
☐ A	atrial systole	cardiac diastole
☐ B	atrial systole	ventricular systole
☐ C	ventricular systole	atrial systole
☐ D	ventricular systole	cardiac diastole

(b) The graph shows pressure changes in the left ventricle of a person.



(i) Calculate the heart rate of this person.

Express your answer to 3 significant figures.

(2)

Answer beats min⁻¹

(ii) Another line could be drawn on this graph to show the pressure changes in the right ventricle.

Describe the shape and position of this line.

Give reasons for your answer.

(3)

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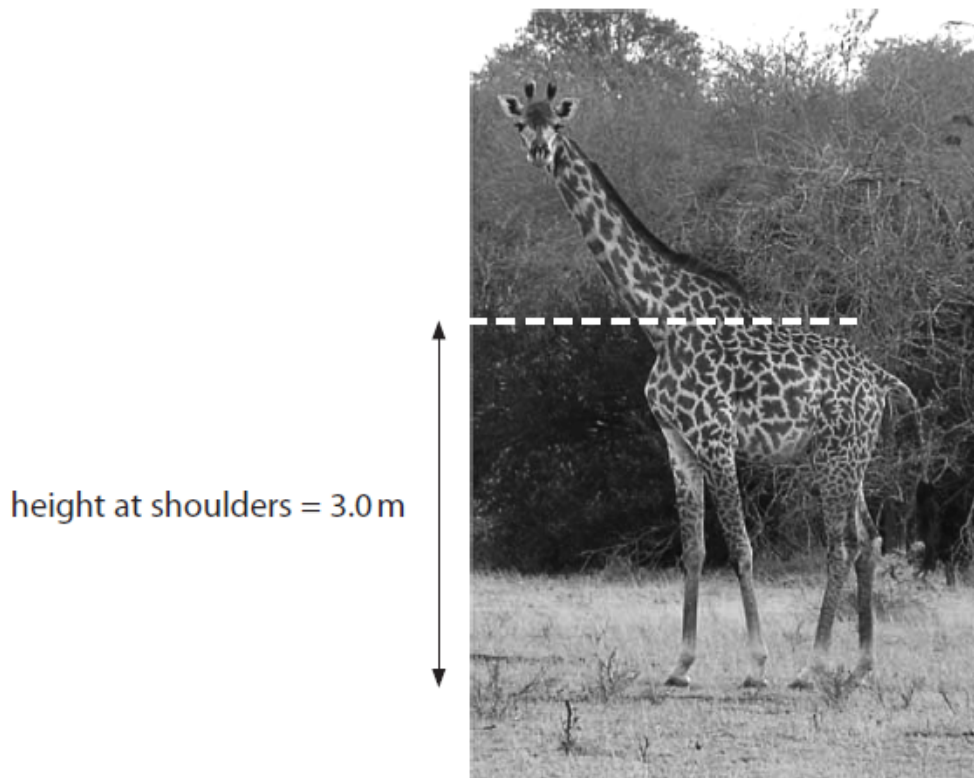
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(Total for question = 7 marks)

Q24.

The photograph shows an adult giraffe.



(a) Estimate the length of the neck of this giraffe from the shoulders, using the information in the photograph.

(1)

Answer m

(b) The heart of an adult giraffe can be 60 cm long.

Explain why the heart of a giraffe needs to be so large.

(2)

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(c) The arteries near the heart of a giraffe are highly elastic.

(i) Draw a labelled diagram of an artery, as seen in section.

(3)

(ii) Explain why the arteries near the heart of a giraffe are highly elastic.

(2)

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(d) Damage to the legs of the giraffe could result in excessive bleeding.

To prevent excessive bleeding, the capillaries near the surface of the skin are very narrow.

(i) Explain why very narrow capillaries prevent excessive bleeding.

(2)

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(ii) The red blood cells of the giraffe are about one third the size of human

red blood cells, so that they can pass through the very narrow capillaries.

The small size of the red blood cells ensures that the legs of the giraffe have a good supply of oxygen.

Explain why smaller red blood cells increase the supply of oxygen to the legs.

(2)

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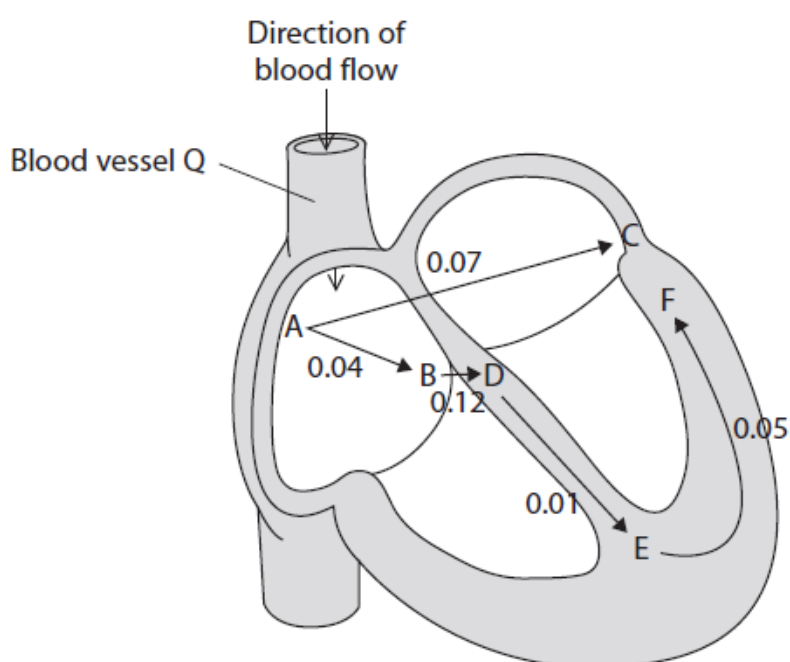
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(Total for question = 12 marks)

Q25.

Answer the question with a cross in the box you think is correct ☐. If you change your mind about an answer, put a line through the box ☐ and then mark your new answer with a cross ☐.

The diagram shows the time taken, in seconds, for an impulse to travel through different parts of the heart.



(a) What is the name of blood vessel Q?

(1)

☒ **A** aorta

- ☐ **B** pulmonary artery
- ☐ **C** pulmonary vein
- ☐ **D** vena cava

(b) The cardiac cycle is divided into three stages. Two of these stages are atrial systole and ventricular systole.

(i) Name the other stage of the cardiac cycle.

(1)

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(ii) The duration of ventricular systole is the time it takes for the impulse to pass between E and F, shown on the diagram.

Calculate the proportion of time that the ventricles are contracting in one heartbeat if this heart beats 73 times per minute.

(2)

Answer

(c) The part labelled B is in the wall of the atrium and the part labelled D is in the wall of the ventricles.

(i) The distance between B and D is 12.5 mm.

Calculate the speed at which the impulse travels between B and D.

(1)

Answer mm s⁻¹

(ii) Explain why this speed needs to be slower than the speeds that the impulse travels between other parts of the heart.

(2)

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(Total for question = 7 marks)

Q26.

Dietary antioxidants may reduce the risk of cardiovascular disease (CVD).

(a) Explain how dietary antioxidants reduce the risk of CVD.

(3)

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(b) Chocolate contains high concentrations of a group of antioxidants called flavonoids.

It has been suggested that eating chocolate could reduce the risk of CVD.

The table shows some information about two types of chocolate.

Type of chocolate	Mass of flavonoids / mg per 100 g of chocolate	Energy content / kJ per 100 g of chocolate
milk chocolate	70	2345
dark chocolate	170	1800

(i) Explain whether eating dark chocolate is likely to reduce the risk of CVD more than eating milk chocolate. Use the information in the table to support your answer.

(4)

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(ii) The table gives some information about ingredients in three different brands of milk chocolate and dark chocolate.

Ingredient	Percentage of ingredient in milk chocolate (%)			Percentage of ingredient in dark chocolate (%)		
	brand 1	brand 2	brand 3	brand 1	brand 2	brand 3
cocoa mass	16	16	16	40	40	40
sugar	40	40	40	50	50	50
milk fat	0	3	0	0	3	1
whole milk powder	20	20	20	0	0	0

Use the information in both tables to identify which ingredient contains the most flavonoids.

(1)

- ☐ **A** cocoa mass
- ☐ **B** milk fat
- ☐ **C** sugar
- ☐ **D** whole milk powder

(iii) Describe how a study could be designed to collect valid and reliable data on the effects of eating chocolate on the risk of CVD.

(3)

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(Total for question = 11 marks)

Q27.

Answer the questions with a cross in the boxes you think are correct ☐. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☐.

The risk of developing cardiovascular disease (CVD) can be increased by a number of factors including diet and a history of thrombosis.

Thrombosis is the development of a blood clot in a blood vessel. Blood clots can develop in veins and then move through the circulatory system into the coronary artery.

(a) A diet high in saturated triglycerides raises the levels of cholesterol in the blood.

(i) What is the ratio of glycerol to fatty acid in a triglyceride molecule?

(1)

☐ **A** 1:1

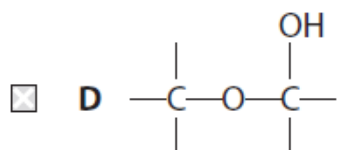
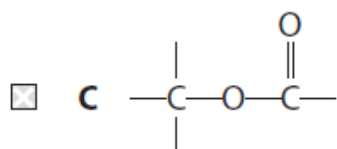
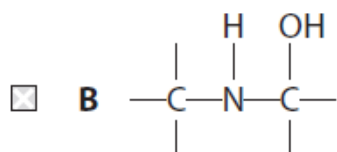
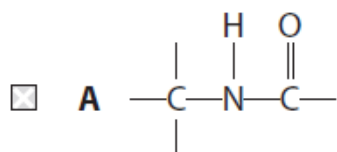
☐ **B** 1:3

☐ **C** 3:1

☐ **D** 3:3

(ii) Which diagram shows the bond that joins a glycerol molecule to a fatty acid in a triglyceride?

(1)



(iii) The table gives some information about four fatty acids.

Fatty acid	Number of double bonds between carbon atoms	Number of carbon atoms
butyric	0	4
stearic	0	18
palmitoleic	1	16
linoleic	2	18

Explain which of these fatty acids would have the lowest risk of causing CVD, if included in a diet in equal masses.

(2)

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(b) Anticoagulants, antiplatelets and thrombolytics are drugs used to treat blood clots.

(i) One anticoagulant binds to the active site of thrombin.

Explain how this drug reduces blood clotting.

(2)

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(ii) Molecules on the surface of platelets enable them to bind to other molecules.

One of the antiplatelet drugs affects molecules on the surface of platelets.

Explain how this drug reduces blood clotting.

(2)

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(iii) One thrombolytic drug converts plasminogen into the active enzyme, plasmin. Plasmin breaks down fibrin.

Explain how this drug reduces the formation of blood clots.

(2)

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Q28.

Warfarin is used in the treatment of cardiovascular disease.

Warfarin inhibits the synthesis of prothrombin.

(a) Describe the role of prothrombin in the blood clotting process.

(3)

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(b) Which type of treatment is warfarin?

(1)

- ☐ **A** anticoagulant
- ☐ **B** antihypertensive
- ☐ **C** platelet inhibitor
- ☐ **D** statin

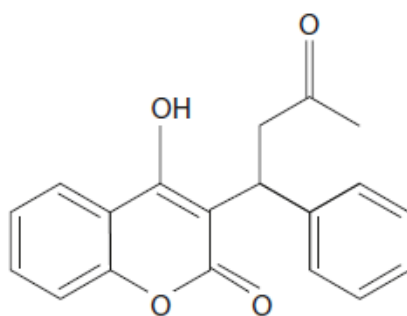
(c) Reduced vitamin K is needed for the synthesis of prothrombin.

An enzyme, vitamin K epoxide reductase (VKOR), converts vitamin K to reduced vitamin K.

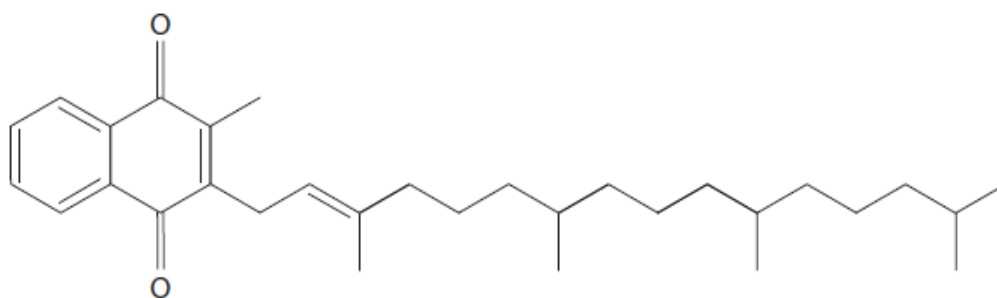
The diagram shows this conversion.



(i) The diagrams show the structures of warfarin and vitamin K.



Warfarin



Vitamin K

Using the information in the diagrams, suggest why warfarin inhibits the synthesis of prothrombin.

(2)

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(ii) Suggest why people taking warfarin have to avoid eating foods that contain a high concentration of vitamin K.

(2)

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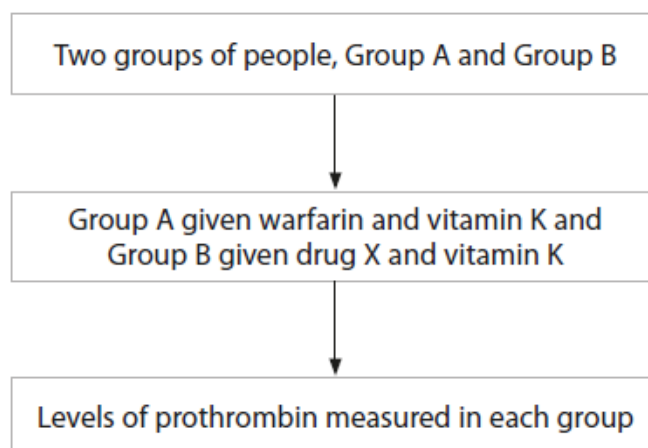
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(d) Other drugs are available that work in a similar way to warfarin.

The diagram shows one study to compare the effect of warfarin with drug X.



Explain how this study should be designed so that the effectiveness of these two drugs can be compared.

(4)

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(Total for question = 12 marks)

Q29.

Water is an important biological molecule.

Read through the following description of water.

Complete the description by writing the most appropriate word on the dotted lines.

Water has an uneven charge distribution so it is described as a

..... molecule. The hydrogen ends of the molecule

have a very slightly charge.

Water is involved in the transport of substances so it is an important

..... in living organisms.

Water is needed in chemical reactions called

.....

reactions that break down disaccharides such as

..... into glucose and galactose.

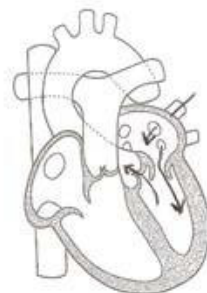
(Total for question = 5 marks)

Mark Scheme

Q1.

Question number	Answer	Additional guidance	Mark
(a)	An explanation that includes the following points: - because (X / coronary artery) carries {oxygen / oxygenated blood} to the heart {cells / muscle / tissue} (1) - for {(aerobic) respiration / metabolism} (in the heart) (1) - aorta is closest blood vessel carrying oxygenated blood (1)	IGNORE glucose / nutrients ACCEPT aorta supplies X blood with <u>high levels of oxygen</u>	(3)

Question number	Answer	Additional guidance	Mark
(b)(i)	An explanation that includes the following points: - diastole / atrial systole / ventricular diastole (1) - because the {atrioventricular / AV / bicuspid / tricuspid} valves are open (1)	ACCEPT semi lunar valves are closed	(2)

Question number	Answer	Additional guidance	Mark
(b)(ii)	An answer that includes the following points: - arrows shown on left-hand side of heart (only) (1) - arrows pointing in correct direction (1) - arrows shown entering atrium through pulmonary vein and leaving through the aorta (1)	<u>example of diagram</u> 	(3)

Question number	Answer	Additional guidance	Mark
(c)	An explanation that includes the following points: - increase in diameter due to {high pressure / large volume / surge} of blood (leaving the left ventricle) (1) - therefore expansion of elastic fibres (1) - decrease in diameter due to recoil (of elastic fibres) (1)	ACCEPT to reduce pressure of blood	(3)

Q2.

Question number	Answer	Mark
(a)(i)	A α glucose molecules join together by a condensation reaction B is incorrect because bonds form by condensation reactions C is incorrect because α glucose molecules join together D is incorrect because α glucose molecules join together by condensation reactions	(1)

Question number	Answer	Additional guidance	Mark
(a)(ii)	glycosidic (bond / link)	Accept covalent (bond) Ignore any numbers eg 1,4 glycosidic	(1)

Question number	Answer	Additional guidance	Mark
(a)(iii)	An explanation that includes the following points: {polymer of glucose / polysaccharide} therefore has a highenergy content (1) {large molecule / polymer / polysaccharide} therefore {insoluble / has no osmotic effect} (1) - branched structure therefore {broken down / energy released /hydrolysis is} faster (1) - compact therefore has a high energy density (1)	Accept {large molecule / polymer} sodoes not diffuse Accept branched so can be broken down from several points at the sametime Ignore easier to break down Accept compact so {high energy stored in a small space / many glucosemolecules stored in a small space}	(3)

Question number	Answer	Additional guidance	Mark
(b)(i)	Answer that includes the following points: - estimate of number of babies with GSD (1) - estimate of mean number of babies with Von Gierke disease (1)	Accept any value between 150 and 200 Accept any value between 38 and 50 Accept non-whole numbers eg 38.5 Correct answer with no working (2)	(2)

Question number	Answer	Additional guidance	Mark
(b)(ii)	An answer that includes the following points: - because allele for Von Gierke disease may be recessive (1) - therefore (both) parents may be heterozygous (1) - because individuals with Von Gierke disease are less likely to have babies (1)	Accept disease caused by two recessive alleles Do not accept {gene / disease} is recessive Accept parents may be carriers (of the allele) Ignore mutation	(2)

Q3.

Question number	Answer	Additional guidance	Mark
(a)(i)	bind to an {oxygen (molecule) / O₂} (1)	Do not accept O Ignore binding to carbon dioxide	(1)

Question number	Answer	Additional guidance	Mark
(a)(ii)	An explanation that includes the following points: - must have R groups that are {polar / hydrophilic} (1) - so that the {haemoglobin / protein} {can dissolve in (red blood cell) cytoplasm / is soluble in water} (1)	Accept they are {polar / hydrophilic} Ignore dissolve in blood / plasma	(2)

Question number	Answer	Additional guidance	Mark
(b)(i)	An explanation that includes two of the following points: - oxygen dissociation curve for {maternal / adult} Hb is shifted to the right of curve for fetal Hb (1) - because oxygen needs to diffuse from {maternal / adult} blood into fetal blood (1) - therefore fetal haemoglobin needs to have a higher affinity for oxygen (1)	Accept shifted down for shifted to the right Accept converse Accept converse Accept because oxygen needs to dissociate from maternal haemoglobin and bind to fetal haemoglobin	(2)

Question number	Answer	Additional guidance	Mark
(b)(ii)	An answer that includes the following points: - total number of amino acids in haemoglobin calculated (1) - percentage of amino acids that are different calculated (1)	574 / 287 14 / 13.6 / 13.59 Correct answer with no working (2)	(2)

Q4.

Question number	Answer	Mark
(a)(i)	The only correct answer is B. <i>A is incorrect because it should be $C_n H_{2n} O_n$</i> <i>C is incorrect because it should be $C_n H_{2n} O_n$</i> <i>D is incorrect because it should be $C_n H_{2n} O_n$</i>	(1)

Question number	Answer	Additional guidance	Mark
(a)(ii)	condensation (reaction)	IGNORE polymerisation	(1)

Question number	Answer	Mark
(b)(i)	The only correct answer is C. <i>A is incorrect because amylose is a polysaccharide found in plants.</i> <i>B is incorrect because galactose is a monosaccharide.</i> <i>D is incorrect because sucrose is found in plants.</i>	(1)

Question number	Answer	Mark
(b)(ii)	The only correct answer is C. <i>A is incorrect because amylopectin is a polysaccharide.</i> <i>B is incorrect because galactose is a monosaccharide.</i> <i>D is incorrect because sucrose contains fructose.</i>	(1)

Question number	Answer	Mark
(b)(iii)	The only correct answer is C. <i>A is incorrect because amylose is found in plants.</i> <i>B is incorrect because fructose is a disaccharide found in plants.</i> <i>D is incorrect because sucrose is a disaccharide found in plants.</i>	(1)

Question number	Answer	Mark
(b)(iv)	The only correct answer is B. <i>A is incorrect because amylose is not branched.</i> <i>C is incorrect because fructose is a monosaccharide.</i> <i>D is incorrect because maltose is a disaccharide.</i>	(1)

Q5.

Question number	Answer	Mark
(a)	The only correct answer is B. <i>A is incorrect because anticoagulants prevent blood clotting.</i> <i>C is incorrect because platelet inhibitors reduce blood clotting.</i> <i>D is incorrect because statins reduce cholesterol levels.</i>	(1)

Question number	Answer	Additional guidance	Mark
(b)	An explanation that includes the following points: - because there is a link between (total) blood cholesterol levels and heart disease (1) - because {HDL is not thought to be a risk factor / LDL is associated with the development of heart disease / the {ratio / balance} of LDL : HDL determines the level of risk} (1)	ACCEPT CHD / CVD / atherosclerosis for heart disease throughout ACCEPT causes / leads / is a risk factor / correlation ACCEPT HDL reduces risk / HDL needed to get the LDL	(2)

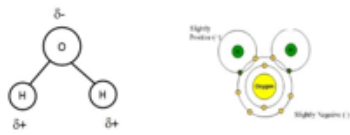
Question number	Answer	Additional guidance	Mark
(c)	An explanation that includes the following points: (10 year CHD risk) increases (1) - because smoking {increases blood pressure / increases heart rate / damages (endothelial) lining of arteries} (1) - damage to lining results in {atheroma / plaque} building up OR {high blood pressure / increase in heart rate} makes the heart work harder (1)	ACCEPT CVD / CHD / heart disease / atherosclerosis / throughout ACCEPT increases the chance of blood clotting / makes platelets sticky ACCEPT blood clots can block arteries	(3)

Question number	Answer		Mark
(d)(i)	salt intake / fibre intake / alcohol intake / (body) mass / BMI / obesity / hip waist ratio / level of exercise / stress levels / family history / genetic factors / taking statins / diastolic blood pressure	IGNORE LDL / antihypertensives / blood pressure	(1)

Question number	Answer	Additional guidance	Mark
(d)(ii)	{salt / low fibre / alcohol / high BMI / obesity / little exercise / stress / family history / genetic factors / high diastolic blood pressure} increase the risk value - OR {low salt / high fibre / low alcohol / suitable mass / exercise / low stress levels / taking statins / low diastolic blood pressure} decrease the risk value	ACCEPT if answer given in (i)	(1)

Question number	Answer	Additional guidance	Mark
(d)(iii)	An explanation that includes two of the following points: - because there are other (risk) factors not included (1) - because people will underestimate {their mass / how much they smoke} (1) - because {total cholesterol / HDL / blood pressure} might be an estimate (1)	ACCEPT named factor but not those shown on the risk calculator ACCEPT {total cholesterol / HDL / blood pressure} are variable are not aware that they have diabetes	(2)

Q6.

Question number	Answer	Additional guidance	Mark
(a)	A diagram that includes the following: 2 hydrogens joined to an oxygen (by covalent bonds) (1) - the charge distribution (1)	 e.g. lines, overlapping circles, shared electrons	(2)

Question number	Answer	Additional guidance	Mark
(b)(i)	A description that includes the following points: - for F increase in temperature increases solubility (1) - for G increase in temperature increases up to 30°C and then decreases the solubility (1) - for H temperature has no effect (on solubility) (1)	ACCEPT 'It' for solubility throughout ACCEPT positive correlation Do not piece together ACCEPT solubility {remains constant / does not change} with an increase in temperature	(3)

Question number	Answer	Mark
(b)(ii)	The only correct answer is B 1.67 A is incorrect because $50 \div 30 = 1.67$ C is incorrect because $50 \div 30 = 1.67$ D is incorrect because $50 \div 30 = 1.67$	(1)

Q7.

Question number	Answer	Mark
(a)	The only correct answer is A (position R, position P) <i>B is incorrect because P will have a carboxyl group and R will have an amino group (Q will have a carboxyl group)</i> <i>C is incorrect because P will have a carboxyl group and R will have an amino group (Q will have a carboxyl group)</i> <i>D is incorrect because P will have a carboxyl group and R will have an amino group (Q will have a carboxyl group)</i>	(1)

Question number	Answer	Additional guidance	Mark
(b)(i)	• 39 / 39.3 / 39.29 (1)		(1)

Question number	Answer	Additional guidance	Mark
(b)(ii)	• 0.13 : 1 / 0.1 : 1 / 0.13 / 0.1 (1)	ACCEPT 1 : 7.5 / 1 : 8	(1)

Question number	Answer	Additional guidance	Mark
(c)	A description that includes the following points: - hydrolysis / using enzymes (1) - of the peptide bonds between P and the connecting chain <u>and</u> R and the connecting chain (1)	ACCEPT protease ACCEPT of peptide bonds between A chain and connecting region <u>and</u> B chain and connecting region	(2)

Question number	Answer	Additional guidance	Mark
(d)	An answer that includes the following points: Similarities : • α glucose (1) • contain C, H and O (only) (1) Differences : • glucose is a monosaccharide and glycogen is a polysaccharide (1) • glycogen has (1-4 / 1-6) glycosidic bonds but glucose does not (1)	DO NOT PIECE TOGETHER	(3)

Question number	Answer	Mark
* (e)	Indicative content: Healthy rats given water • levels of glucose {fell slightly / maintained} (D) • because the healthy rats were producing insulin (E) • so were controlling the blood glucose levels naturally (E) Healthy rats given cinnamon • levels of glucose very slightly lower (D) • as cinnamon was adding to the effect of insulin (CE) OR • levels of glucose very similar (D) • as cinnamon had no (added) effect in healthy rats (CE) Diabetic rats given water • levels of glucose rose (D) • levels of glucose were higher than healthy rats (D) • because diabetic rats had no insulin to control their blood glucose levels (E) Diabetic rats given cinnamon • unhealthy rats given cinnamon had fairly constant levels of glucose (D) • cinnamon lowered blood glucose by moving it into the liver (E) • cinnamon stimulated enzymes to convert glucose into glycogen (E) • so that it could not diffuse back into the blood (E) • levels of glucose were higher than in the healthy rats (D) • because cinnamon not as effective as insulin (CE) • possibly {not absorbed well / worked slowly / did not stimulate so many enzymes} (CE) • fluctuations in levels of glucose (D) • depending on how much glucose is used (E)	(6)

			Additional guidance
Level 0	0	No awardable content	
Level 1	1-2	An explanation may be attempted but with limited interpretation or analysis of the scientific information and with a focus on mainly just one piece of scientific information. The explanation will contain basic information, with some attempt made to link knowledge and understanding to the given context.	Simple descriptions of data with no real attempt of an explanation 1 mark = some description of the data 2 marks = detailed description of the data
Level 2	3-4	An explanation will be given, with occasional evidence of analysis, interpretation and/or evaluation of both pieces of scientific information. The explanation shows some linkages and lines of scientific reasoning, with some structure.	Some explanation given using the information given / own knowledge (E) 3 marks = simple explanation of what {cinnamon / insulin} is doing 4 marks = more detailed explanation of how {cinnamon / insulin} decreases glucose level
Level 3	5-6	An explanation is made that is supported throughout by sustained application of relevant evidence of analysis, interpretation and/or evaluation of both pieces of scientific information. The explanation shows a well-developed and sustained line of scientific reasoning, which is clear and logically structured.	Data logically explained with extended use of information provided (CE) 5 marks = plus a comparison made of effectiveness of cinnamon compared to insulin 6 marks = data explained in detail

Q8.

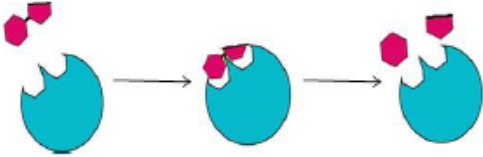
Question number	Answer	Additional guidance	Mark
(a)	An explanation that includes the following points: - because the rate of miscarriage increases with (increase in) age(1) - there is no evidence age is causing the miscarriage (1)	ACCEPT directly proportional to each other it shows that an increase in one variable is reflected by an increase in the other variable ACCEPT no evidence of causation	(2)

Question number	Answer	Additional guidance	Mark
(b)(i)	An explanation that includes the following points: - aneuploidy results in miscarriage because the screened embryos result in fewer miscarriages (1) - other {factors / named factor} cause miscarriages because {screened embryos / embryos that do not have aneuploidy} are miscarried (1)	ACCEPT converse where appropriate e.g. age, mutations, the process of implanting embryos, smoking, alcohol, dietary factors IGNORE lifestyle / screening causes miscarriage	(2)

Question number	Answer	Additional guidance	Mark
(b)(ii)	An explanation that includes three of the following points: - because no indication of sample size (1) - because no statistics presented (1) - because no idea how many of the unscreened embryos had aneuploidy (1) - other {lifestyles / factors / named factor} not {taken into account / not shown} (1) - false (negative / positive) results (1)	ACCEPT small sample size IGNORE age / sex	(3)

Question number	Answer	Additional guidance	Mark
(c)	An answer that includes three of the following points: (preimplantation) screened embryos still result in miscarriages so raising false hopes (1) - issues surrounding the embryos (that have aneuploidy) (1) - false (positive) results resulting in unnecessary {wastage / destruction} of embryos (1) - other (genetic) defects may be found (1)	DO NOT ACCEPT {fetus / baby} e.g. discarding the embryos is unethical ACCEPT false (negative) result leads to use of that embryo	(3)

Q9.

Question number	Answer	Mark
(a)(i)	B  The only correct answer is B. <i>A is incorrect because it shows the substrate unchanged</i> <i>C is incorrect because it shows lactose being made not broken down</i> <i>D is incorrect because the two substrates have not been bonded together</i>	(1)

Question number	Answer	Mark
(a)(ii)	B galactose and glucose The only correct answer is B. <i>A is incorrect because sucrose is not a monosaccharide</i> <i>C is incorrect because glucose and fructose are the monomers of sucrose</i> <i>D is incorrect because sucrose is not a monosaccharide</i>	(1)

Question number	Answer	Mark		
(b)	C <table><tr><td>reaction without enzyme</td><td>Q</td></tr></table> The only correct answer is C. <i>A is incorrect because line P shows the reaction without enzyme</i> <i>B is incorrect because line P shows the reaction without enzyme</i> <i>D is incorrect because R is the activation energy with the enzyme not the decrease</i>	reaction without enzyme	Q	(1)
reaction without enzyme	Q			

Question number	Answer	Additional guidance	Mark
(c)(i)	An explanation that includes the following points: - as the concentration (of substrate) increases there are more (substrate) molecules / particles (1) (therefore) a greater chance of {collisions with active site / enzyme substrate complexes forming} increasing the rate of reaction {rate/graph} levels off when {all active sites are filled (at any one time) / enzyme is saturated} (1)	ACCEPT converse for mp1 and 2 Piece together ACCEPT substrate concentration is limiting factor in the first part of the graph ACCEPT {greater frequency of collisions / collisions more likely to occur} etc ACCEPT enzyme for active site / "successful collisions" for collisions with active site IGNORE {more collisions / more enzyme-substrate complexes forming} ACCEPT {rate / graph} levels off {when enzyme becomes rate limiting / as enzyme is limiting factor} IGNORE idea of substrate being used up as reaction proceeds	(2)

Question number	Answer	Additional guidance	Mark
(c)(ii)	An answer that includes the following points: - correct values for $V_{\max}$ and K read from the graph (1) - correct answer for values substituted into the formula (1)	$V_{\max} = 50$ $K = 1.9$ $V = \frac{50 \times 4}{1.9 + 4} = 33.898 / 34$ (ignore units) ACCEPT 33.9 IGNORE 33.90 / 33.89 Correct answer gets 2 marks ecf for mp2 if wrong values read from graph	(2)

Q10.

Question number	Answer	Mark
(a)(i)	C galactose and glucose A is incorrect because lactose consists of glucose and galactose monomers B is incorrect because lactose consists of glucose and galactose monomers D is incorrect because lactose consists of glucose and galactose monomers	(1)

Question number	Answer	Additional guidance	Mark
(a)(ii)	An explanation that includes three of the following points: - lactase is soluble because of its {globular shape / external polar R groups} (1) (and therefore) lactase collides with lactose (1) - active site of lactase is complementary to the lactose (1) - Formation of enzyme-substrate complex lowers the activation energy (1)	Accept hydrophilic for polar Accept active site of lactase binds to lactose / active site allows enzyme-substrate complex to form Accept R group interactions break the glycosidic bonds	(3)

Question number	Answer	Additional guidance	Mark
(b)(i)	{lactase / enzyme} is reusable / milk is not contaminated with {lactase / enzyme} (1)	Accept higher enzyme activity	(1)

Question number	Answer	Additional guidance	Mark
(b)(ii)	An explanation that includes four of the following points: - pH {below 5 / above 5} reduces lactase activity (1) - because pH affects the shape of the active site (1) - due to ionisation of the R groups (1) - immobilised lactase is active at wider range of pH values (1) - immobilisation holds the R groups in place so active site does not change shape (1)	Accept pH 5 is the optimum for both enzymes / pH 4-6 is the optimum for both enzymes Accept active site denatured by pH Accept bonds between R groups are broken	(4)

Question number	Answer	Additional guidance	Mark												
(b)(iii)	An answer that includes the following points: - measure the decrease in concentration of lactose over time - see table for units OR - measure the increase in concentration of {glucose / galactose} over time - see table for units	Accept measure rate of loss of lactose Ignore: measure how long it takes for lactose to be fully broken down Accept measure rate of production of {glucose / galactose} Units can be expressed as: - mass per volume per time - mass volume⁻¹ time⁻¹ - amount per volume per time - amount volume⁻¹ time⁻¹ <table border="1"> <tr> <td>mass</td><td>volume</td><td>time</td></tr> <tr> <td>g / mg / µg / kg</td><td>cm⁻³ / mm⁻³ / dm⁻³ / litre⁻¹</td><td>s⁻¹ / min⁻¹ / hour⁻¹</td></tr> <tr> <td>amount</td><td>volume</td><td>time</td></tr> <tr> <td>mmol / mol / µmol</td><td>cm⁻³ / mm⁻³ / dm⁻³ / litre⁻¹</td><td>s⁻¹ / min⁻¹ / hour⁻¹</td></tr> </table>	mass	volume	time	g / mg / µg / kg	cm ⁻³ / mm ⁻³ / dm ⁻³ / litre ⁻¹	s ⁻¹ / min ⁻¹ / hour ⁻¹	amount	volume	time	mmol / mol / µmol	cm ⁻³ / mm ⁻³ / dm ⁻³ / litre ⁻¹	s ⁻¹ / min ⁻¹ / hour ⁻¹	(2)
mass	volume	time													
g / mg / µg / kg	cm ⁻³ / mm ⁻³ / dm ⁻³ / litre ⁻¹	s ⁻¹ / min ⁻¹ / hour ⁻¹													
amount	volume	time													
mmol / mol / µmol	cm ⁻³ / mm ⁻³ / dm ⁻³ / litre ⁻¹	s ⁻¹ / min ⁻¹ / hour ⁻¹													

Question number	Answer	Additional guidance	Mark
(c)	An answer that includes two of the following points: - mutation (that resulted in CLI) occurred in the {gene / DNA} (of people living in one country) (1) - people from this country (had children that) stayed in this country(1) - relatively new mutation so has not had the chance to spread (1)	Accept limited emigration from this country / reproduction with others from same country Ignore idea that mutation is caused by drinking milk / not drinking milk	(2)

Question number	Answer	Mark
(a)(i)	D hydrolysis	(1)

Question number	Answer	Mark
(a)(ii)	A calculation in which: $\text{kJ of energy} = \text{mass of lactose in 200 g of milk} \times \text{energy per gram}$ Example of calculation: $4.9 \times 2 \times 16 = 156.8 \text{ kJ}$	(1)

Question number	Answer	Additional guidance	Mark
(b)	An answer that includes the following points: similarities: • both polysaccharides / formed from many (alpha) glucose monomers (1) • joined by glycosidic bonds (1) differences: • starch is composed of two polysaccharides, glycogen only one (1) • amylose is a {straight / helical} chain, amylopectin and glycogen are both branched molecules (1)	Allow description of glycosidic bonds as 1,4 and 1,6	(4)

Question number	Answer	Additional guidance	Mark
(c)(i)	An answer that includes one of the following points: • saturated lipids have no carbon - carbon double bonds and unsaturated lipids have a carbon - carbon double bond or • saturated lipids have straight chains and unsaturated lipids have bent chains or • saturated lipids have a greater ratio of hydrogen to carbon / unsaturated lipids have a lower ratio of hydrogen to carbon	Answer must be comparative	(1)

Question number	Answer	Mark
(c)(ii)	An description that includes the following points: • one glycerol molecule and three fatty acid molecules (1) • which react via a condensation reaction (1) • and are joined by ester bonds (1)	(3)

Question number	Answer	Additional guidance	Mark
(a)(i)	An explanation that includes the following points: - because both lines rise and fall (in parallel) (1) - but the line for deaths from lung cancer is a period of time after the line for cigarettes smoked (1)	Accept {delay / timelag} for deaths	(2)

Question number	Answer	Additional guidance	Mark
(a)(ii)	An explanation that includes the following points: - alveoli will have a smaller surface area (to volume ratio) (1) - therefore the (rate of) diffusion of oxygen into the bloodstream will be slower (1)	Accept gas exchange area will be smaller Accept gas exchange for diffusion Ignore less gas exchange / diffusion	(2)

Question number	Answer						
* (b)	Indicative content: <table border="1"> <tr> <td>Egg points (E)</td><td> {number / density of pores} {width / size} of pores - area of pores - thickness of shell and membranes - rate of respiration of developing embryo - rate of blood flow of embryo - temperature - shell is impermeable / pores are permeable - shell supports membrane so there is a large SA for gas exchange </td></tr> <tr> <td>Theory points (T)</td><td> - Ficks Law of diffusion can be used to calculate diffusion rate - State Fick's Law (3) - because rate of diffusion depends on surface area / mp11 - because rate of diffusion depends on diffusion distance / mp11 - because rate of diffusion depends on concentration gradient / mp11 - speed of molecules depends on temperature - because rate of diffusion depends on what substances oxygen is passing through eg water / air - diffusion coefficient through air - diffusion coefficient through membranes </td></tr> <tr> <td>Explanation points (X) Accept converse for all</td><td> - increasing SA (or any named factor increasing this) causes increase in rate of diffusion - increasing distance (or any named factor increasing this) causes decrease in rate of diffusion - increasing conc gradient (or any named factor increasing this) causes increase in rate of diffusion - increasing temperature increases rate of diffusion </td></tr> </table>	Egg points (E)	{number / density of pores} {width / size} of pores - area of pores - thickness of shell and membranes - rate of respiration of developing embryo - rate of blood flow of embryo - temperature - shell is impermeable / pores are permeable - shell supports membrane so there is a large SA for gas exchange	Theory points (T)	- Ficks Law of diffusion can be used to calculate diffusion rate - State Fick's Law (3) - because rate of diffusion depends on surface area / mp11 - because rate of diffusion depends on diffusion distance / mp11 - because rate of diffusion depends on concentration gradient / mp11 - speed of molecules depends on temperature - because rate of diffusion depends on what substances oxygen is passing through eg water / air - diffusion coefficient through air - diffusion coefficient through membranes	Explanation points (X) Accept converse for all	- increasing SA (or any named factor increasing this) causes increase in rate of diffusion - increasing distance (or any named factor increasing this) causes decrease in rate of diffusion - increasing conc gradient (or any named factor increasing this) causes increase in rate of diffusion - increasing temperature increases rate of diffusion
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Explanation points (X) Accept converse for all	- increasing SA (or any named factor increasing this) causes increase in rate of diffusion - increasing distance (or any named factor increasing this) causes decrease in rate of diffusion - increasing conc gradient (or any named factor increasing this) causes increase in rate of diffusion - increasing temperature increases rate of diffusion						

	Level 1 Up to 4 points from anywhere; 2 points for one mark and 4 points for 2 marks Level 2 5 points or more, from two best categories; 5 points for 3 marks, 6 points for 4 marks. Must achieve 6 marks to progress to level 3 Level 3 As level 2 plus up to 2 points from third category; 7 points for 5 marks and 8 points for 6 marks
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Q13.

Question number	Answer	Additional guidance	Mark
(a)	ACCEPT any two from : - BMI / body mass index - waist to hip ratio / hip to waist ratio - waist to height ratio / height to waist ratio - waist circumference - skin fold (thickness)	IGNORE risk factors ACCEPT mass ÷ height² / weight ÷ height²	(1)

Question number	Answer	Mark
(b)(i)	The only correct answer is B B 1-6 only <i>A is incorrect because 1-4 bonds are present in straight chains only</i> <i>C is incorrect because 1-4 bonds are present in straight chains only</i> <i>D is incorrect because 1-6 bonds form the branches</i>	(1)

Question number	Answer	Additional guidance	Mark
(b)(ii)	makes the person feel full / prevents so much food from being in the stomach / fills up the stomach so less food needed to satisfy hunger / glucomannan takes the space of the food (1)	IGNORE: reduces food intake decreases volume of stomach	(1)

Question number	Answer	Additional guidance	Mark
(b)(iii)	An explanation that includes the following points: - because it contains lots of {monosaccharides / glucose / energy} (1) - therefore {energy input could be greater than energy output / (excess) glucose converted to fat} (1) - glucomannan would no longer be filling up the stomach so more food could be eaten (1)	ACCEPT sugar for glucose polymer of glucose lots of mannose broken down into lots of {glucose / monosaccharides / mannose} ACCEPT excess energy stored as fat	(2)

Question number	Answer	Additional guidance	Mark
(c)(i)	An answer that includes the following points: - group on low fat diet lost 4.3 (kg) and group on very low-carbohydrate diet lost 8.1 (kg) (1) (overall) loss of 8.1 (kg) is {1.88 / 1.9} times more weight (1) - which is slightly lower than the other studies are claiming (1) - claims are referring to low-carbohydrate diet but this one is a very low-carbohydrate diet (1)	ACCEPT group on low fat diet lost 3.8 (kg) more ACCEPT about twice as much / for low-fat diet this is 4.6% of starting weight and for very low-carbohydrate 8.9% starting weight ACCEPT results are at the lower end of the claim	(3)

Question number	Answer	Additional guidance	Mark
(c)(ii)	An answer that includes two of the following points: (blood) {cholesterol / LDL} levels (1) - blood pressure (1) - heart rate (1)	IGNORE other named risk factors ACCEPT LDL : HDL	(2)

Q14.

Question number	Answer	Mark		
(a)(i)	The only correct answer is C. <table><tr><td>fructose and glucose</td><td>sucrose only</td></tr></table> A is incorrect because glucose is also a monosaccharide not a disaccharide B is incorrect because fructose is also a monosaccharide and not a disaccharide D is incorrect because sucrose is not a monosaccharide and fructose is not a disaccharide	fructose and glucose	sucrose only	(1)
fructose and glucose	sucrose only			

Question number	Answer	Mark
(a)(ii)	The only correct answer is B glycosidic A is incorrect because ester bonds join organic acids and alcohols together C is incorrect because peptide bonds join amino acids together D is incorrect because phosphodiester bonds joins mononucleotides together	(1)

Question number	Answer	Additional guidance	Mark
(b)(i)	A calculation showing the following steps: - the mean calculated (1) - the mean converted to g dm^{-3} (1)	Example of calculation : $(1.22 + 1.02 + 1.00) \div 3 / 1.08$ $0.00108 / 0.0011 / 1.08 \times 10^{-3}$ Correct answer with no working shown gains both marks.	(1)

Question number	Answer
(b) (ii)	Indicative content: • sugar solution with a lower water potential than the cytoplasm of the cell (D) • sugar solution should be hypertonic (D) • so that water will pass out of the cytoplasm by osmosis (E) • concentration of sugar solution should be the same as the cytoplasm (D) • so that sugars will not diffuse out (E) • each individual sugar concentration should be the same as the cytoplasm (D) • mean concentration of sugars stated (fructose = 1.52, glucose = 1.08, sucrose = 8.55) (D) • range of sugar concentrations stated (from table) (D) • so that concentration of each sugar remains the same (E) • another solute needs to be used (D) • so that the sugar concentration remains the same but the water passes out (E)

	Level 1 : description of conditions needed for osmosis and maintaining sugar concentration 1 mark = a description of one condition 2 marks = a description of each condition or an explanation of one condition Level 2 : explanation of conditions needed for both osmosis and maintaining sugar concentration 3 marks = a description of one condition and an explanation of the other condition 4 marks = an explanation of each condition Level 3 : indicates that concentration of each sugar needs to be the same as in the pineapple and another solute needs to be included. 5 marks = and includes one of the above 6 marks = and includes both of the above
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Q15.

Question number	Answer	Additional guidance	Mark
(a)(i)	pressure exerted by one (type of) gas in a mixture of gases (1)	ACCEPT pressure exerted by oxygen in a mixture of gases/air ACCEPT is a measure of concentration of a gas / concentration of oxygen (ignore location) IGNORE amount of oxygen / amount of gas / % of gas / proportion of gas	(1)

Question number	Answer	Additional guidance	Mark
(a)(ii)	An explanation that includes three of the following points: - haemoglobin is composed of four sub-units (1) - binding of the first oxygen molecule is difficult (1) - binding of the other molecules becomes easier (1) - due to a conformational change (1) - as Hb becomes saturated less oxygen can bind (so the curve flattens out) (1)	ACCEPT context of release of oxygen from Hb for mp 2, 3 and 4 ACCEPT 4 haem groups / 4 polypeptide chains / 4 iron ions IGNORE slow binding ACCEPT cooperative binding ACCEPT increased affinity for other molecules IGNORE faster binding ACCEPT due to a change in the {3D/ tertiary} structure IGNORE change of shape	(3)

Question number	Answer	Additional guidance	Mark
(b)(i)	An explanation that includes one of the following points: • {water vapour / carbon dioxide} is added to the air (1) • oxygen {used by cells / used in respiration} (1) • oxygen moves into {capillaries / blood} (1)	ACCEPT idea of carbon dioxide diffusing into the alveoli ACCEPT oxygen transported by blood IGNORE "to maintain a gradient for oxygen to diffuse"	(1)

Question number	Answer	Additional guidance	Mark
(b)(ii)	An explanation that includes the following points: • arteries take blood to {tissues / cells}, veins take blood away from {tissues / cells} (1) • oxygen diffuses (out of the capillaries) into {the tissues / cells} (1) • because there is a lower {partial pressure / concentration} in tissues / cells (1) • carbon dioxide is {increasing in / entering} (the blood)(1)	ACCEPT arteries take blood away from the heart and veins take it towards the heart. Can be pieced together. ACCEPT oxygen diffuses out of the blood ACCEPT oxygen {unloaded / released / dissociates} from haemoglobin ACCEPT because the {tissues / cells} are respiring (aerobically)	(3)

Question number	Answer	Additional guidance	Mark
(b)(iii)	Correct value for percentage saturation given (1)	81 ACCEPT 80 - 82	(1)

Question number	Answer	Additional guidance	Mark
(b)(iv)	An explanation that includes four of the following points: - partial pressure of oxygen (in the atmosphere) at high altitudes is low / lower (than at sea level) (1) (therefore) the partial pressure of oxygen in the alveoli will be lower (1) - the concentration gradient between the alveoli and the blood will be smaller (1) (therefore) the rate of diffusion of oxygen into the blood will be slower (1) (therefore) the haemoglobin will not be able to bind to as much oxygen (1)	ACCEPT converse for all marking points ACCEPT {concentration of oxygen / level of oxygen} for partial pressure in all marking points ACCEPT less oxygen (available) at high altitude ACCEPT difference in concentration of oxygen between the alveoli and the blood IGNORE less diffusion, this is about rate ACCEPT lower partial pressure of oxygen in the blood ACCEPT less oxyhaemoglobin produced IGNORE saturation of Hb is low	(4)

Q16.

Question number	Answer	Additional guidance	Mark
(a)(i)	A description that includes the following points: - smoking increases the risk of developing CVD (1) - age increases the risk of developing CVD (1)	ACCEPT a higher chance, positive correlation, smoking higher than not smoking ACCEPT a higher chance, positive correlation	(2)

Question number	Answer	Additional guidance	Mark
(a)(ii)	An explanation that includes two of the following points: - smokers still have greater risk because cigarettes still contain same chemicals / smokers have lower risk than before because people smoking (e cigarettes / fewer cigarettes) (1) - risk lower because people more aware of other risk factors / risk higher because of other named risk factor (1) - risk lower as improvements in health care (1)	Accept no change if supported by an explanation ACCEPT more aware of their health e.g. poor diet, junk food, high fat, high salt, less exercise, obesity	(2)

Question number	Answer	Mark
(b)	C 57.1×10^6 The only correct answer is C. <i>A is incorrect because $(17.7 \text{ million} \div 31) \times 100 = 57.1 \times 10^6$</i> <i>B is incorrect because $(17.7 \text{ million} \div 31) \times 100 = 57.1 \times 10^6$</i> <i>D is incorrect because $(17.7 \text{ million} \div 31) \times 100 = 57.1 \times 10^6$</i>	(1)

Q17.

Question number	Answer	Additional guidance	Mark
(a)	One from - high BMI / smoking / alcohol intake / high salt intake / high cholesterol intake And one from - age / sex / gender	Accept: obesity / overweight / high waist to hip ratio high level of {fat / sugar} in diet type 2 diabetes high stress levels air pollution	(1)

Question number	Answer	Additional guidance	Mark
(b)	A description that includes two of the following points: - increase in intensity of exercise decreases the risk of death from heart disease (1) - increase in the energy needed for exercise decreases the risk of death from heart disease (1) - for the same energy expenditure, {vigorous exercise / moderate exercise} decreases risk of death from CVD more than light exercise (1)	Accept converse throughout Accept if you expend 4000kJ per week, intensity of exercise makes no difference to risk of death from CVD	(2)

Question number	Answer	Additional guidance	Mark
(c)(i)	An explanation that includes the following points: - because antioxidants reduce free radicals (1) - free radicals cause {cell damage / tissue damage / oxidative stress / damage to endothelial lining} (1) (antioxidants) reduce {plaque / atheroma} formation (1)	Accept neutralise / stabilise / donate electrons Accept antioxidants {prevent cell damage / tissue damage / reduce oxidative stress / prevent damage to endothelial lining} Accept reduces {cholesterol build up / bloodclot formation / atherosclerosis}	(3)

Question number	Answer	Additional guidance	Mark
(c)(ii)	An answer that includes three of the following points: - use (a large number of) {healthy individuals / individuals with no known heart condition} (1) - who have similar (lifestyle and non-lifestyle) risk factors (1) - compare group given antioxidants to a group using other preventative treatments (1) - monitor the incidence of heart disease over a (long) period of time (1)	Accept control for named factor Accept give one group antioxidants and the other group {a placebo / no antioxidants} Accept at least 6 months if time is given	(3)

Question number	Answer
* (d) Indicative content:	
Outline of events (O points)	- less blood reaches the heart muscle cells, - muscle cells are not supplied with enough oxygen - muscle cells are not supplied with enough glucose - aerobic respiration decreases
Contraction stops (C points)	- anaerobic respiration produces lactic acid - lactic acid lowers pH and denatures enzymes - glycogen used as respiratory substrate - anaerobic respiration produces much less ATP / energy - therefore less / no blood is pumped by the heart - reference to effect on other organs
Use of graph / stem info (G points)	- energy released from heart cells decreases with time after blockage - reference to data from graph (not mp13 or 15) - after 8 minutes the energy released is 52 - 54 a.u. - after 8 minutes there is not enough energy for contraction - after 20 minutes the energy released is 23 - 24 a.u. - which is too low to maintain cell viability / for cells to survive - cells die as not enough ATP for vital processes eg active transport
Level 1: up to two points from anywhere; one point for 1 mark and two points for 2 marks Level 2: up to two points from each of two categories; 3 points for 3 marks, 4 points for 4 marks Must achieve 4 marks to progress to level 3 Level 3: Level 2 plus two points from the third category; five points for 5 marks and six points for 6 marks	

Q18.

Question number	Answer	Additional guidance	Mark
(a)(i)	GUG	ACCEPT guanine uracil guanine / CAC / cytosine adenine cytosine IGNORE val / valine	(1)

Question number	Answer	Additional guidance	Mark
(a)(ii)	substitution	DO NOT ACCEPT frameshift / deletion / addition / insertion IGNORE {gene / point} mutation	(1)

Question number	Answer	Additional guidance	Mark
(a)(iii)	An answer that includes the following points: - the R groups (of these two amino acids) have different {properties / bonding} (1) - glu may have repelled polar groups on other haemoglobin molecules (1) {val / hydrophobic R group / hydrophobic part} might form other (hydrophobic) interactions (with other haemoglobin molecules) (1) (part of haemoglobin containing) val (R group) turns away from {water / cytoplasm} (1)	ACCEPT amino acids have different properties ACCEPT bonds / Van der Waals DO NOT ACCEPT incorrect named bonds ACCEPT repels water DO NOT ACCEPT blood / plasma	(3)

Question number	Answer	Additional guidance	Mark
(b)	- number of non-affected babies calculated (1) $0.002 : 1 / 2 \times 10^{-3} : 1$ (1)	(140 million - 305 800 =) 139 694 200 0.002189 ACCEPT 0.0022 / 0.00219 / 0.002189 ACCEPT 1 : 457 / 456.8 NB 1 mark for 1 : 458 / 1 : 457.8 0.002184 : 1 (0.002 / 0.0022 / 0.0218) Bald answer = 2 marks	(2)

Question number	Answer	Additional guidance	Mark
(c)(i)	- values read correctly from the graph (1) 3.3 / 3.4 (1)	ACCEPT 4.4 / 4.9 and 5.7 / 5.8 / 7.7 / 7.8 ACCEPT ecf for correct subtraction using {4.4 / 7.7 / 7.8} and one incorrect value Bald answer = 2 marks	(2)

Question number	Answer	Additional guidance	Mark
(c)(ii)	An answer that includes the following points: - person without the disease has higher saturation than person with the disease (at all partial pressures of oxygen) (1) - there is {greater variability / wider range} (in the saturation) of a person with the disease than a person without the disease (at a particular partial pressure of oxygen) (1)	NB accept converse throughout but all conclusions must be comparative ACCEPT refs to affinity (for oxygen) IGNORE graph shifted	(2)

Question number	Answer	Additional guidance	Mark
(c)(iii)	120 (days) (1)		(1)

Question number	Answer	Additional guidance	Mark
(c)(iv)	An explanation that includes three of the following points: (change in structure of haemoglobin) haemoglobin {binds / carries} less oxygen (1) (shape of red blood cell) smaller surface area so less oxygen <u>diffuses</u> in / red blood cells get lodged in blood vessels preventing flow of blood to cells (1) - therefore less oxygen to {cells / tissues} so {less available for (aerobic) <u>respiration</u> / switch to <u>anaerobic respiration</u>} (1) - credit an example of why less oxygen to cells could be fatal (1)	NB accept converse where appropriate ACCEPT named cell / tissue e.g. heart attack, stroke, sepsis, infection	(3)

C1

Q19.

Question number	Answer	Additional guidance	Mark
(a)(i)	An answer that includes the following points: Similarities: - the solubility of both sodium chloride and glucose increase with (increasing) temperature (1) Differences: - sodium chloride solubility increases linearly with (increasing) temperature but glucose {does not increase linearly / increases exponentially} (1) (increasing) temperature has a greater effect on solubility of glucose than sodium chloride (1)	Piece within same / adjacent sentences, but not outside this Statement "temperature has no effect on solubility of sodium chloride" followed by "solubility of NaCl increases slightly" negates mp1 IGNORE references to dissolving faster with increasing temperature IGNORE attempts to describe glucose solubility unless compared to {linear / constant} increase for sodium chloride ACCEPT converse ACCEPT solubility of glucose increases more than solubility of sodium chloride ACCEPT manipulation if a direct comparison is made	(3)

Question number	Answer	Additional guidance	Mark
(a)(ii)	An answer that includes the following points: - six carbons, twelve hydrogens and six oxygens used in calculation (1) - molecular mass calculated (1)	ACCEPT formula written down $(6 \times 12) + (12 \times 1) + (6 \times 16) = 180$ Correct answer gets 2 marks CE if wrong formula for glucose used (as long as formula is written)	(2)

Question number	Answer	Additional guidance	Mark
(a)(iii)	correct answer (1)	CE from 4(a)(ii) applies $180 \div 58.44 = 3.08$ ACCEPT 3 / 3.1	(1)

Question number	Answer	Additional guidance	Mark
(a)(iv)	An answer that includes the following points: • (glucose is a larger molecule than sodium chloride therefore) glucose can be surrounded by more water molecules (1) • glucose has {(many) hydroxyl groups / (more) polar groups} (1) • (therefore) glucose forms (more) hydrogen bonds with water molecules (1) • strength of bonding (between particles) is lower in glucose compared to sodium chloride (1)	ACCEPT converse for all marking points IGNORE glucose is {more polar / a polar molecule} ACCEPT increase in entropy is greater when glucose dissolves (for either mp1 or mp2)	(2)

Question number	Answer	Additional guidance	Mark
(b)	An explanation that includes the following points: • water is a polar solvent (1) • fatty acids have {hydrophobic / non-polar} tails (1) • {fatty acids / non-polar molecules} {do not form hydrogen bonds / do not dissolve in polar liquids / repel polar liquids} (1)	ACCEPT water is dipolar ACCEPT fatty acids are {hydrophobic / non-polar} ACCEPT fatty acids {stick together / aggregate / form micelles} ACCEPT {water/blood/plasma} for polar liquids only in context of repulsion IGNORE fatty acids are too big to dissolve	(2)

Question number	Answer	Additional guidance	Mark
(a)	The correct answer is C A is incorrect because starch is insoluble in water and consists of amylose and amylopectin is insoluble in water B is incorrect because starch is insoluble in water and consists of amylose and amylopectin is insoluble in water D is incorrect because starch has 1-4 bonds as well as 1-6		(1)

Question number	Answer	Additional guidance	Mark
(b)(i)	An answer that includes the following points: - glycosidic (1) (α) glucose (1) - fructose (1) - galactose (1)	IGNORE 1-4 / 1-6 IGNORE α and β IGNORE α and β	(4)

Question number	Answer	Additional guidance	Mark
(b)(ii)	condensation (reaction) (1)	ACCEPT polymerisation	(1)

Question number	Answer	Additional guidance	Mark
(b)(iii)	The correct answer is C A is incorrect because the molecular mass is $180 + 180 - 18 = 342$ B is incorrect because the molecular mass is $180 + 180 - 18 = 342$ D is incorrect because the molecular mass is $180 + 180 - 18 = 342$		(1)

Q21.

Question number	Answer	Additional guidance	Mark
(a)	An answer that includes three of the following points: Similarities Any two from: • both contain a glycerol (1) • both contain fatty acids (1) • both contain ester bonds (1) Differences • triglycerides have three fatty acids and phospholipids have two fatty acids (1) • triglycerides do not contain a phosphate group but phospholipids do contain a phosphate group (1)	NB Do not piece together from two descriptions in separate sentences IGNORE diagrams	(3)

Question number	Answer	Additional guidance	Mark
(b)	An explanation that includes the following points: • {protein / phosphate heads / phospholipid heads} are {soluble / hydrophilic / polar} and interact with {blood / plasma} (1) • {fatty acids / triglycerides /cholesterol} is {insoluble / non-polar / hydrophobic} (1) • therefore cholesterol is surrounded by {fatty acid tails / triglycerides} (1)		(3)

Question number	Answer	Additional guidance	Mark												
(c)(i)	- volume of sphere calculated / values substituted into the equation (1) - volume of sphere rounded up to nearest whole number (1) - ratio calculated (1)	Example of calculation = 6912 if using $\pi = 3$ = 7142.4 if using $\pi = 3.1$ = 7234.56 if using $\pi = 3.14$ = 7239.168 if using $\pi = 3.142$ = 7241.472 if using $\pi = 3.143$ = 7238.22947387 if pressing π on calculator = 6912 / 7142 / 7235 / 7239 / 7238 / 7241 ACCEPT 6910 / 7140 / 7240 NB Just these values given = 2 marks 14 : 1 13 : 1 if 6910 / 6912 CE apply throughout NB mark answer in table if different from in the working e.g. <table border="1"> <thead> <tr> <th>Diameter of LDL / nm</th><th>Volume of LDL / nm³</th><th>Volume of cholesterol / nm³</th><th>Ratio of LDL volume to cholesterol volume</th></tr> </thead> <tbody> <tr> <td></td><td></td><td></td><td></td></tr> <tr> <td></td><td>7235 = 2 marks</td><td></td><td>14 : 1 = 1 mark</td></tr> </tbody> </table>	Diameter of LDL / nm	Volume of LDL / nm ³	Volume of cholesterol / nm ³	Ratio of LDL volume to cholesterol volume						7235 = 2 marks		14 : 1 = 1 mark	(3)
Diameter of LDL / nm	Volume of LDL / nm ³	Volume of cholesterol / nm ³	Ratio of LDL volume to cholesterol volume												
	7235 = 2 marks		14 : 1 = 1 mark												

Question number	Answer	Additional guidance	Mark
* (c)(ii)	Indicative content: • as LDL increases, risk increases (K / G) • several factors beside LDLs can increase the risk of CVD (K) • example of a factor given e.g. high blood pressure (K) • LDLs can be different sizes (Q) • and therefore be absorbed by endothelial cells differently (Q) • and therefore get broken down at different rates (K / Q) • and therefore carry different volumes of cholesterol (Q) • level of HDL (in blood) affects risk (of CVD) (K / G) • example given from graph e.g. 0.65 a.u. has greater risk than 2.20 a.u. (G) • ratio of LDL : HDL affects risk (of developing CVD) (K / G) • the lower LDL : HDL the ratio the lower risk of CVD (K / G)		(6)
Own knowledge (K), information given in the graph (G), information in the question (Q) Level 1 : uses either (K), (G) or (Q) 1 mark = 1 comment, 2 marks = 2 comments Level 2 : uses two from (K), (G) or (Q) 3 marks = 3 comments, 4 marks = 4 comments Level 3 : uses (K), (G) and (Q) 5 marks = 5 comments, 6 marks = 6 comments			

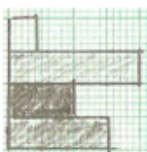
Q22.

Question number	Answer	Additional guidance	Mark
(a)	• surface area of one vein calculated (1) • total surface area = $1.4 \times 10^3 / 1.5 \times 10^3$ (1) • length of vena cava = 40.7 / 40.8 / 42.7 (1)	37.68 DO NOT ACCEPT 37 ecf for wrong value in mp 1 but multiplied by 40 and incorrect standard form Bald answer in table or in space (provided same as in table if given) = 2 marks Bald answer of {36 / 37.68 / 37.7 / or in correct standard form} in box = 1 mark NB if they have shown the correct answer but not in standard form, award mp 1 as they must have calculated this value correctly (check the box below)	(3)

mp	Value used for π		
	3	3.14	calculator
1. S.A. of one vein	36	37.68	37.699111843077518 861551720599354
2. Total S.A	1,440	1,507.2	1,507.96447372310075446 20688239742
	1.4×10^3	1.5×10^3	1.5×10^3
3. Length	42.666666666666666 666666666666667	40.7643312101910828 02547770700637	40.743665431525205 956834243423363
	42.7	40.8	40.7

Question number	Answer	Additional guidance	Mark
(b)	An explanation that includes the three of the following points: • blood in aorta is under higher pressure as it has just been pumped out of the {heart / (left) ventricle} (1) • aorta branches into many arteries /(blood flowing through) more vessels (1) • the {friction / resistance} between blood and vessel (slows the velocity down) (1) • blood cannot be pushed through because of {loss of elasticity in arteries / less elastic recoil} (1)	NB may need to piece together NB statements about the arteries do not need qualifying as the question is about arteries. If comparative statements about the aorta are made then they must be qualified ACCEPT velocity slower in arteries as they do not receive blood directly from the heart ACCEPT (total) cross-sectional area of arteries are greater than the aorta ACCEPT diameter of artery <u>lumen</u> is smaller / artery <u>lumen</u> is narrower diameter of aorta <u>lumen</u> is greater so velocity will be faster ACCEPT in the form of a comparison with the aorta being able to force blood because of more elastic fibres	(3)

Question number	Answer	Additional guidance	Mark
(c)	An explanation that includes the following points: • more plasma is able to leave (the capillaries) (1) • results in faster diffusion (1) • more capillaries are in contact with the cells (in the tissue) (1)	ACCEPT named molecule e.g. oxygen, glucose ACCEPT faster gas exchange / rate of diffusion is fast enough / diffusion is rapid ACCEPT capillaries are close to more cells / diffusion distance is short	(2)

Question number	Answer	Additional guidance	Mark
(d)(i)	The correct answer is A,  B is incorrect because arteries have a high proportion of elastic fibres C is incorrect because arteries have an endothelial lining D is incorrect because artery walls contain collagen		(1)

Question number	Answer	Additional guidance	Mark
(d)(ii)	• a diagram showing a bar for the endothelial cell layer only (1)	ACCEPT any length	(1)

Q23.

Question number	Answer	Additional guidance	Mark
(a)(i)	The correct answer is B <i>A is incorrect because the aorta takes blood away from the left hand side of the heart</i> <i>C is incorrect because pulmonary vein returns blood to the left hand side of the heart</i> <i>D is incorrect because the vena cava returns blood to the right atrium</i>		(1)

Question number	Answer	Additional guidance	Mark
(a)(ii)	The correct answer is A <i>B is incorrect because stage F which is ventricular systole</i> <i>C is incorrect because F is ventricular systole</i> <i>D is incorrect because F is ventricular systole</i>		(1)

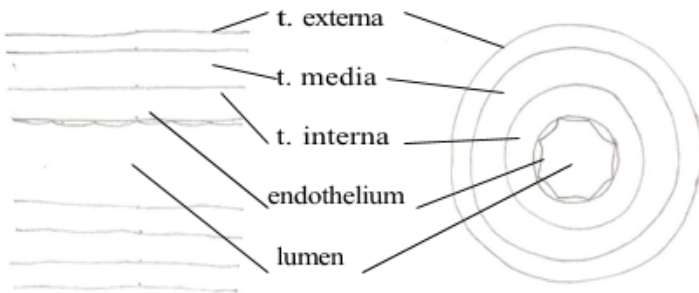
Question number	Answer	Additional guidance	Mark
(b)(i)	- values read from the graph and subtracted to give the time for one heart beat (1) 75.0 (1)	0.8 / any pair of values that give 0.8 when subtracted DO NOT ACCEPT 75 ECF from mph 1 if values correspond to readings from graph Bald answer of 75.0 = 2 marks Bald answer of 75 = 1 mark	(2)

Question number	Answer	Additional guidance	Mark
(b)(ii)	An answer that includes three of the following points: - graph will be {the same / similar in} {shape / position} (1) - because the left hand side and right hand side beat simultaneously (1) - peaks will be lower (1) - because pressure in right hand side is lower {as blood is only pumped to <u>lungs</u> / to prevent damage to <u>alveoli</u>} (1)	NB 'It' refers to the line for the right ventricle NB accept converse where appropriate ACCEPT line ACCEPT description e.g. both ventricles contract at the same time IGNORE graph lower down ACCEPT because right ventricle has {less muscle / thinner walls} as blood is only pumped to <u>lungs</u> less force to <u>lungs</u> NB If candidate says that there is something drawn on the graph you must send it to review	(3)

Q24.

Question number	Answer	Additional guidance	Mark
(a)	answer to no more than one decimal place in the range of 1.3 to 2.4 (m)		(1)

Question number	Answer	Additional guidance	Mark
(b)	An explanation that includes two of the following points: - because blood has to be pumped under high pressure (from the heart) (1) - so that the blood can reach the { brain / head} (1) - pump blood against (the force of) gravity (to the upper parts of the body) (1)		(2)

Question number	Answer	Additional guidance	Mark
(c)(i)	A drawing that shows : {3 layers / 3 layers and endothelium} + lumen (1) Any two from: - lumen (1) - endothelium / epithelium (1) - tunica {interna / intima} (1) - tunica media (1) - tunica {externa / adventitia} (1)	 ACCEPT inside line labelled if 2 layer diagram with no endothelium labelled IGNORE smooth muscle ACCEPT (smooth) muscle (cells) and elastic fibres ACCEPT collagen fibres N.B. If one incorrect label, max of 1 label mark If two incorrect labels then no label marks can be awarded	(3)

Question number	Answer	Additional guidance	Mark
(c)(ii)	An explanation that includes the following points: - the blood is under high pressure so that the {arteries need to widen / elastic fibres need to stretch} (1) - elastic recoil necessary to maintain the high blood pressure (1)	N.B. need to stretch and recoil to {maintain / accommodate} high pressure = 1 mark if no other mps awarded	(2)

Question number	Answer	Additional guidance	Mark
(d)(i)	An explanation that includes the following points: - because there will be less blood flowing (near the surface of the skin at any one time) (1) - therefore blood clot will form {more easily / faster} (1)	ACCEPT blood at {lower / low} pressure ACCEPT clotting will be {faster / easier} less blood lost whilst clot forming	(2)

Question number	Answer	Additional guidance	Mark
(d)(ii)	An explanation that includes the following points: - because (the smaller red blood cells will have) a greater surface area (1) - and therefore oxygen will be able to diffuse (into / out of the RBCs) faster (1)	IGNORE easier to diffuse / more can diffuse	(2)

Q25.

Question number	Answer	Mark
(a)	The only correct answer is D (vena cava) A is incorrect because the diagram shows a blood vessel bringing blood back into the right atrium B is incorrect because the diagram shows a blood vessel bringing blood back into the right atrium C is incorrect because the diagram shows a blood vessel bringing blood back into the right atrium	(1)

Question number	Answer	Additional guidance	Mark
(b)(i)	(cardiac) diastole (1)	ACCEPT (heart / complete / total / ventricular <u>and</u> atrial / atrioventricular) diastole DO NOT ACCEPT diasystole / dystole / ventricular diastole / systic diastole	(1)

Question number	Answer	Additional guidance	Mark
(b)(ii)	An answer that makes reference to the following points: - length of one heart beat calculated (1) 0.06 / 0.061 / 0.0608 (1)	Example of calculation 0.82191780821917808219178082191781 6 / 6.1 / 6.08 % 5/82 Ecf if $73 \div 60$: 0.04 / 0.041 / 0.0411 4 / 4.1 / 4.11 % 3/73 Bald answer score two marks Bald answer with incorrect number of decimal places scores 1 mark.	(2)

Question number	Answer	Additional guidance	Mark
(c)(i)	104 / 104.17 / 104.2 (1)		(1)

Question number	Answer	Additional guidance	Mark
(c)(ii)	An explanation that makes reference to the following points: - to delay the movement of the impulse across the (atrioventricular) septum (1) - so that the atria can finish emptying (1) - so that the atrioventricular valves can close (1)	ACCEPT to delay the contraction of the ventricles ACCEPT so that ventricles can fill NB Accept answers that refer to right atrium and right ventricle	(2)

Q26.

Question number	Answer	Additional guidance	Mark
(a)	An explanation that includes the following points: • because antioxidants reduce free radicals (1) • free radicals cause {cell damage / oxidative stress} (1) • (antioxidants) reduce {plaque / atheroma} formation (1)	ACCEPT neutralise / stabilise / donate electrons ACCEPT antioxidants {prevent cell damage / reduce oxidative stress} ACCEPT reduces cholesterol build up	(3)

Question number	Answer	Additional guidance	Mark
(b)(i)	An explanation that includes the following points: • dark chocolate contains more flavenoids (than milk chocolate per 100g) (1) • and therefore more antioxidants to reduce the risk of CVD (1) • dark chocolate contains less energy (per unit mass) than milk chocolate (1) • so is less likely to cause obesity which {is a risk factor / decreases the risk} of CVD (1)	ACCEPT matching converse points ACCEPT description of what antioxidants do IGNORE incorrect descriptions ACCEPT calories ACCEPT overweight	(4)

Question number	Answer	Mark
(b)(ii)	The only correct answer is A cocoa mass B is incorrect because both types of chocolate contain similar % of milk fat C is incorrect because both types of chocolate contain similar % of sugar D is incorrect because milk chocolate contains more whole milk powder than dark chocolate	(1)

Question number	Answer	Additional guidance	Mark
(b)(iii)	An answer that includes three of the following points: - two groups of people one eating chocolate and one {control / not eating chocolate} (1) - who {have no (known) risk of / do not have} CVD (1) - credit description of control variable - incidence of heart disease recorded (over a period of time, at least a year) (1)	ACCEPT 3 groups if one has no chocolate, one has milk chocolate and one has dark chocolate ACCEPT healthy e.g. same sex, similar {size / age / lifestyle} ACCEPT same mass of chocolate if comparing dark with milk chocolate IGNORE amount ACCEPT monitor risk factors / examples e.g. blood pressure, cholesterol levels, BMI	(3)

Q27.

Question number	Answer	Mark
(a)(i)	The only correct answer is B 1 : 3 A is incorrect because triglycerides are composed of one glycerol molecule and three fatty acids C is incorrect because triglycerides are composed of one glycerol molecule and three fatty acids D is incorrect because triglycerides are composed of one glycerol molecule and three fatty acids	(1)

Question number	Answer	Mark
(a)(ii)	 The only correct answer is C. A is incorrect because this shows a peptide bond B is incorrect because an ester bond does not contain a nitrogen D is incorrect because there should be a double O on the carbon	(1)

Question number	Answer	Additional guidance	Mark
(a)(iii)	An explanation that includes the following points: - palmitoleic and linoleic (acid) (1) - because they {are unsaturated fatty acids / have double bonds (between carbon atoms)} (1) OR - linoleic (acid) (1) - because it has {two / the most} double bonds (between carbon atoms) (1)	ACCEPT converse in the context of butyric acid and stearic acid having the lowest risk IGNORE chain length ACCEPT polyunsaturated IGNORE chain length	(2)

Question number	Answer	Additional guidance	Mark
(b)(i)	An explanation that includes the following points: - because thrombin would not be able to bind to fibrinogen (1) - therefore fibrin is not formed (1)	ACCEPT fits active site / thrombin – fibrinogen complexes ACCEPT less fibrin formed	(2)

Question number	Answer	Additional guidance	Mark
(b)(ii)	An explanation that includes the following points: - because the platelets would not be able to bind to fibrin (1) - therefore the {mesh / clot} would not be formed (1) OR - and therefore do not release thromboplastin (if not binding to each other / endothelium) (1)	ACCEPT not able to bind to {blood cells / other platelets / endothelium} less sticky	(2)

Question number	Answer	Additional guidance	Mark
(b)(iii)	An explanation that includes the following points: - therefore plasmin {hydrolyses fibrin / breaks the peptide bonds in fibrin} (1) - because {without fibrin / with less fibrin} there is {nothing / less} to trap the {platelets / blood cells} (1)	ACCEPT {no / less} mesh formed	(2)

Q28.

Question number	Answer	Additional guidance	Mark
(a)	A description that includes the following point: - to be present in the blood (all the time) (1) and any TWO of the following: - needed to make thrombin (when blood needs to clot) (1) - which is an {enzyme / catalyst} (1) - so that fibrinogen can be converted into fibrin (1)	ACCEPT precursor of clotting process / inactive form of thrombin / inactive enzyme / inactive plasma protein NB thrombin catalyses fibrinogen into fibrin = 2 marks	(3)

Question number	Answer	Mark
(b)	The only correct answer is A A anticoagulant <i>B is incorrect because antihypertensives treat high blood pressure</i> <i>C is incorrect because platelet inhibitors inhibit platelets, which are involved in the cascade before prothrombin and prothrombin is made by the liver</i> <i>D is incorrect because statins treat high blood cholesterol levels</i>	(1)

Question number	Answer	Additional guidance	Mark
(c)(i)	An answer that includes the following points: - warfarin and vitamin K have a similar structure (1) - therefore warfarin {binds / blocks} to the {vitamin K epoxide reductase / VKOR} (1) (as a result of warfarin binding to enzyme) {less / no} vitamin K reduced (1)	ACCEPT both have rings / double bond oxygen ACCEPT warfarin is a {competitive / active-site directed } inhibitor / description DO NOT ACCEPT non-competitive inhibitor / description of one binds to vitamin K	(2)

Question number	Answer	Additional guidance	Mark
(c)(ii)	An answer that includes the following points: - increase in vitamin K would compete with warfarin for the active site (of vitamin K epoxide reductase / VKOR) (1) - therefore {some / more} vitamin K will be reduced (if vitamin K binds to enzyme) (1)	ACCEPT a description e.g. more enzyme substrate complexes	(2)

Question number	Answer	Additional guidance	Mark
(d)	An explanation that includes the following points: - large groups of people (1) (sample size is large) for reproducibility (1) - people in both groups consume the same {mass / volume / concentration} of vitamin K (1) - people in both groups consume the same concentration of drugs (1) (variables controlled) for validity (1)	ACCEPT 20 + IGNORE reference to control groups ACCEPT repeatable / reliable IGNORE accurate / precise / valid IGNORE amount ACCEPT other appropriate named control variable e.g. sex, age, diet, level of activity, alcohol intake IGNORE same number of people in each group / amount IGNORE accurate / precise /reproducible / repeatable / reliable	(4)

Q29.

Question number	Answer	Additional guidance	Mark
	An answer that includes the following points (in order): - dipolar (1) - positive (1) - solvent (1) - hydrolysis (1) - lactose (1)	ACCEPT dipole / polar ACCEPT medium DO NOT ACCEPT hydration DO NOT ACCEPT lactase / other named molecules	(5)