PEARSON EDEXCEL IAL BIOLOGY · YBI11

# BIOLOGY



## EXAM QUESTION PACK

### UNIT 1: MOLECULES, TRANSPORT AND HEALTH

| SCORE | 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)**

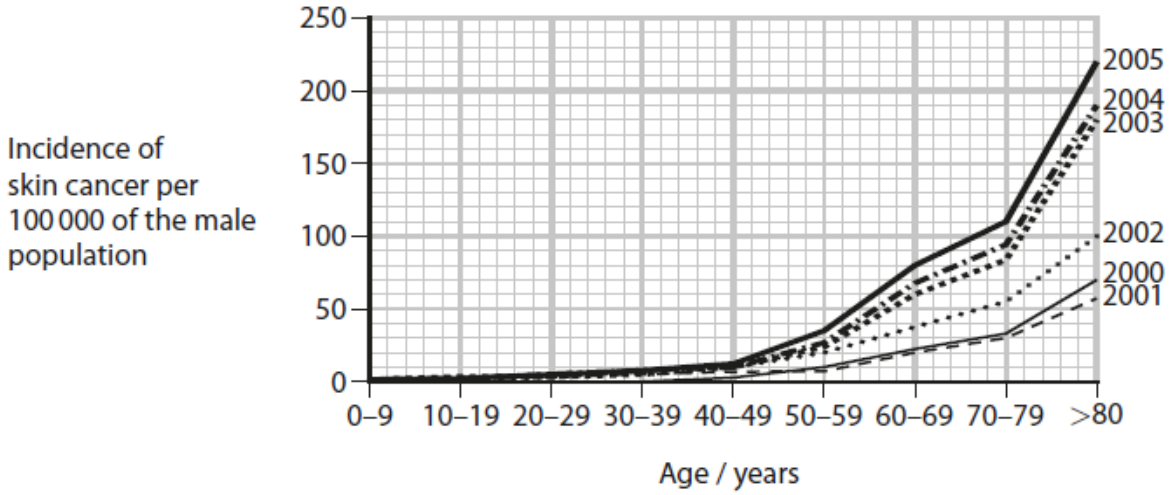
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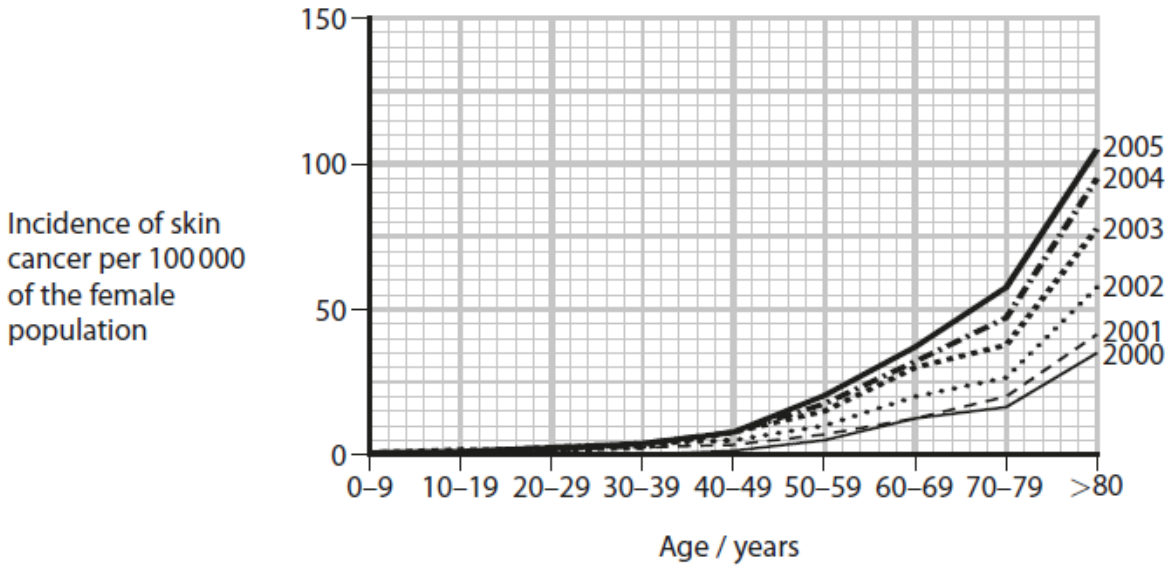
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(b) Exposure to ultraviolet light is associated with the development of skin cancer.

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**.

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(ii) Describe the correlations shown by these graphs.

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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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**(Total for question = 14 marks)**

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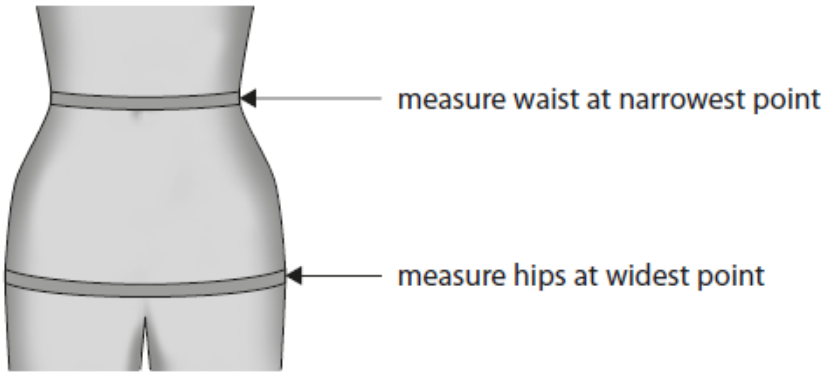
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(iv) The diagram shows how the waist and hip measurements should be taken, using a tape measure.




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

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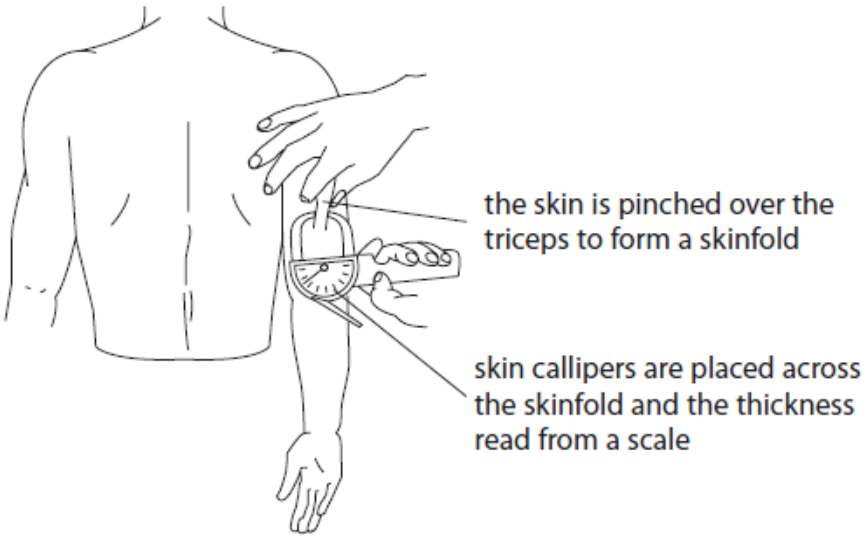
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(b) The diagram shows how a skinfold thickness measurement is taken over the triceps muscle at the back of the arm.




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 .....

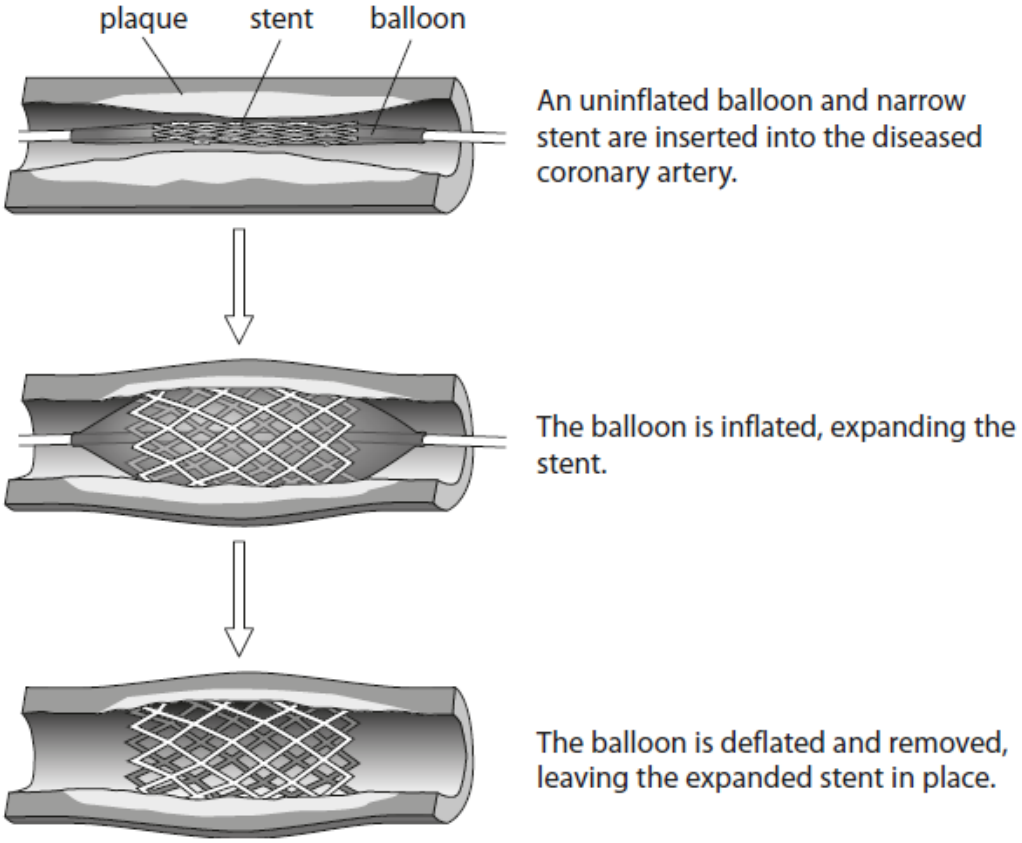
**(Total for question = 11 marks)**

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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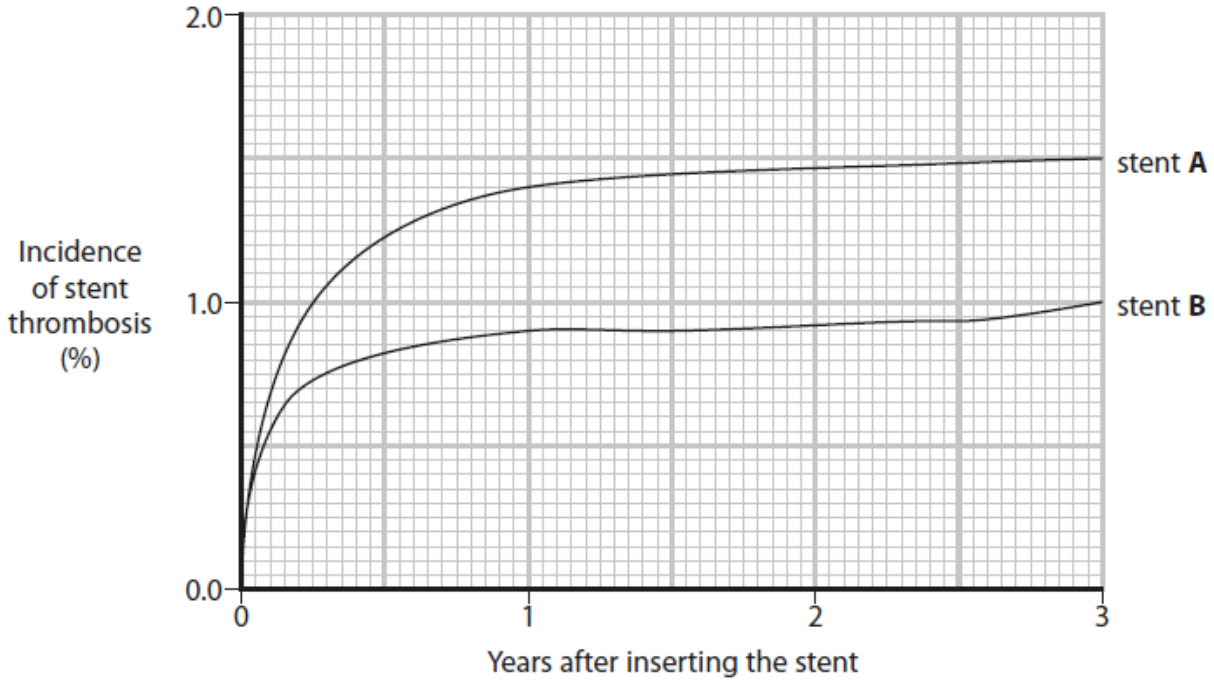
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(b) Inserting a stent can damage the artery.

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)**

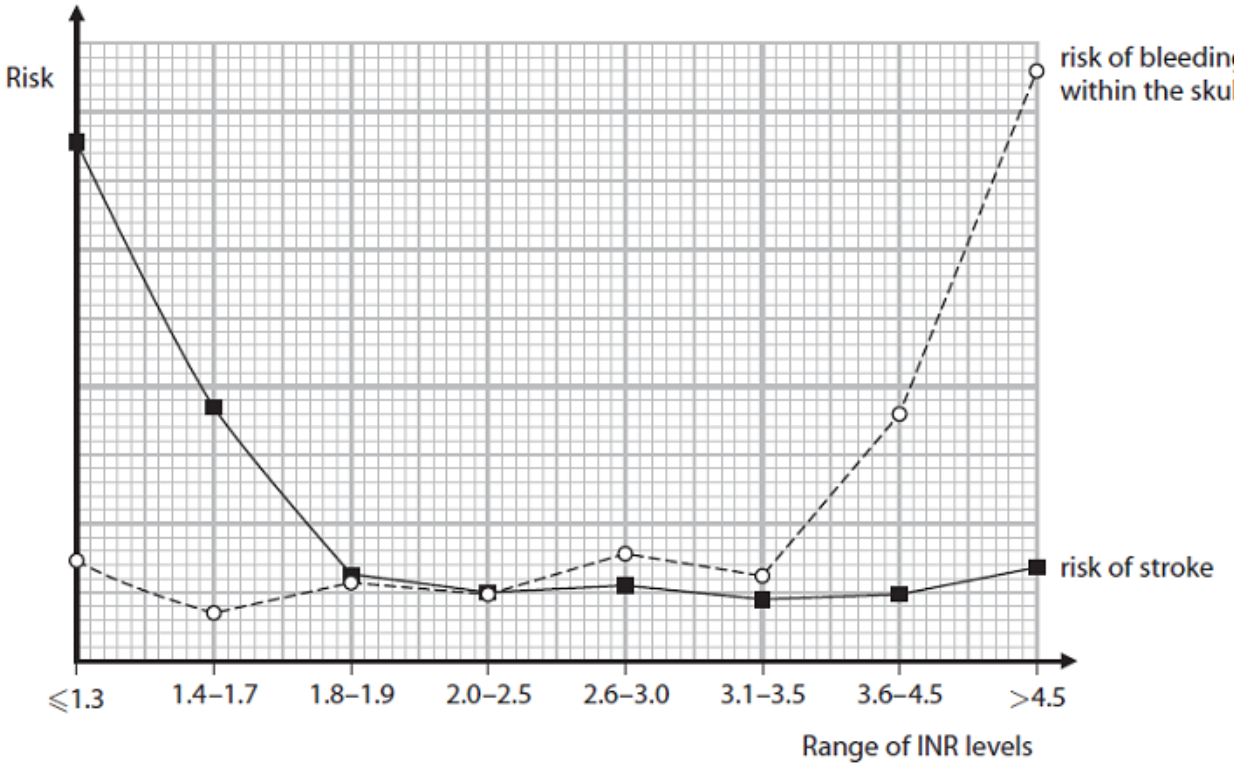
☐ **A** none

☐ **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.

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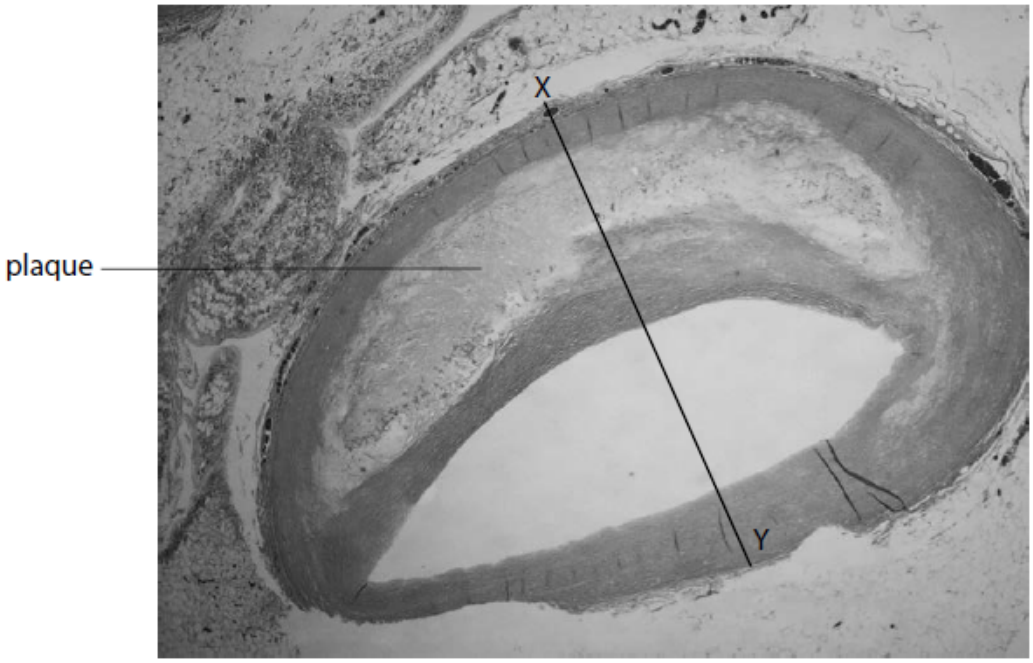
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**(Total for question = 12 marks)**

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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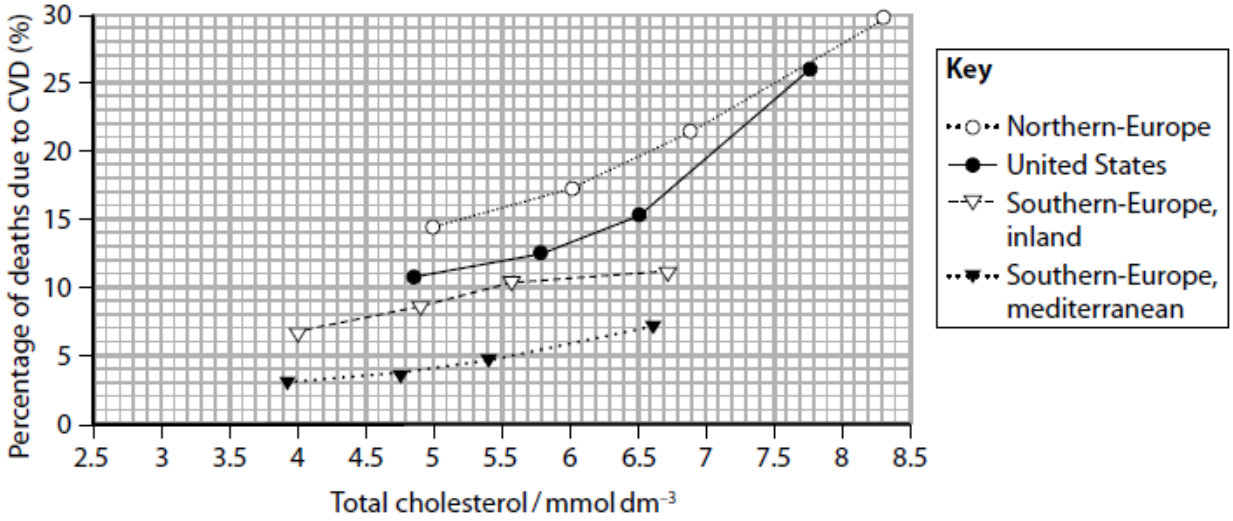
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*(c) Cholesterol is transported in the blood as lipoproteins LDL and HDL.

In one study, the relationship between total blood cholesterol and the risk of death from CVD was investigated.

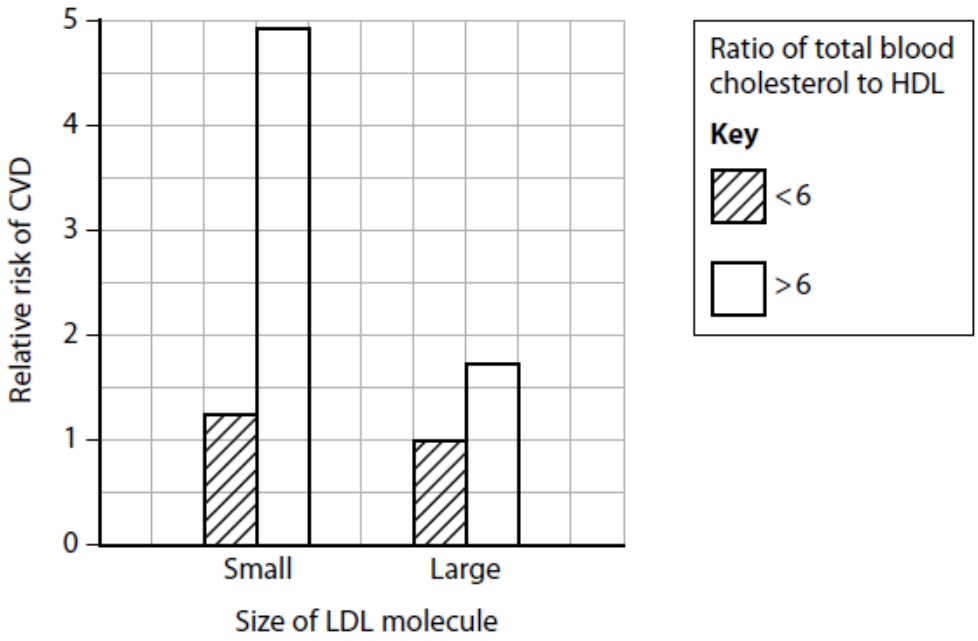
The results are shown in the graph.




**Graph 1**

In another study, the effect of the size of LDL and the ratio of total blood cholesterol to HDL on the relative risk of CVD was investigated.

The results are shown in the graph.




**Graph 2**

Assess the contribution of lipoproteins to the risk of developing CVD. Use the information in the graph to support your answer.

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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 ..... | ..... |

(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

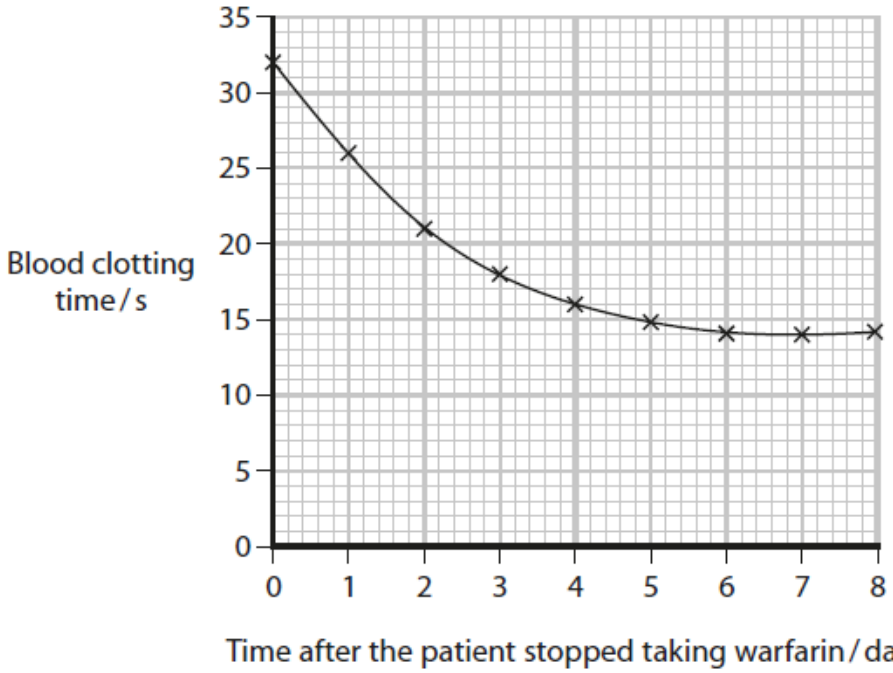
☒ **B** an antihypertensive

☒ **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** 4

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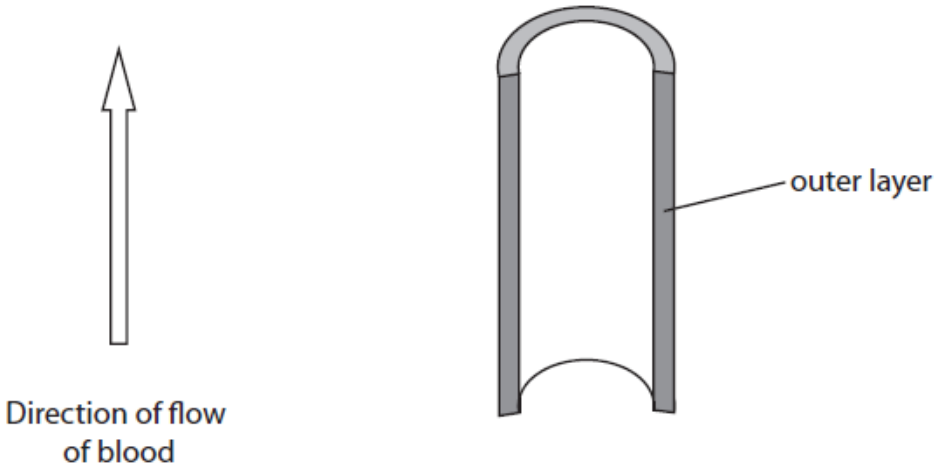
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(c) Blood returns to the heart through the veins.

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 ☒.**

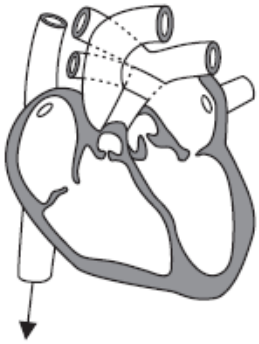
Blood flows through the heart during the cardiac cycle.

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

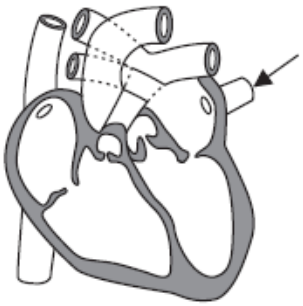
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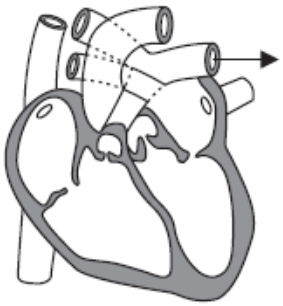
☒ A



☒ 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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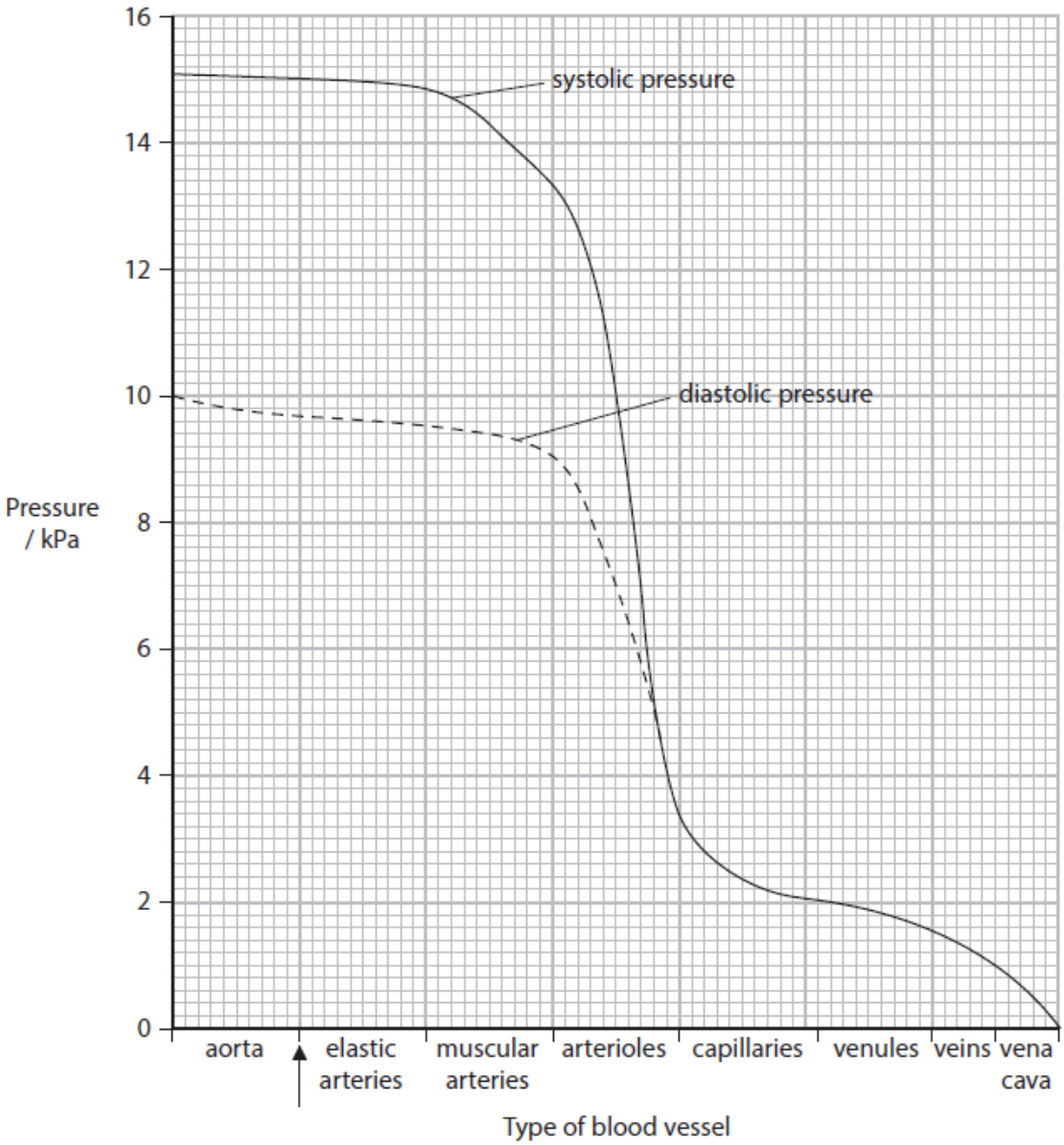
**(Total for question = 7 marks)**

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.

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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 ($\Delta P$), the radius of the blood vessel lumen (r), the length of the blood vessel ($\lambda$) and the viscosity of the blood ($\eta$).

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** $\frac{8\eta\lambda}{\pi\Delta Pr^4}$

☒ **B** $\frac{\pi\Delta Pr^4}{8\eta\lambda}$

☒ **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).

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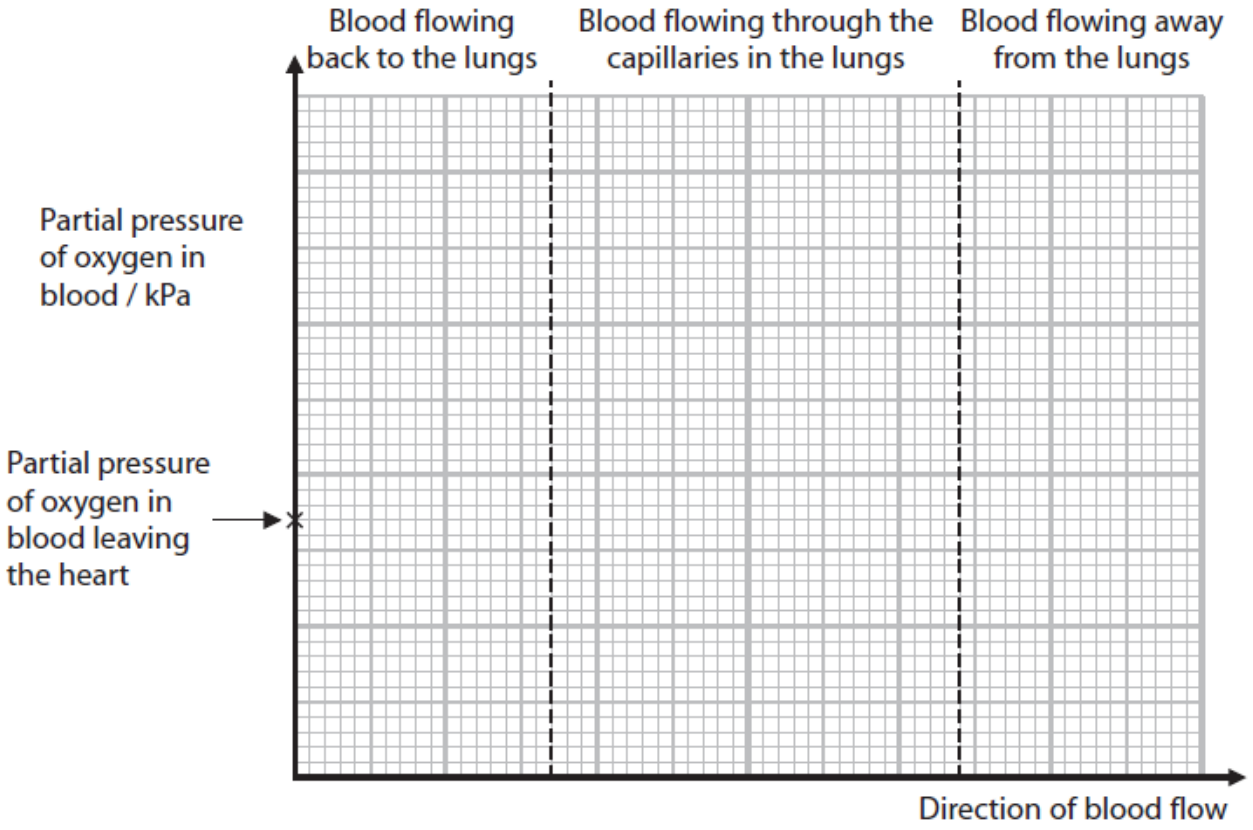
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(d) Deoxygenated blood is taken to the lungs and oxygenated blood is taken away from the lungs.

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)**

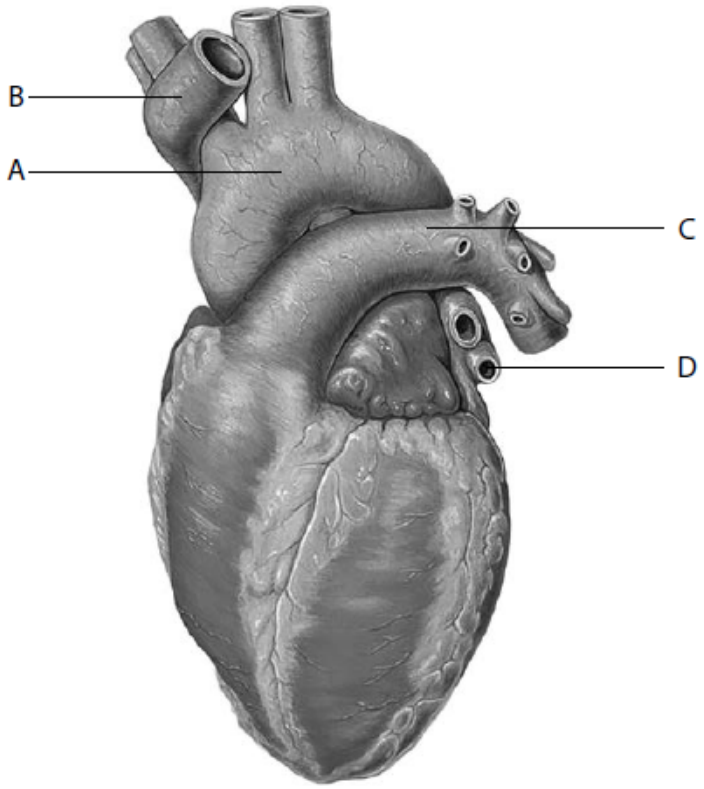



**(Total for question = 10 marks)**

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)**

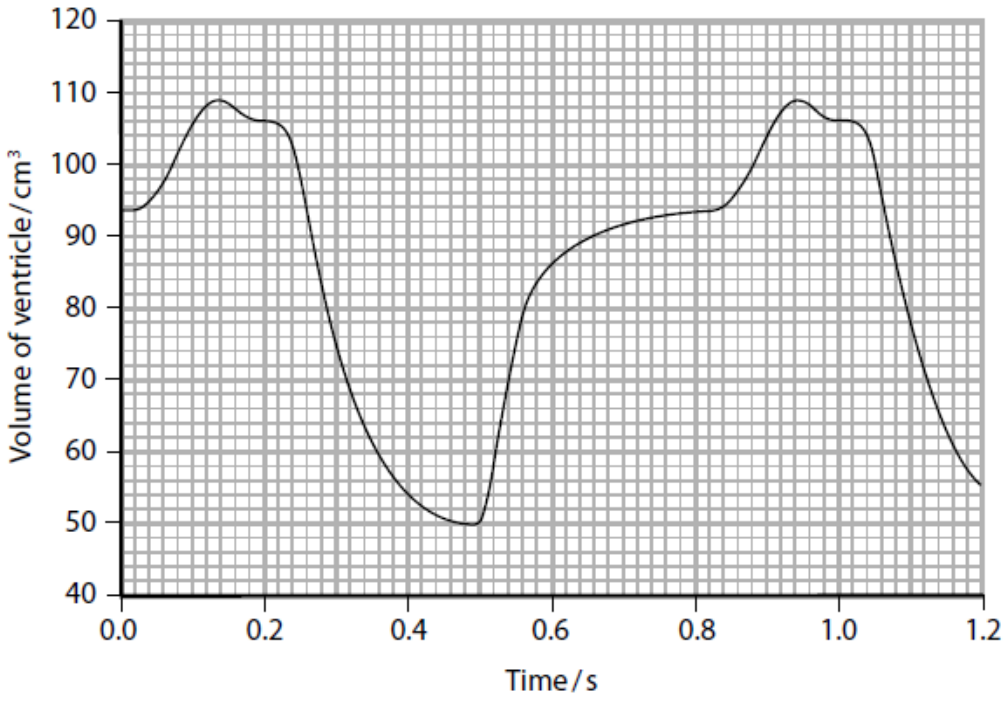
☒ **A**

☒ **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.

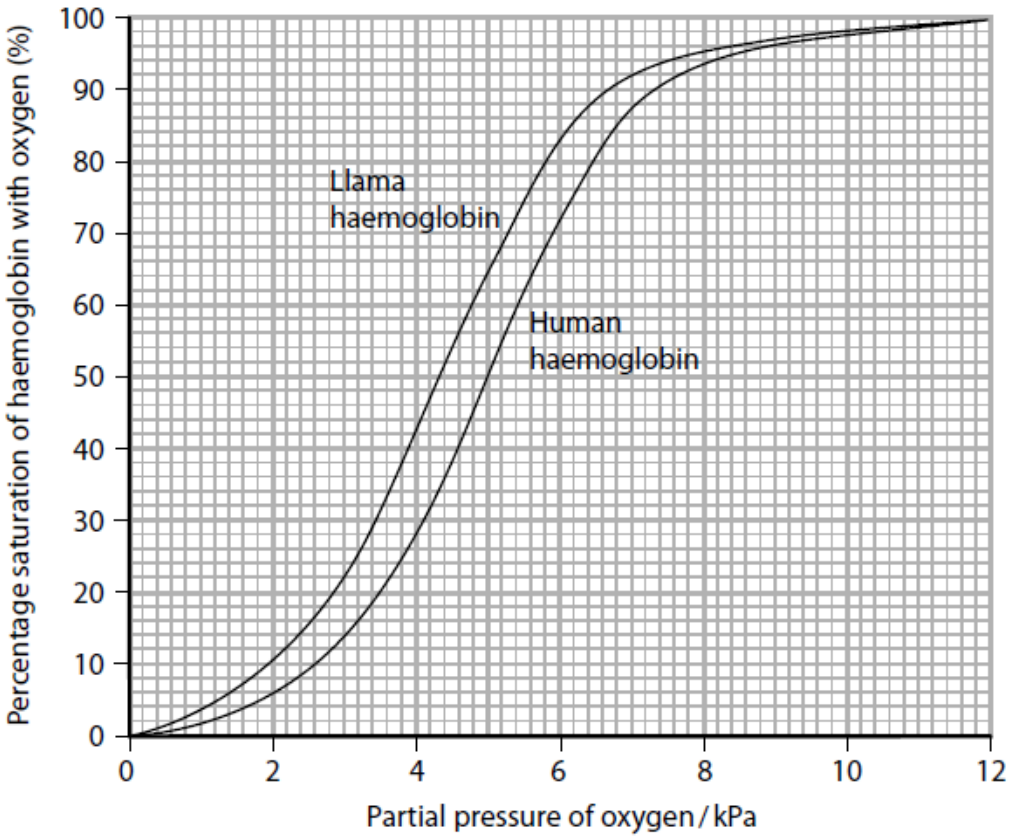
**(3)**

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 |

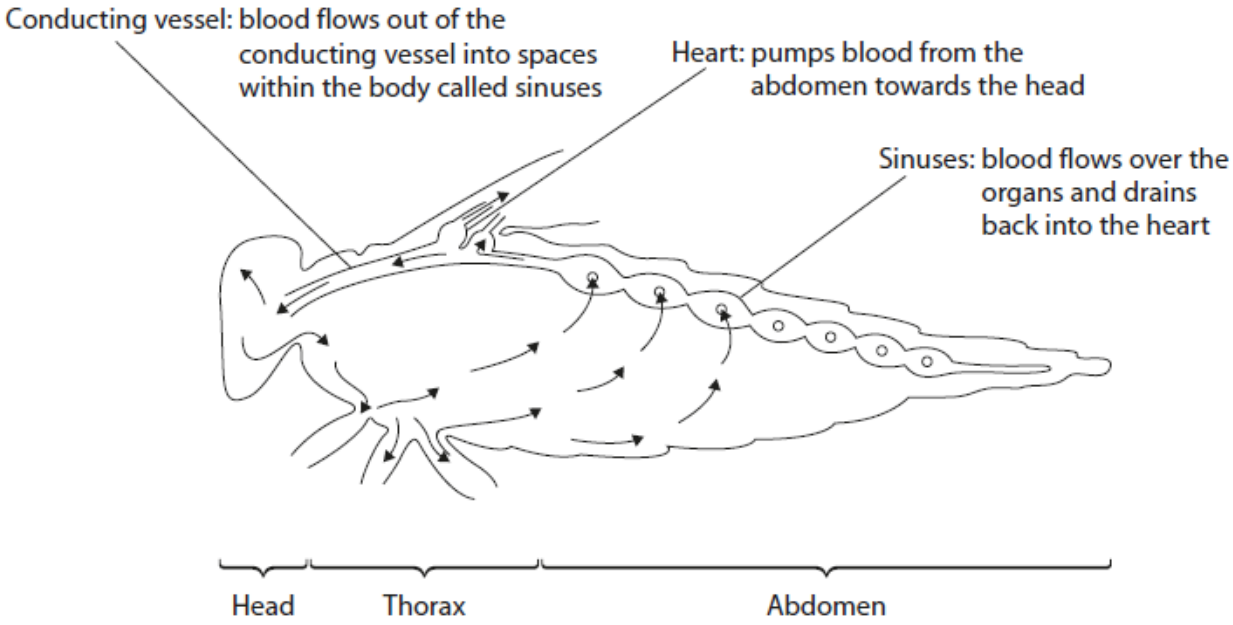
(iii) Which row of the table describes a saturated lipid?

**(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 $mm^2$.

**(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.

**(2)**

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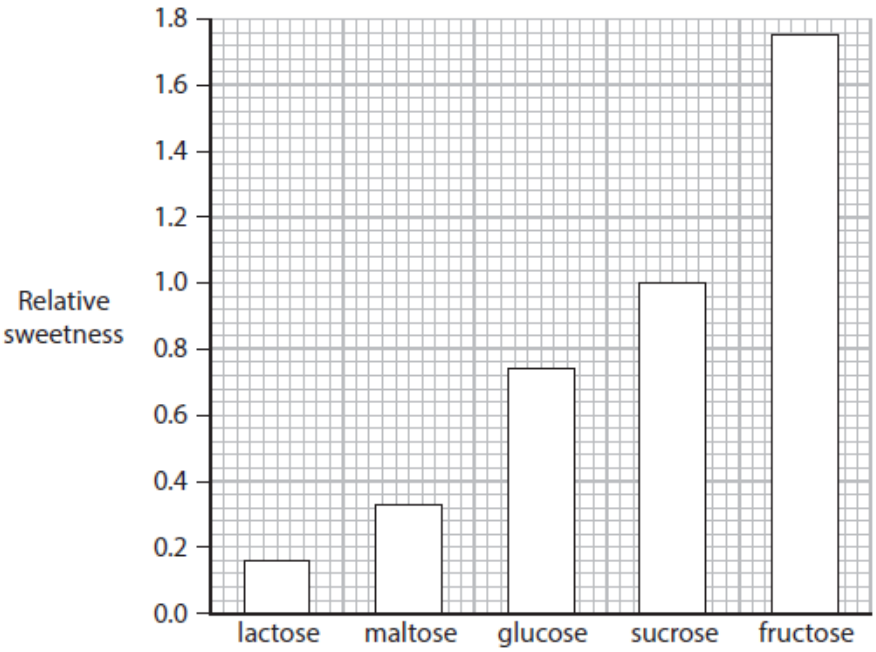
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**(Total for question = 6 marks)**

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)**

1 .....

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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.

**(3)**

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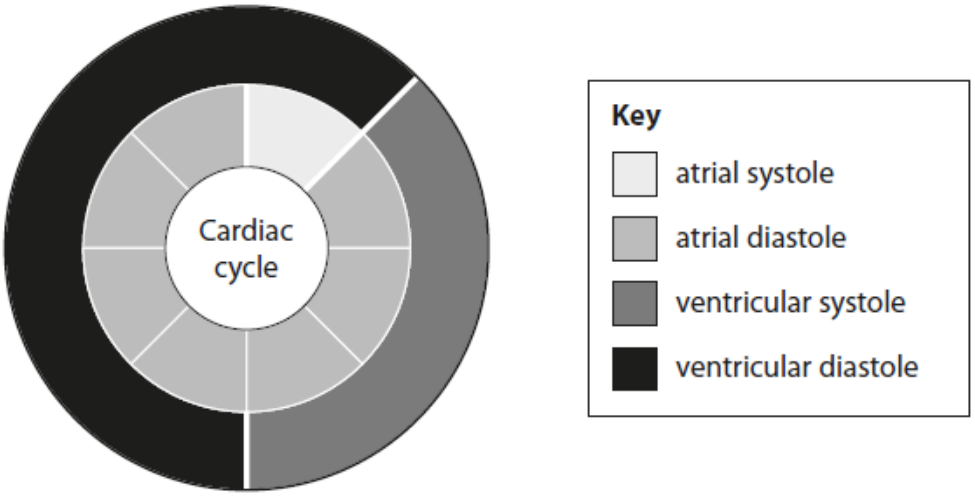
**(Total for question = 10 marks)**

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.

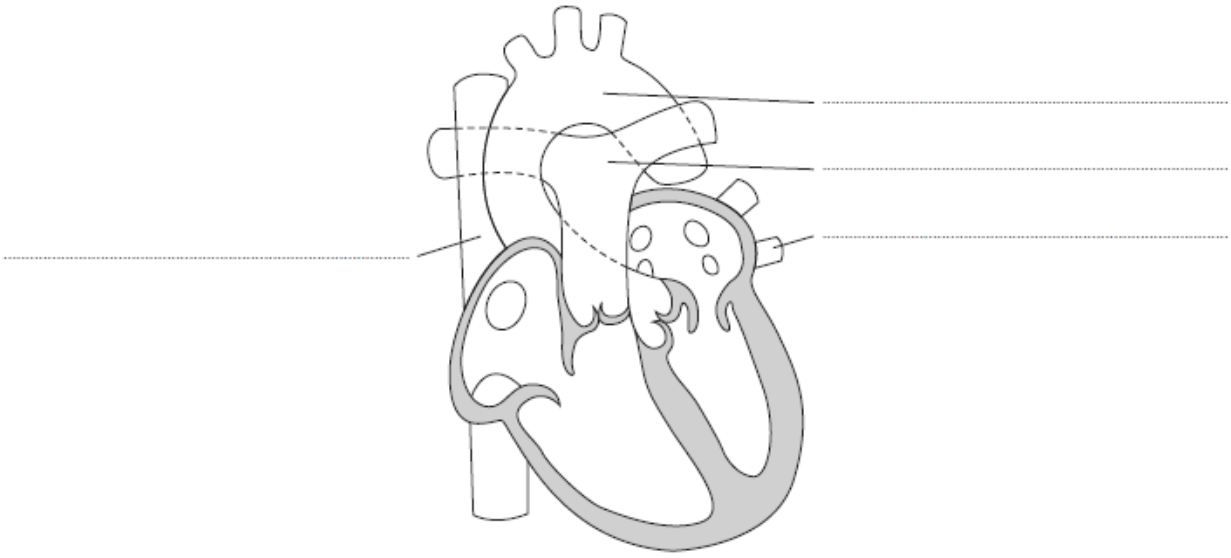
**Answer the question with a cross in the box you think is correct ☒ . If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒ .**

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)**



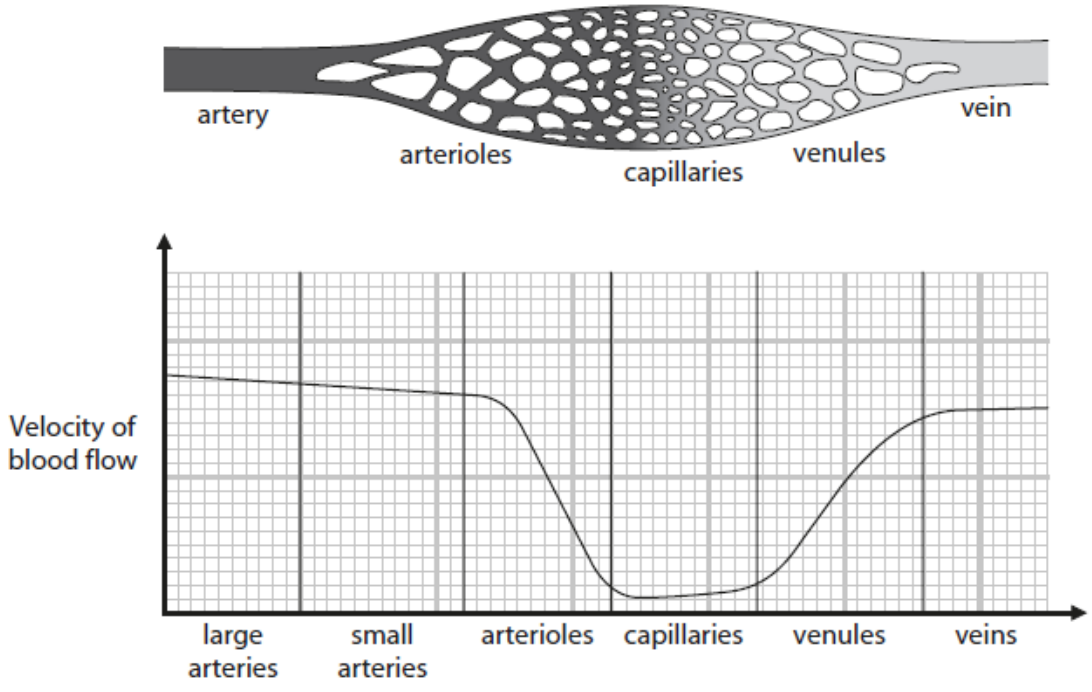
(b) The table shows some structures and the types of blood vessel that they are found in.

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.

**(3)**

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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 ☒.**

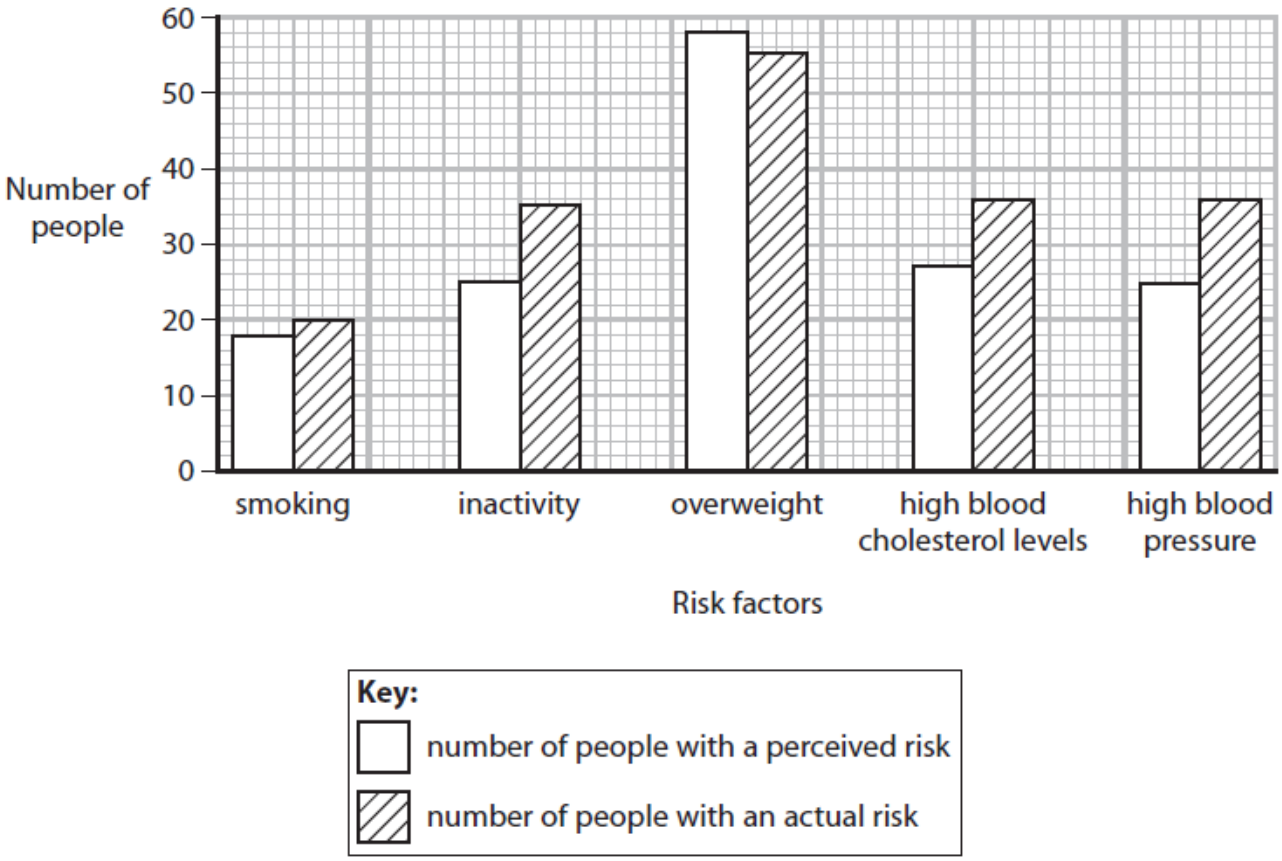
The risk of developing cardiovascular disease (CVD) is dependent on a number of factors.

(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)**

1 .....

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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)**

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(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)**

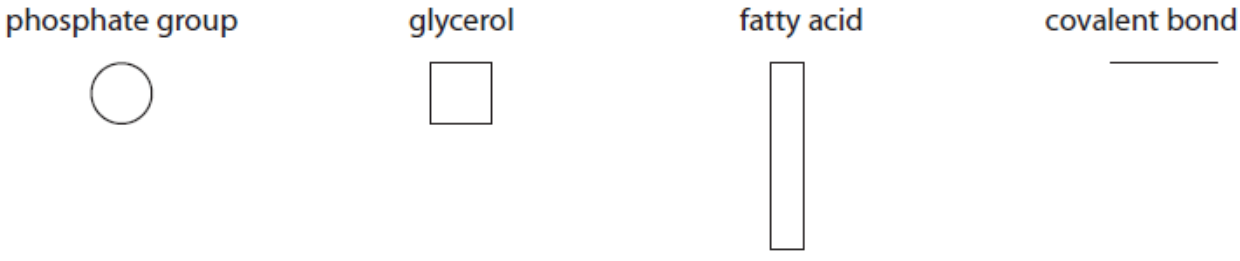
Q21.

**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.




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?

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

**(1)**

☒ **A** none

☒ **B** one

☒ **C** two

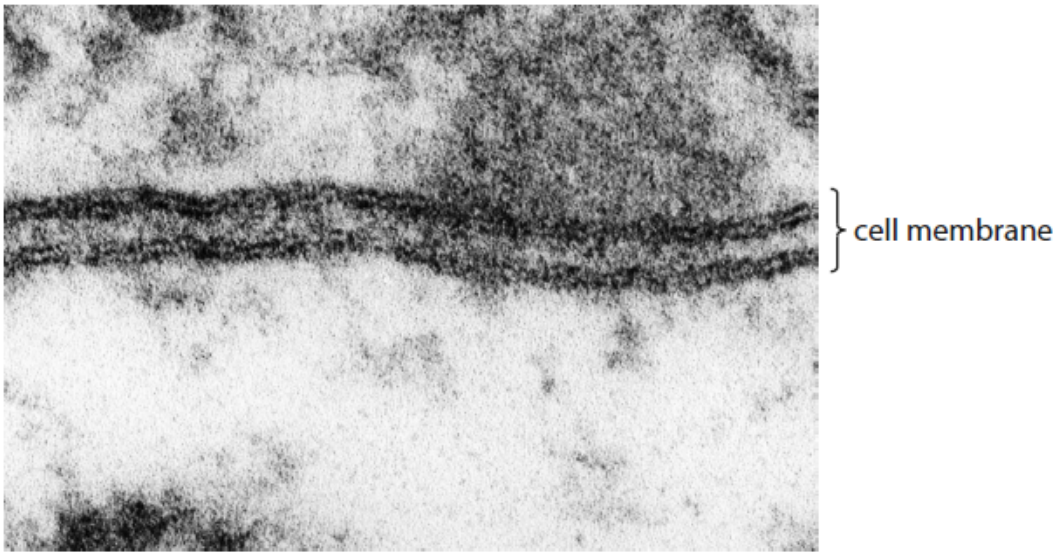
☒ **D** three

**(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.

**(3)**

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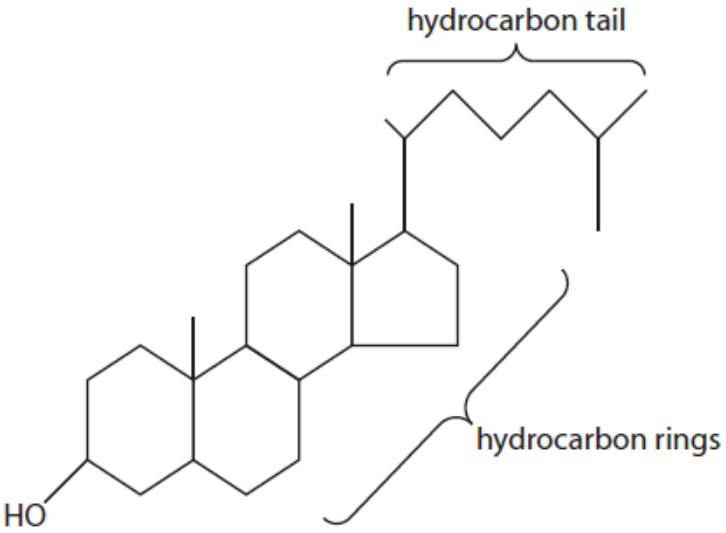
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(b) Cell membranes contain cholesterol.

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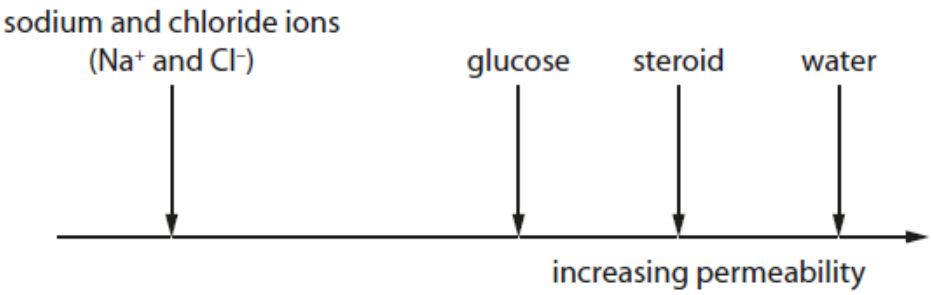
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(c) The diagram shows the permeability of cell membranes to some chemicals.




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)**

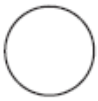
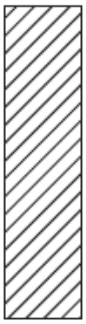
Q23.

**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 |  |

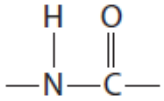
(i) Draw a diagram of a phospholipid, using the information in the table.

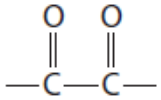
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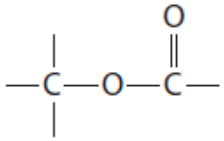
(ii) One of the bonds present in phospholipids is an ester bond.

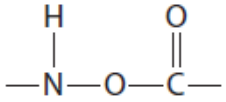
Which diagram shows an ester bond?

**(1)**

☒ **A** 

☒ **B** 

☒ **C** 

☒ **D** 

(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.

**(3)**

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

**(2)**

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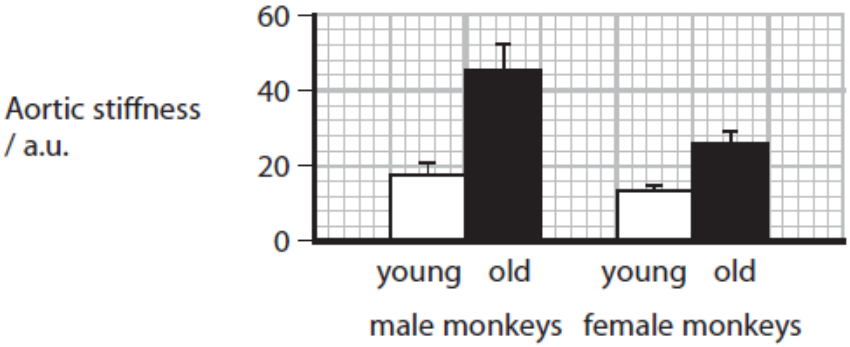
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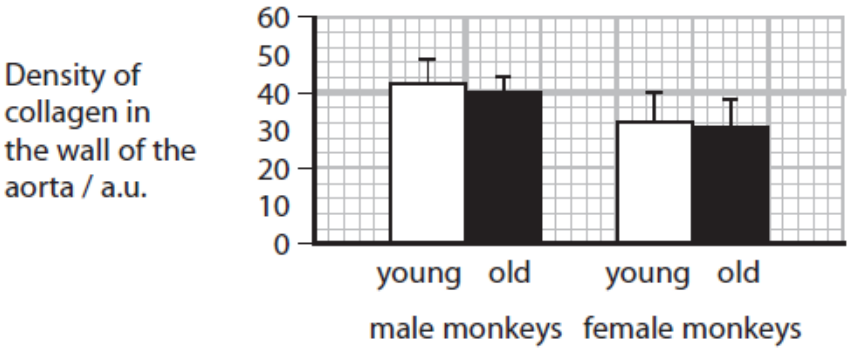
*(b) Age and sex affect the types and density of collagen found in the wall of the aorta.

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.

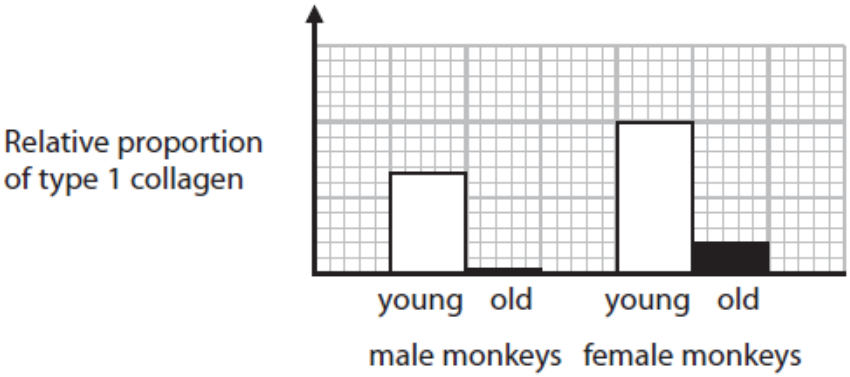
The graphs show the results of this study.

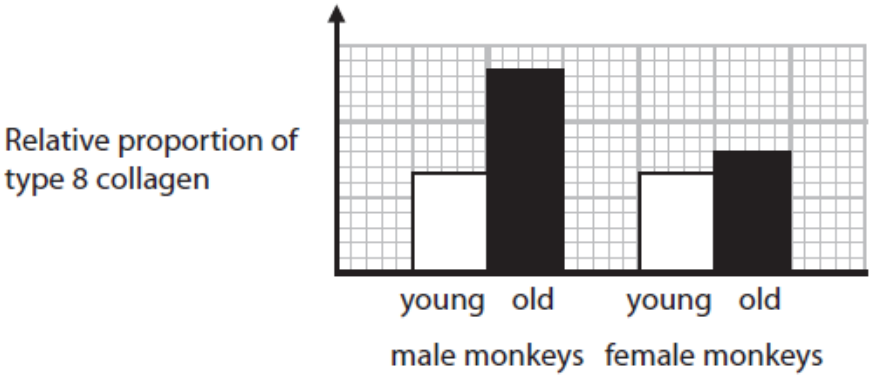



In another study, scientists investigated the effect of age and sex on two types of collagen present in the wall of the aorta.

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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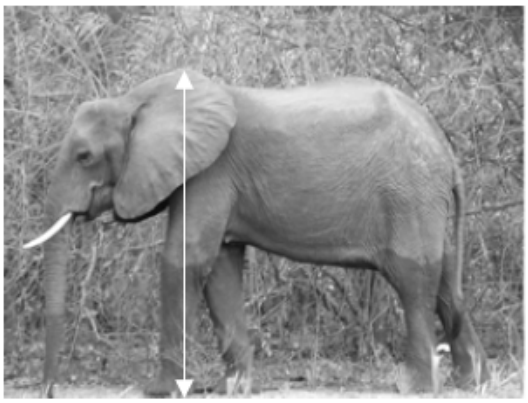
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**(Total for question = 11 marks)**

Q25.

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





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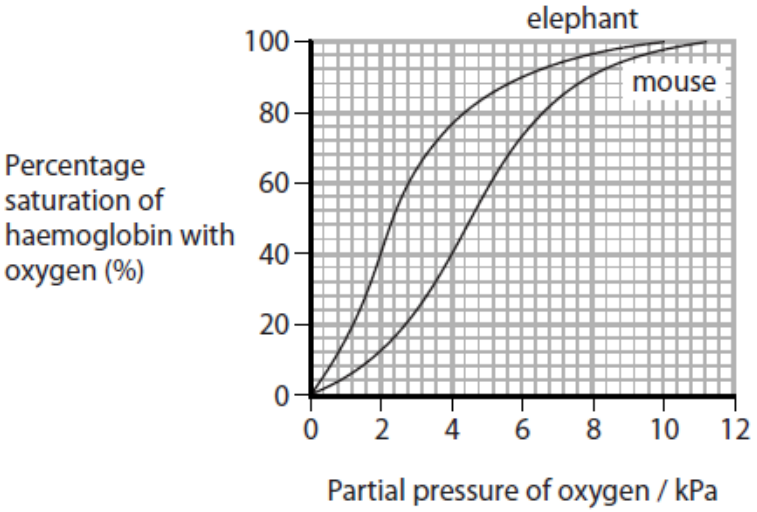
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* (c) Graph 1 shows the oxygen dissociation curve of haemoglobin for a mouse and for an elephant.

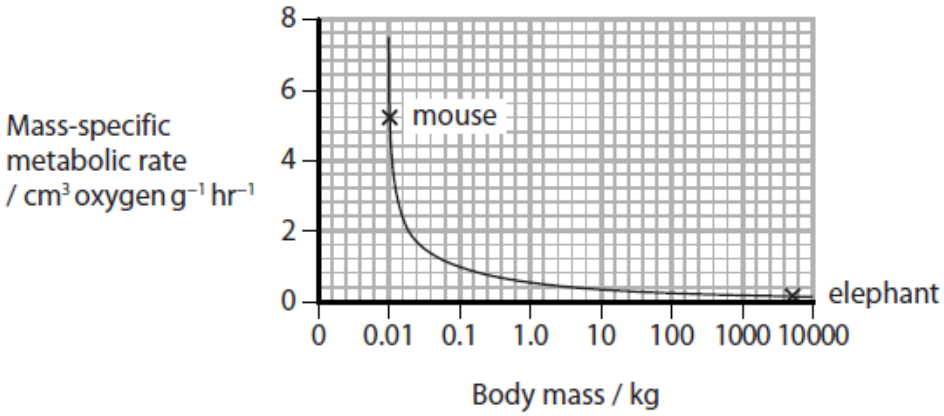
**Graph 1**




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)**

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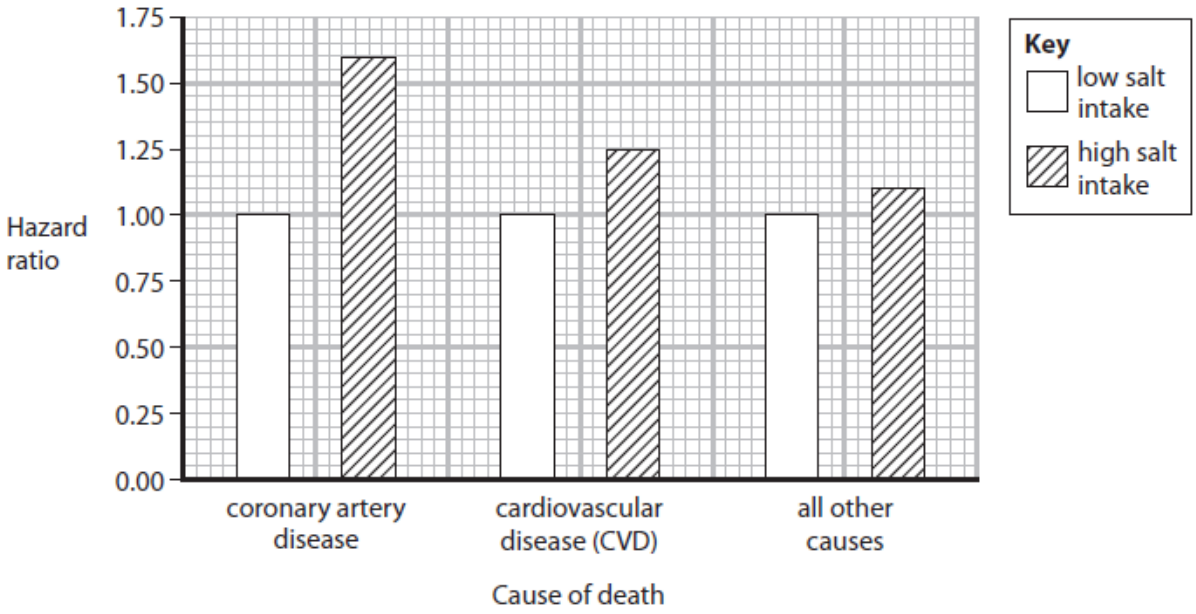
**(Total for question = 7 marks)**

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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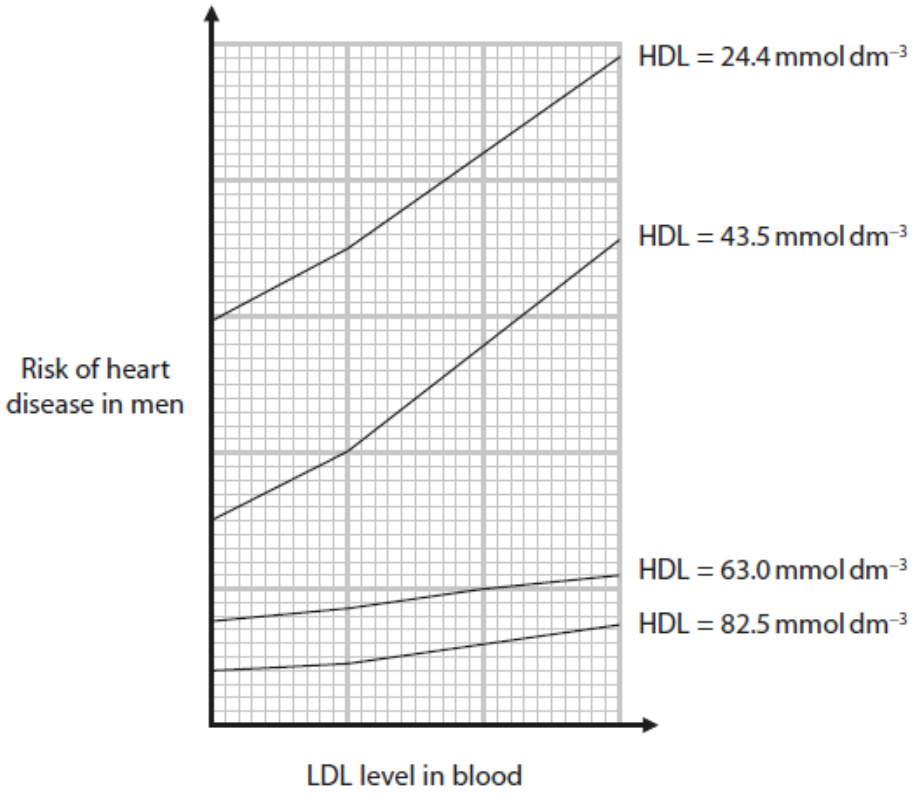
**(Total for question = 12 marks)**

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.

**(6)**

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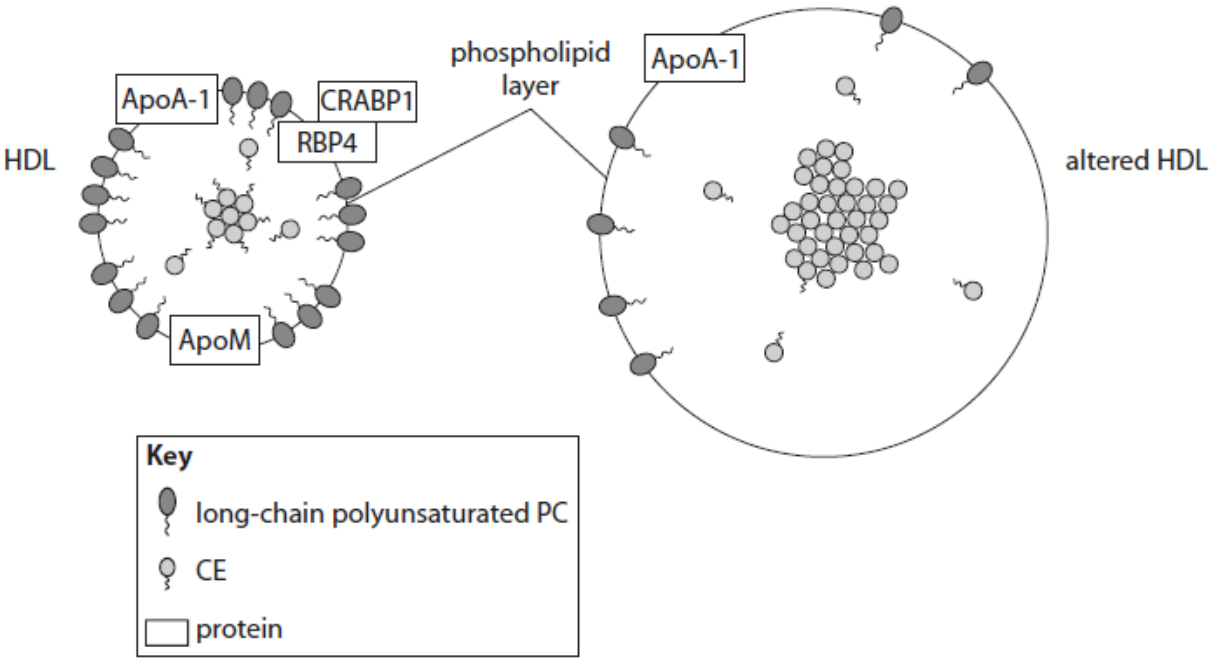
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(b) Very high levels of cholesterol in the blood can alter the structure of HDL.
This altered HDL is less effective in reducing the risk of heart disease.

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.

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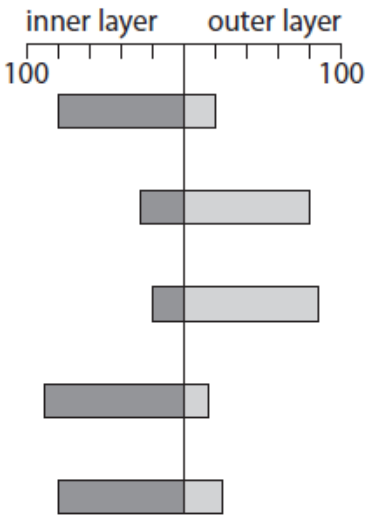
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**(Total for question = 12 marks)**

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 (%) |
|---|---|---|
| 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.

**(4)**

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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.

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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)**

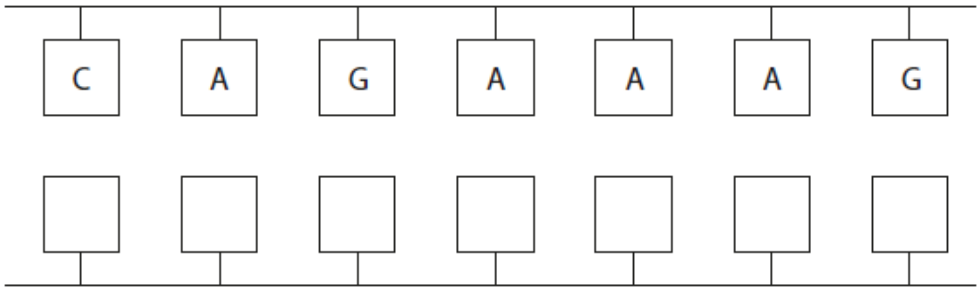
Answer .....

(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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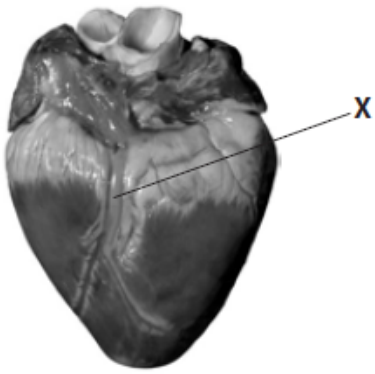
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**(Total for question = 14 marks)**

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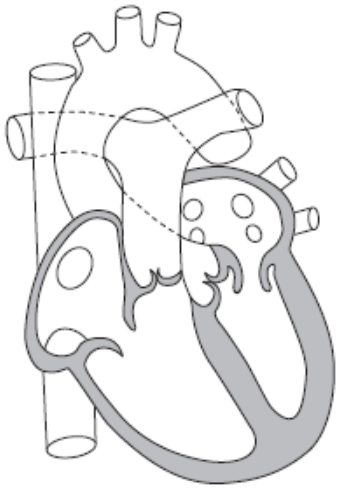
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(b) The diagram shows the internal structure of a mammalian heart.



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

**(2)**

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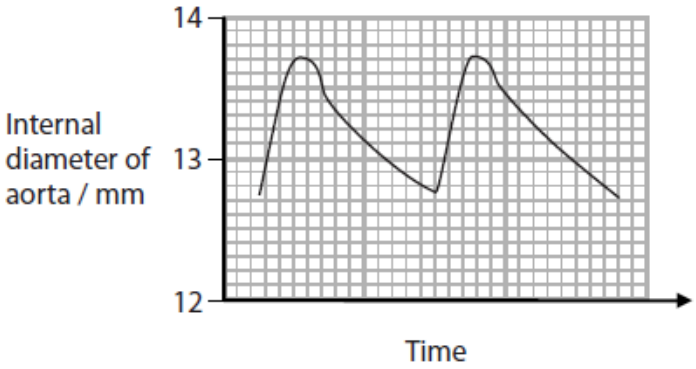
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(ii) Draw arrows on the diagram to show the flow of blood through the left side of the heart and into the aorta.

**(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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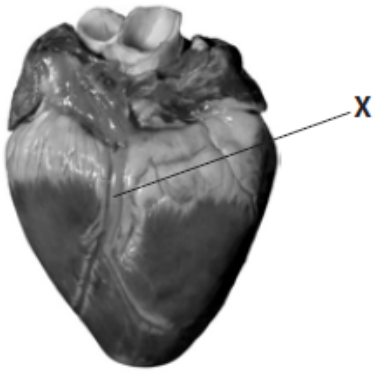
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**(Total for question = 11 marks)**

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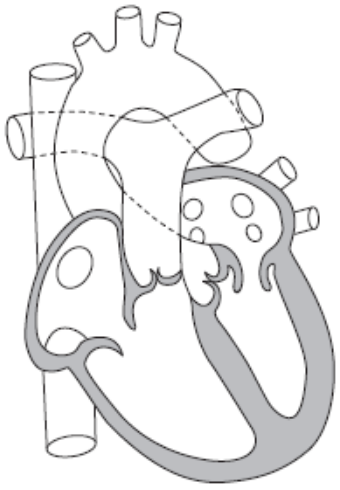
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(b) The diagram shows the internal structure of a mammalian heart.



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

**(2)**

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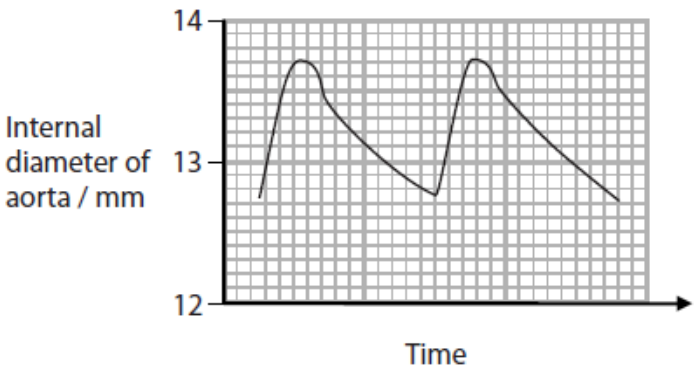
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(ii) Draw arrows on the diagram to show the flow of blood through the left side of the heart and into the aorta.

**(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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**(Total for question = 11 marks)**

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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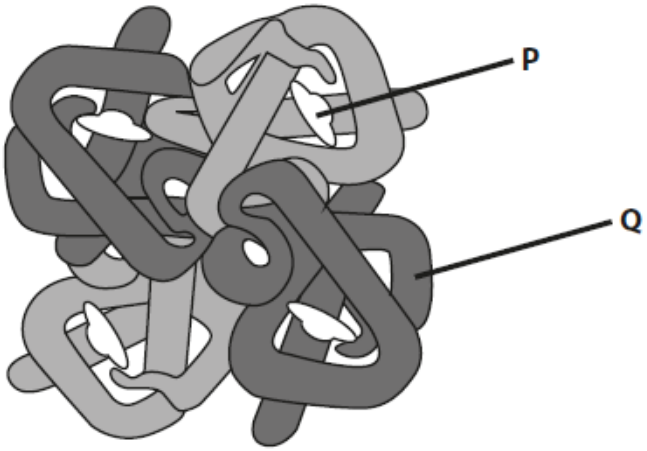
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**(Total for question = 9 marks)**

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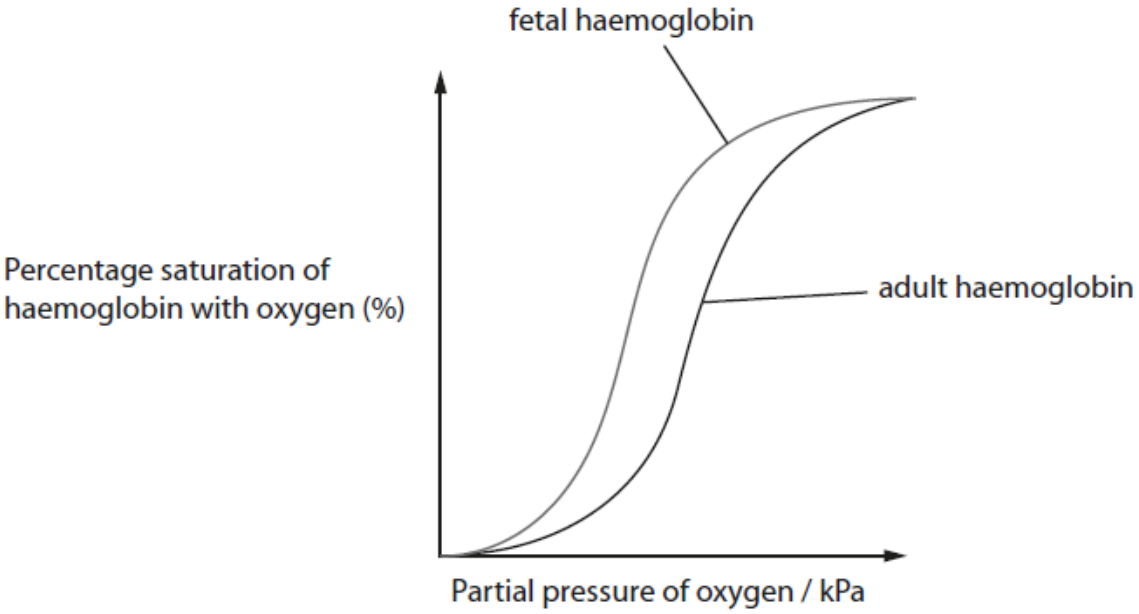
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(b) The graph shows the oxygen dissociation curves of adult and fetal haemoglobin.




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

**(2)**

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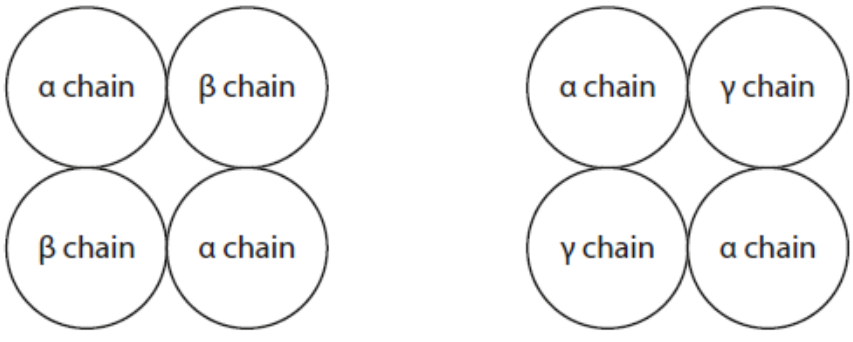
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(ii) The structures of adult and fetal haemoglobin are different.

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.

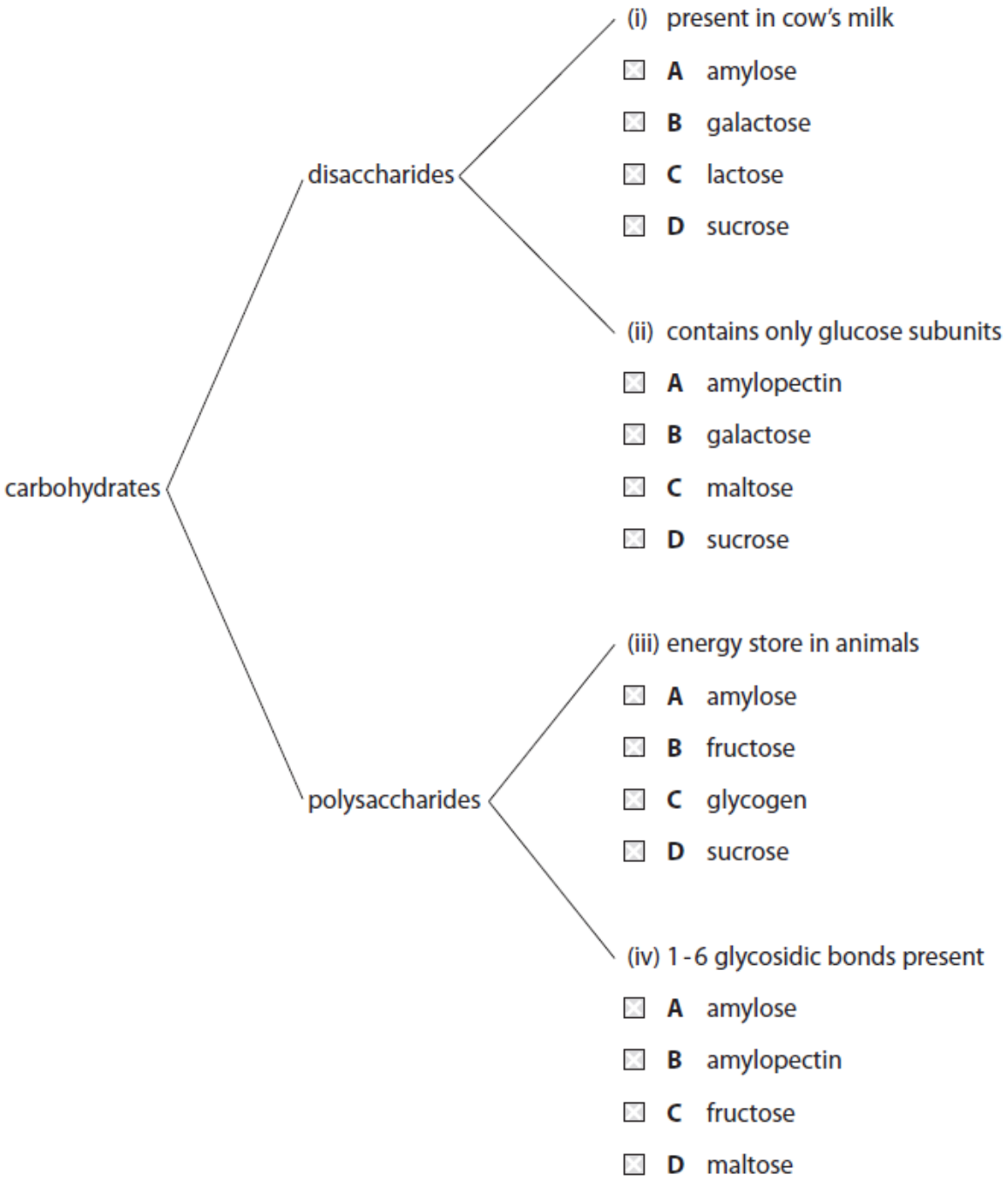
**(1)**

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(b) The diagram shows some information about carbohydrates.

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

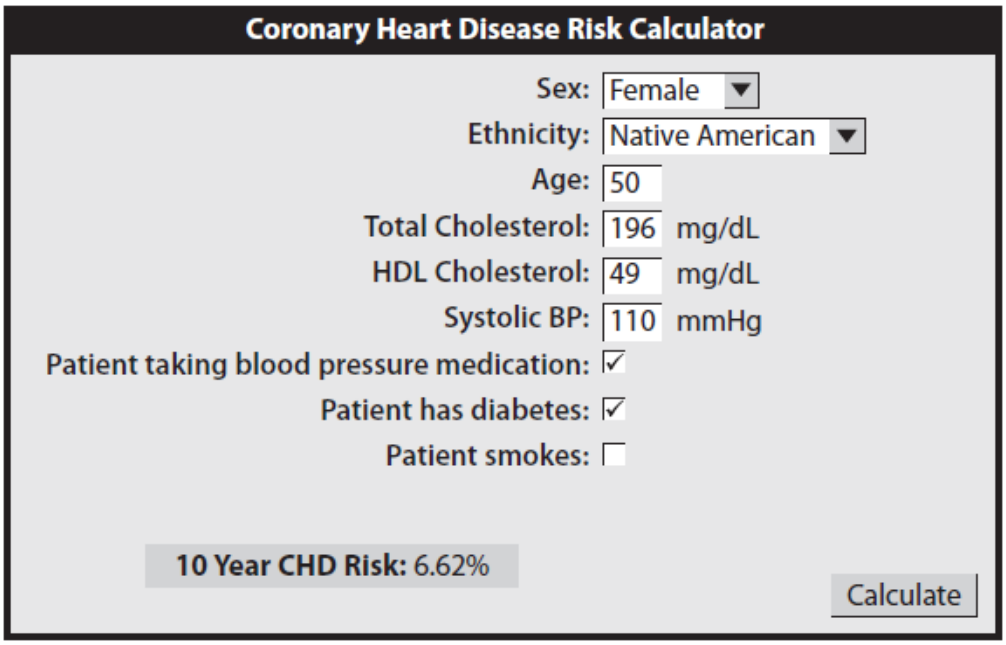
**(4)**




**(Total for question = 6 marks)**

Q5.

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




(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.

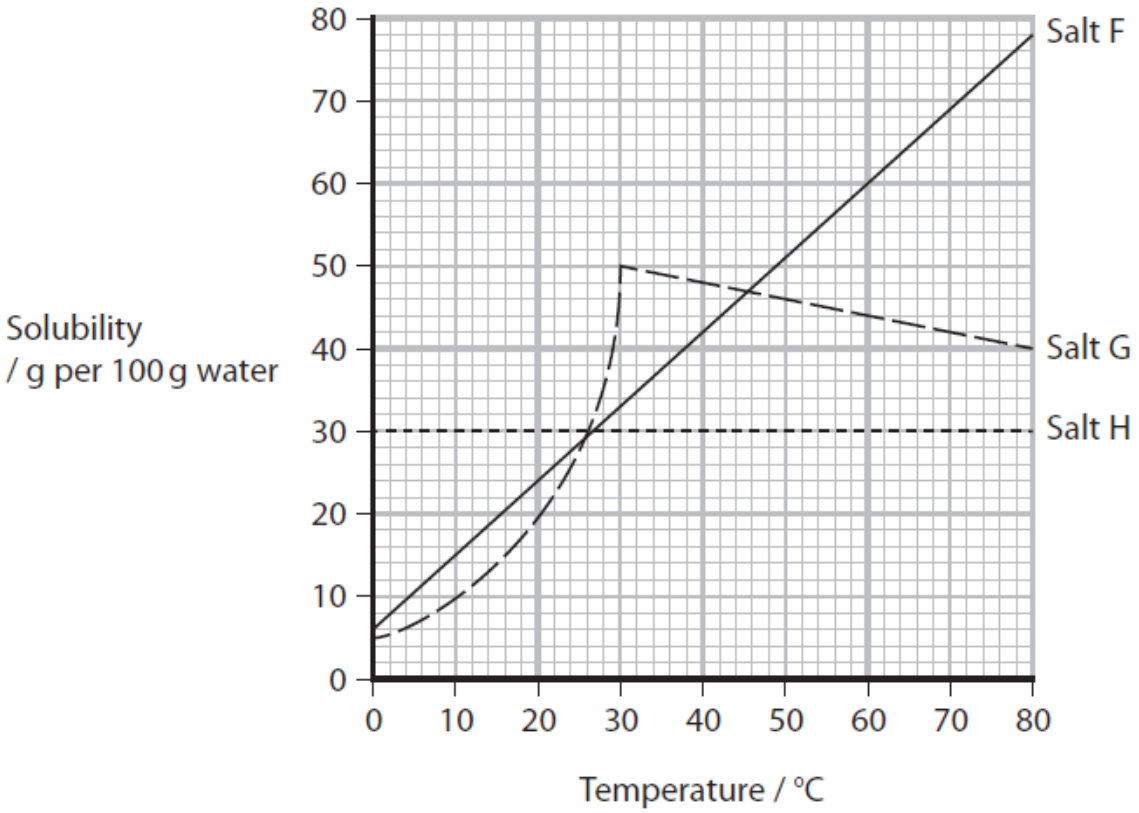
**Answer the question with a cross in the box you think is correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.**

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.

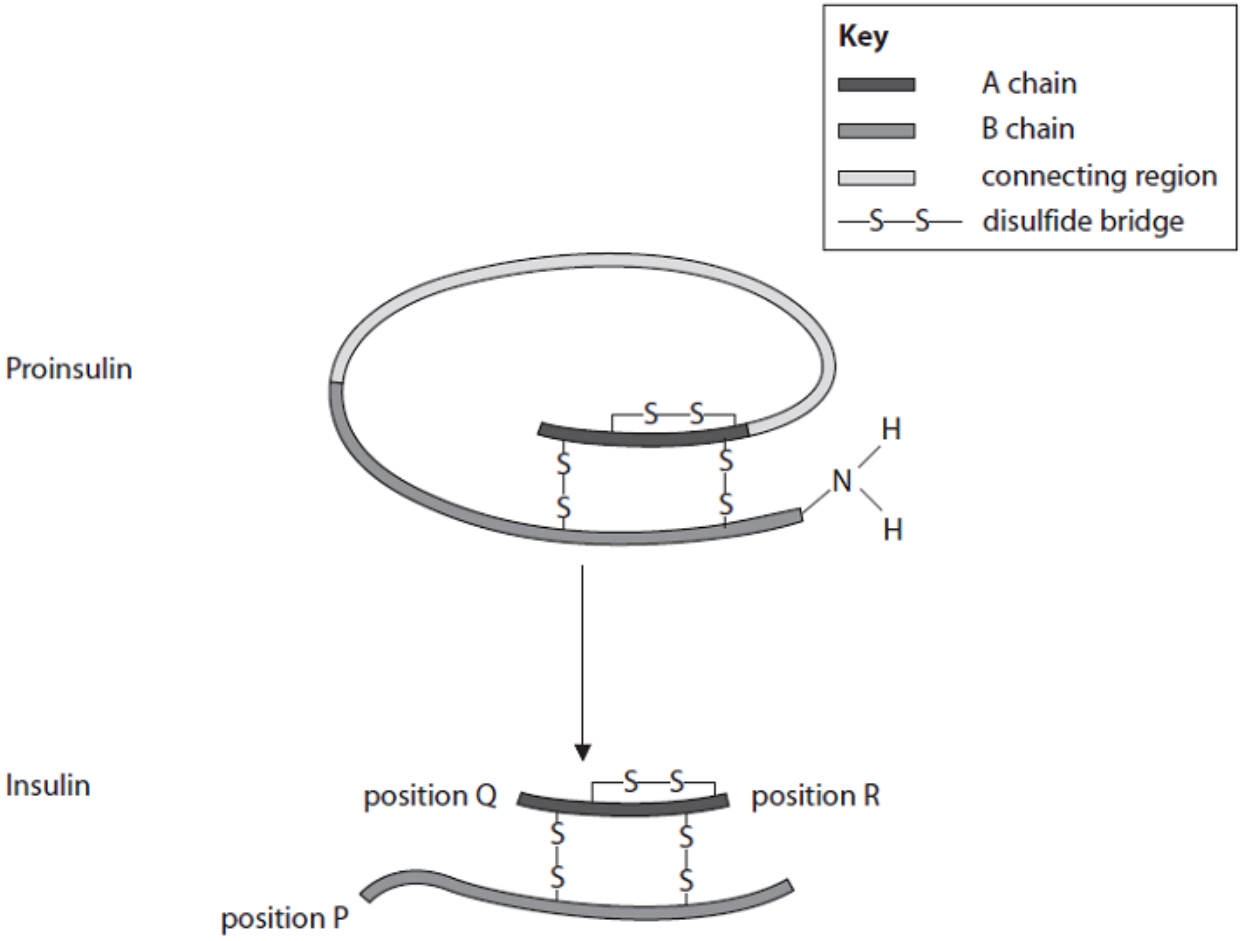
**Answer the question with a cross in the box you think is correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.**

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 ($NH_2$) 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

- increase the synthesis of glycogen.

In a study using rats, the effects of a cinnamon extract on levels of glucose in the blood was determined.

In this study a group of healthy rats and a group of rats with induced diabetes were used. The rats were given either the cinnamon extract or water, each day for 30 days.

The table shows the results of this study.

| Time / days | Levels of glucose in the blood in healthy rats / mg $dm^{-3}$ | | Levels of glucose in the blood in rats with induced diabetes / mg $dm^{-3}$ | |
|---|---|---|---|---|
| | Rats given water | Rats given cinnamon extract | Rats given water | Rats given cinnamon extract |
| 0 | 106 | 102 | 395 | 378 |
| 10 | 101 | 103 | 403 | 346 |
| 20 | 99 | 96 | 419 | 384 |
| 30 | 94 | 90 | 493 | 369 |

Explain the results of this study.

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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.

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

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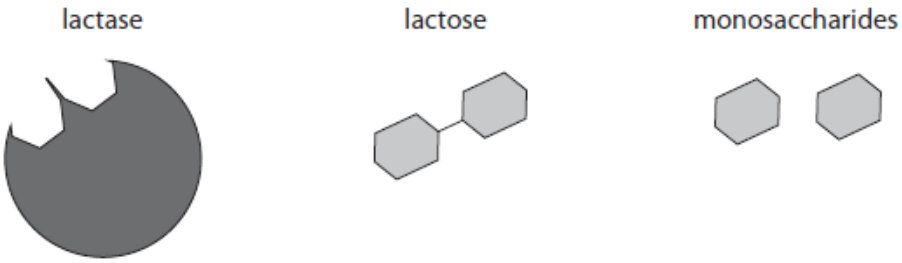
**(Total for question = 10 marks)**

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.

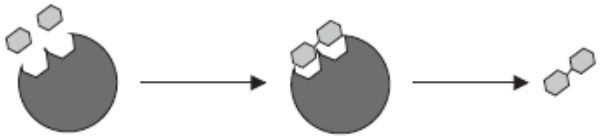


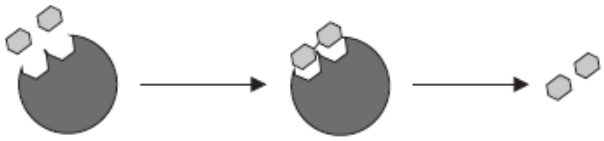

Which diagram shows the sequence of events for the hydrolysis of lactose?

**(1)**

☒ A 

☒ B 

☒ C 

☒ D 

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

**(1)**

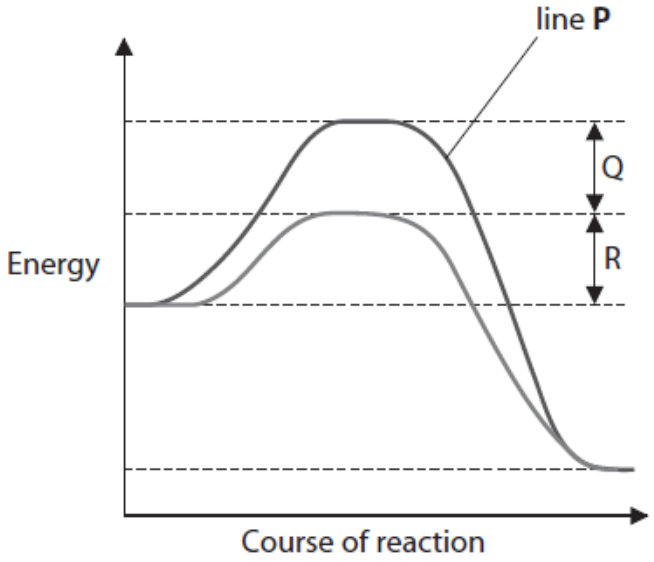
☒ **A** fructose and sucrose

☒ **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.

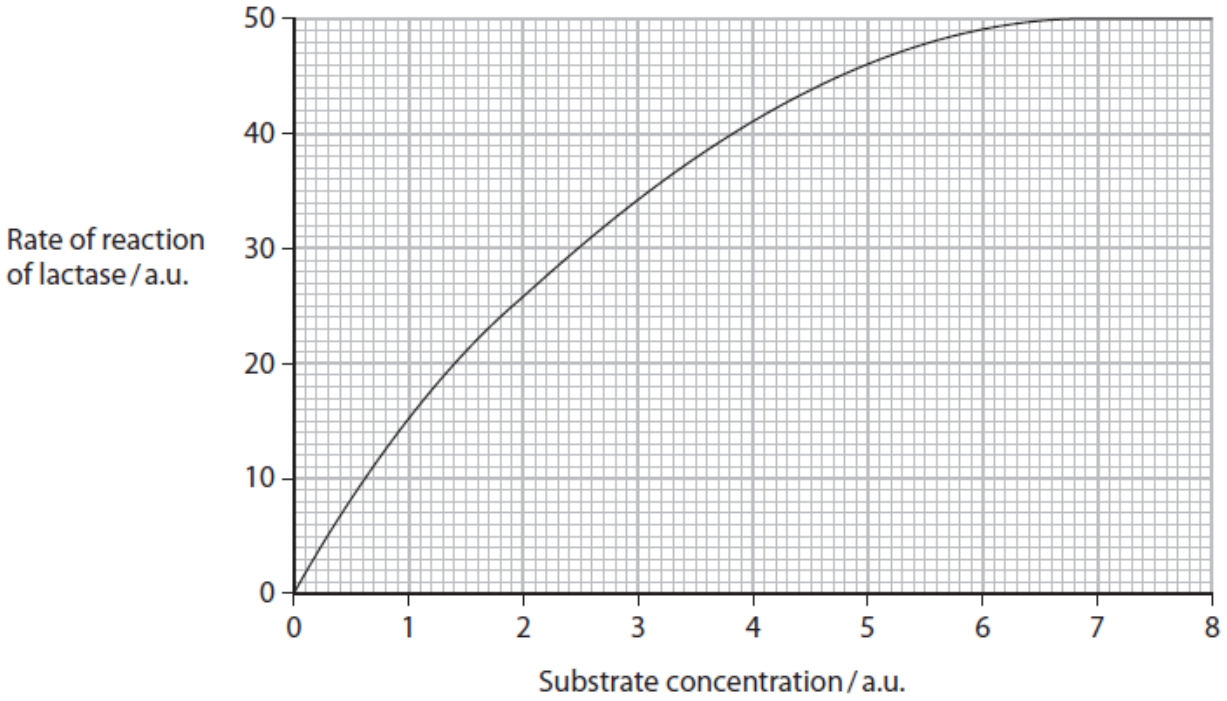



Which row in the table describes line **P** and identifies the letter that shows the decrease in activation energy due to lactase?

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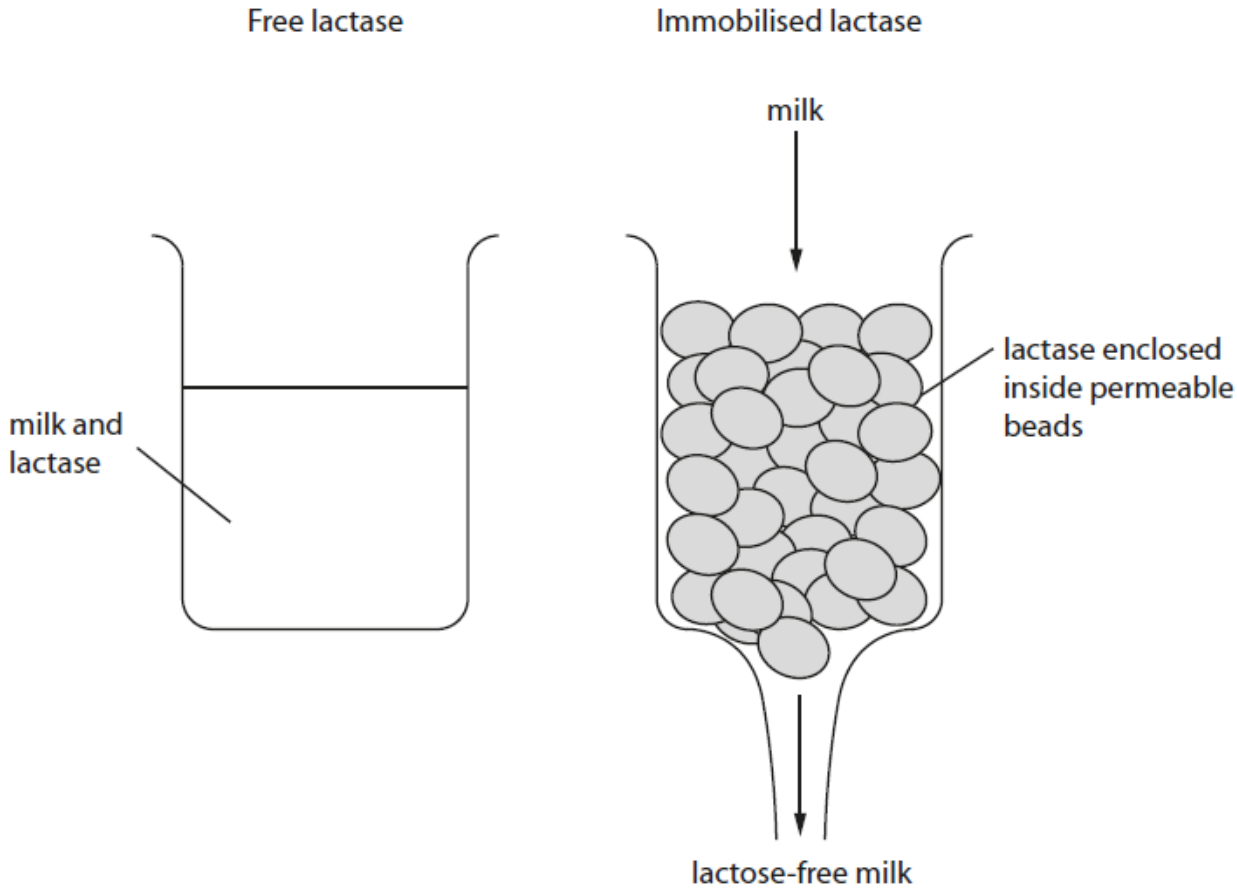
(b) People with lactose intolerance can drink lactose-free milk.

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.

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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)**

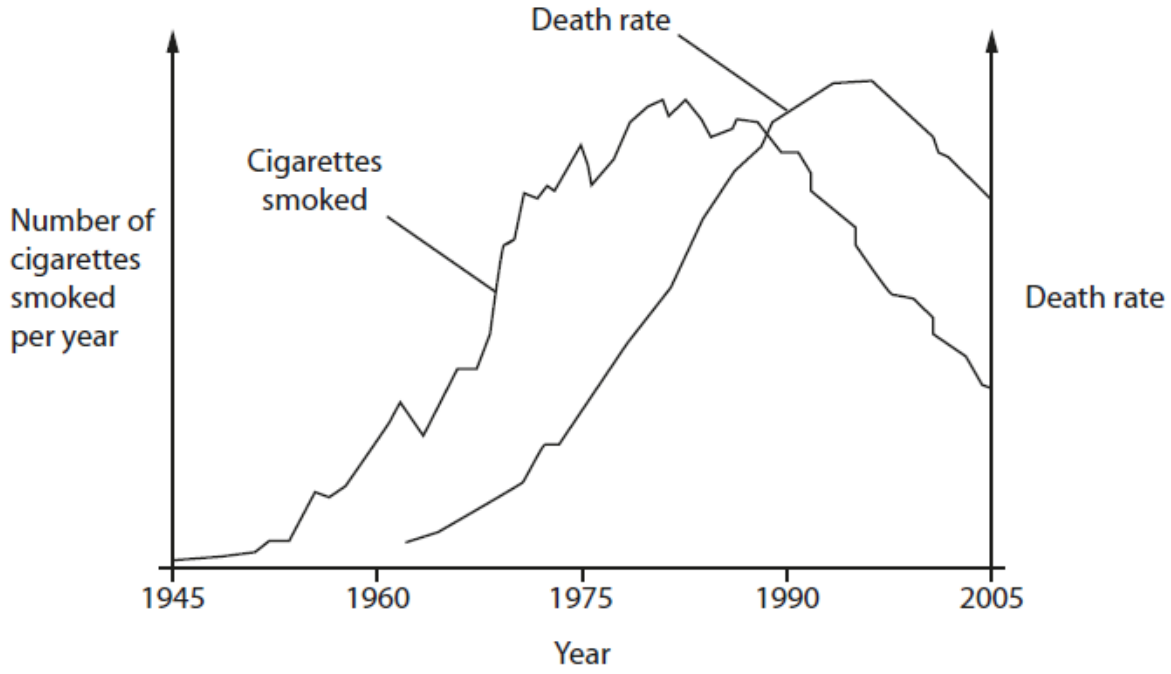
Q12.

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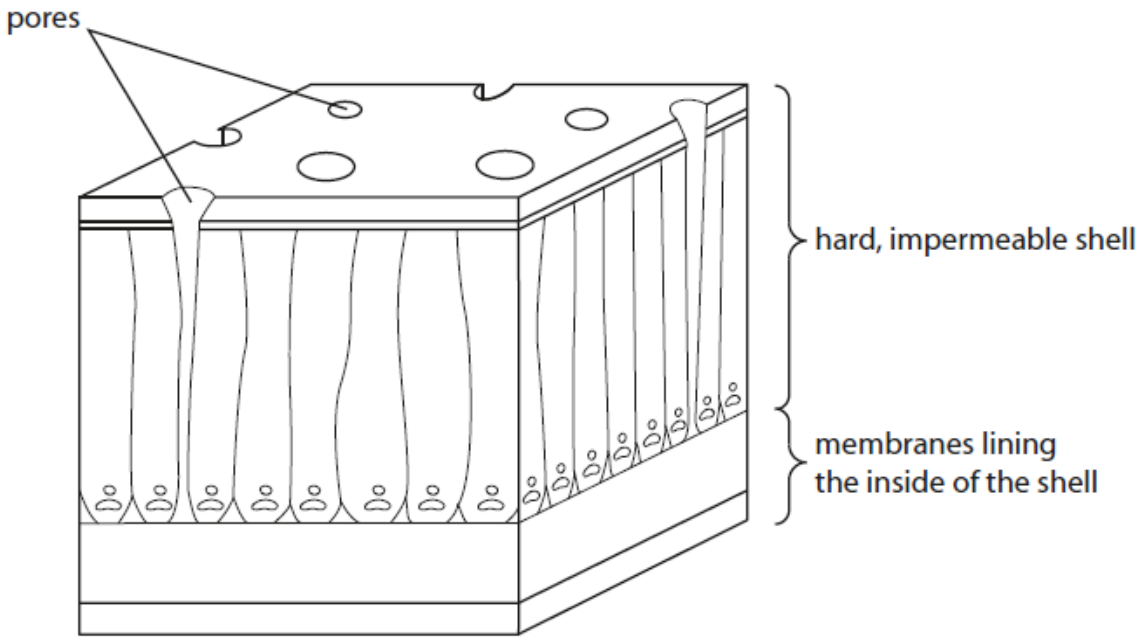
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(b) Bird embryos develop inside hard-shelled eggs.

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 $cm^2$.

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.

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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)**

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(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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**(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$^{-3}$**.

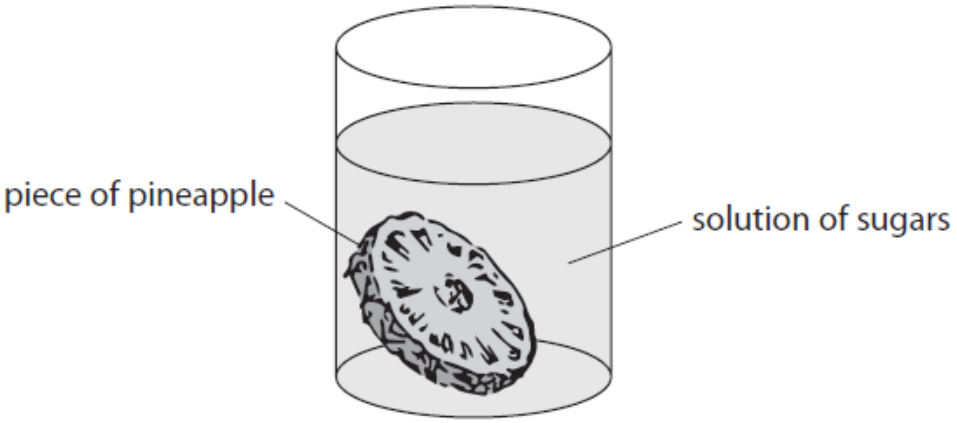
**(2)**

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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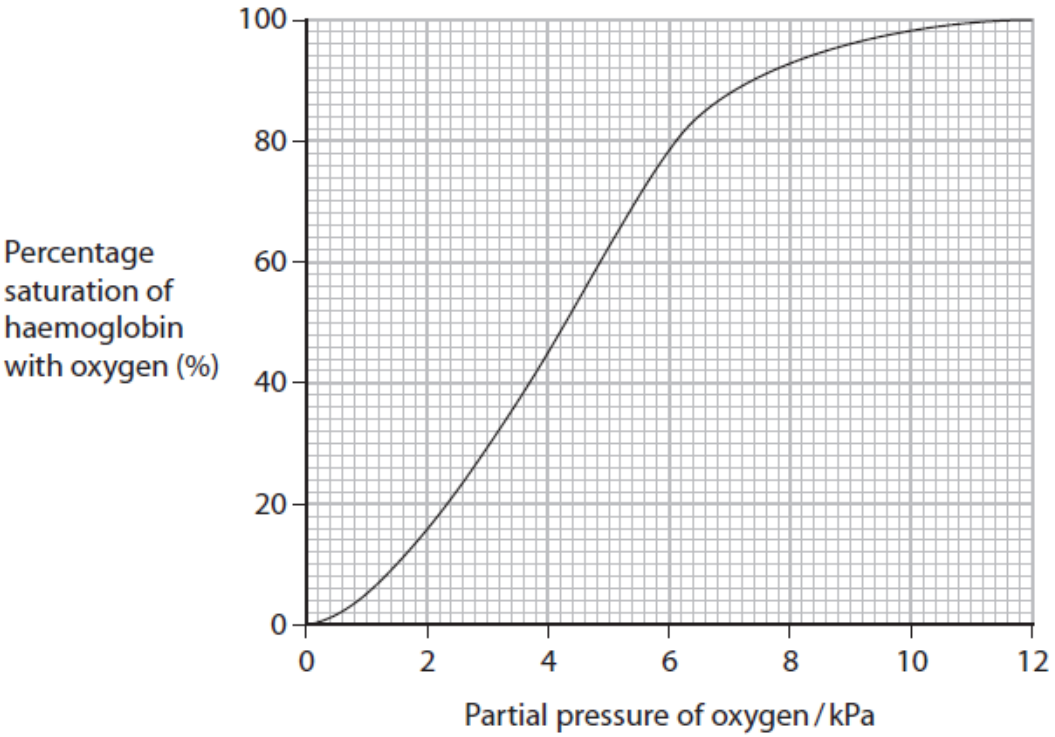
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**(Total for question = 10 marks)**

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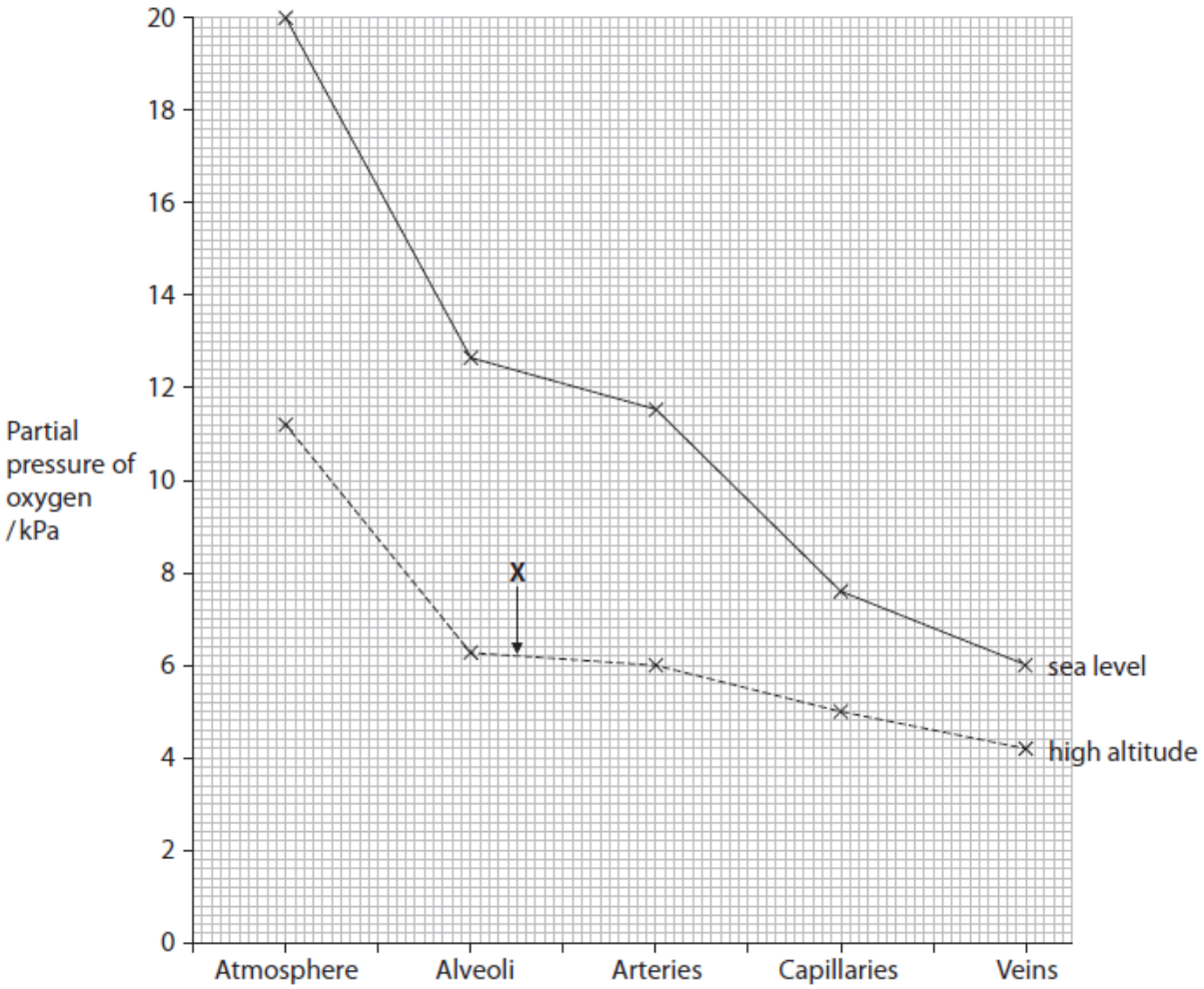
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(b) The oxygen cascade describes the differences in the partial pressure of oxygen between different blood vessels and the external atmosphere.

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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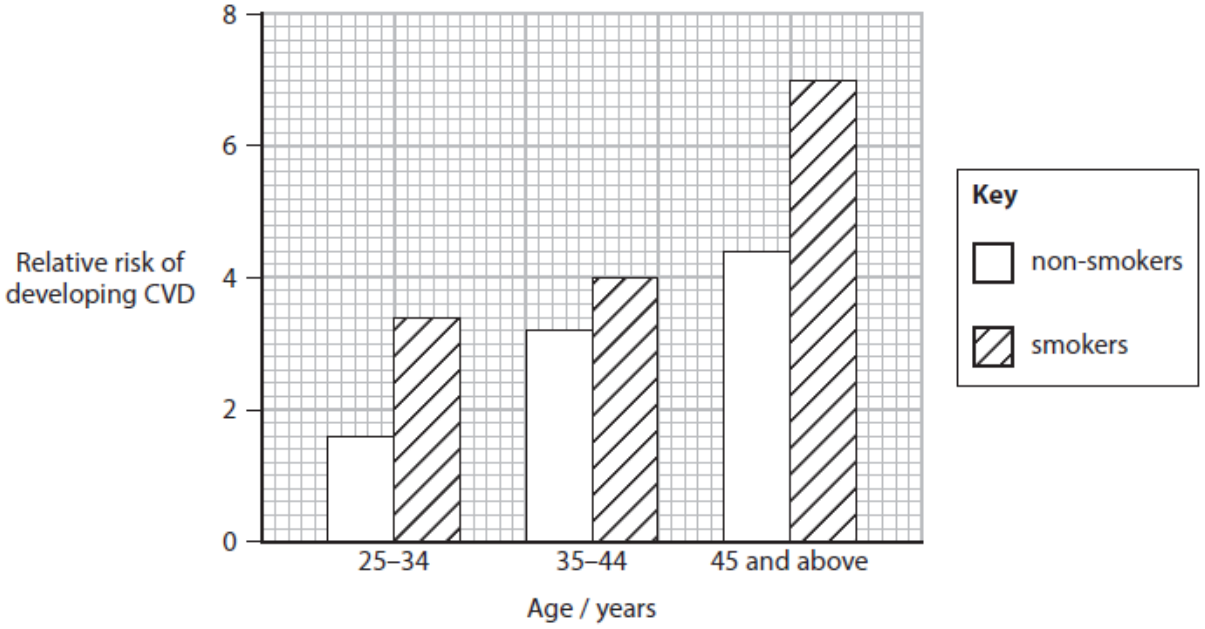
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**(Total for question = 13 marks)**

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)**

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(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** $0.571 \times 10^6$

☒ **B** $5.71 \times 10^6$

☒ **C** $57.1 \times 10^6$

☒ **D** $571.00 \times 10^6$

**(Total for question = 5 marks)**

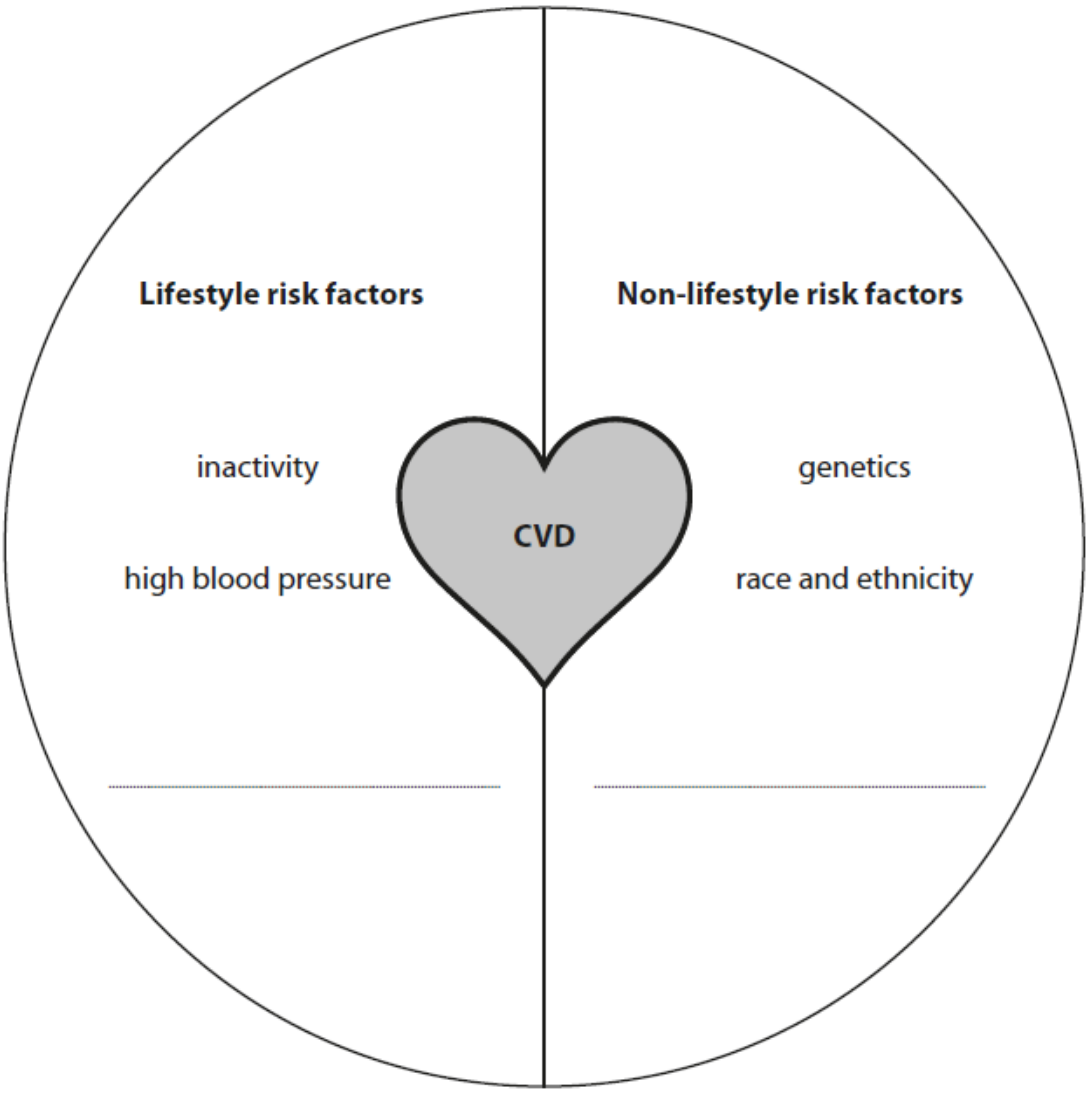
Q17.

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

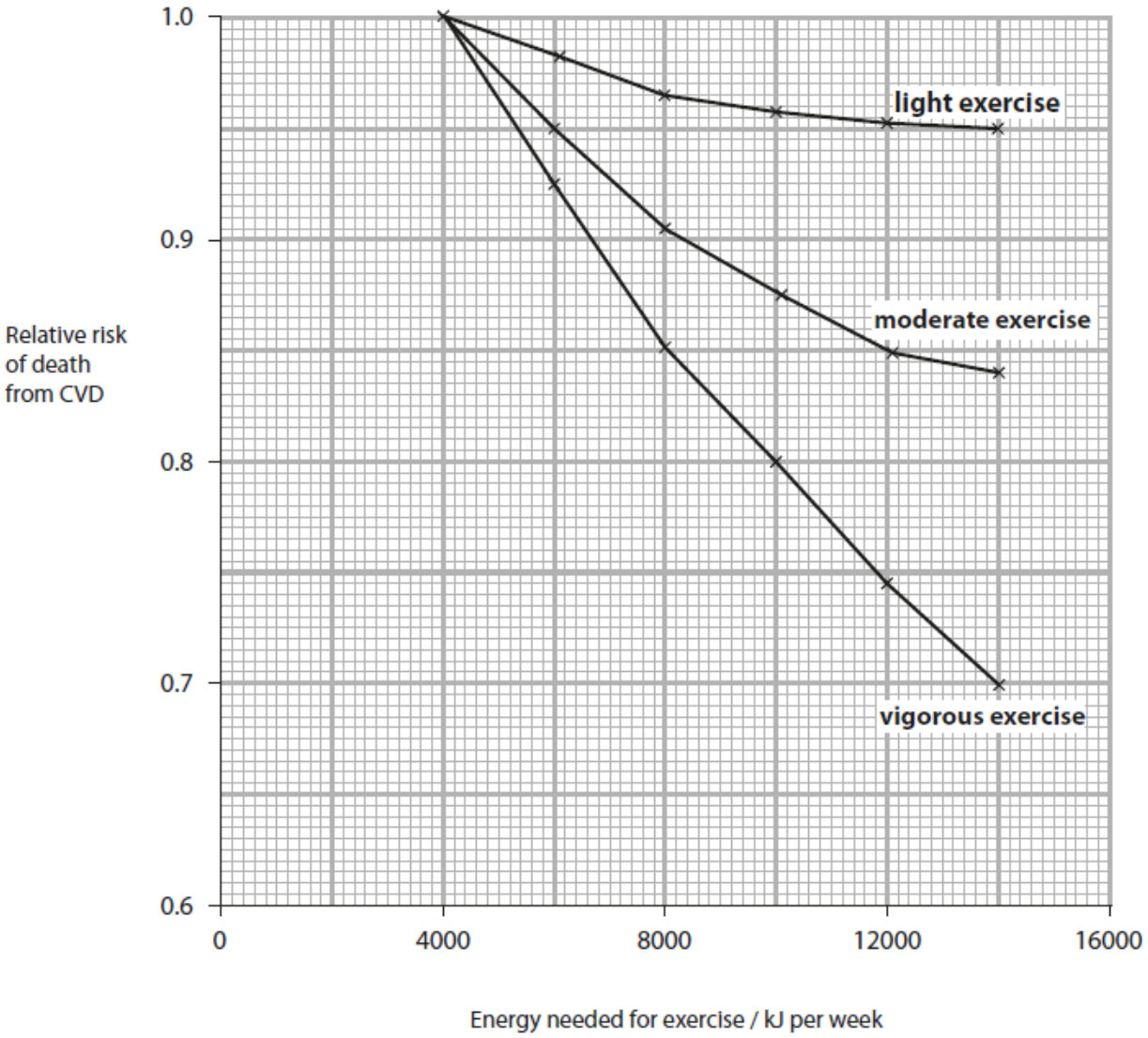
(a) The diagram shows some factors that increase the risk of CVD.

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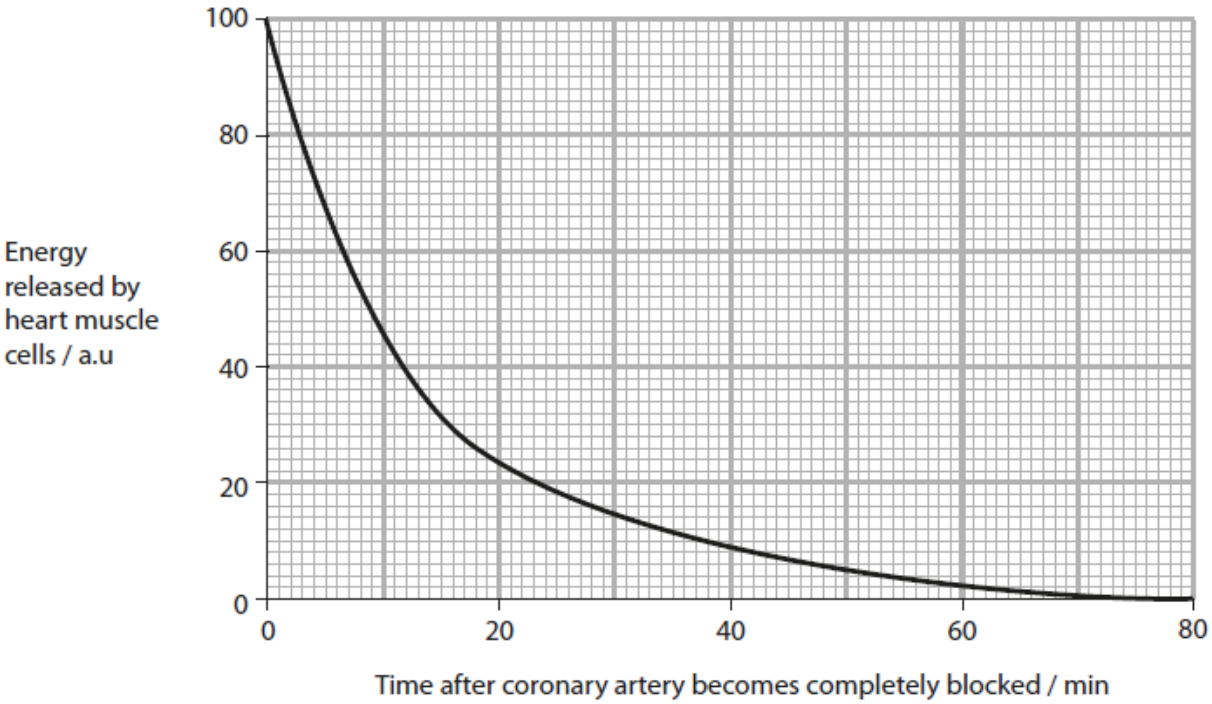
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*(d) The coronary artery may become completely blocked in people with CVD.

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




The heart muscle cells no longer contract 8 minutes after the coronary artery becomes completely blocked.

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

Explain the effects on the heart function after the coronary artery becomes completely blocked.

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

**(6)**

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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)**

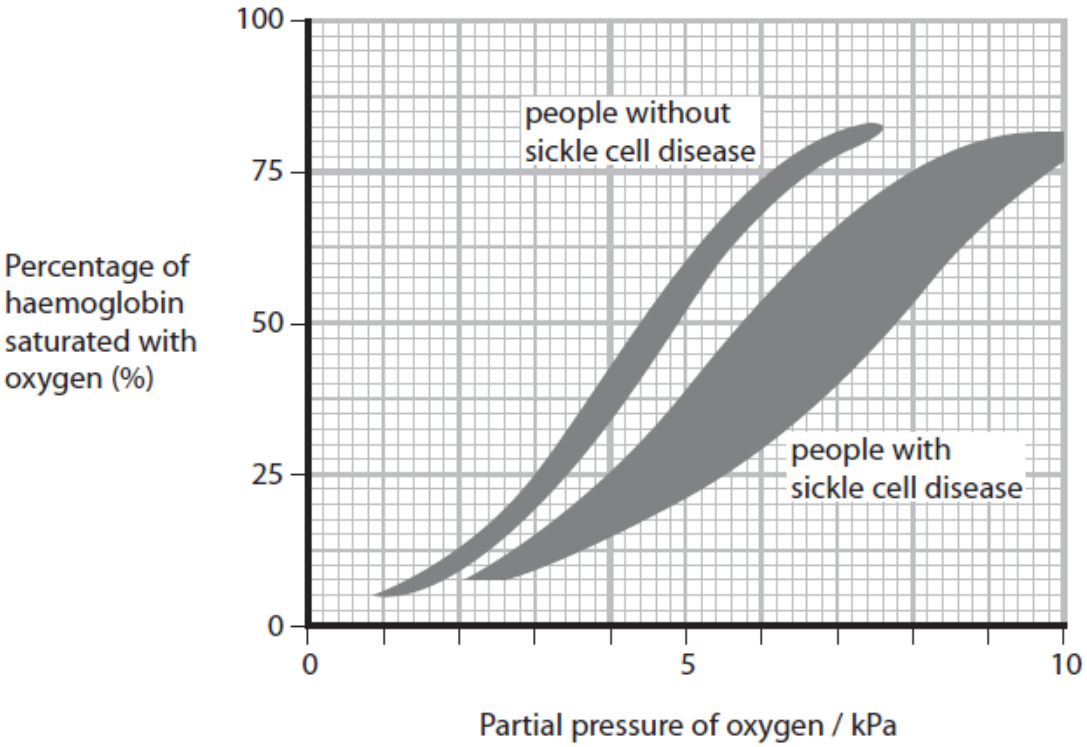
Answer .....

(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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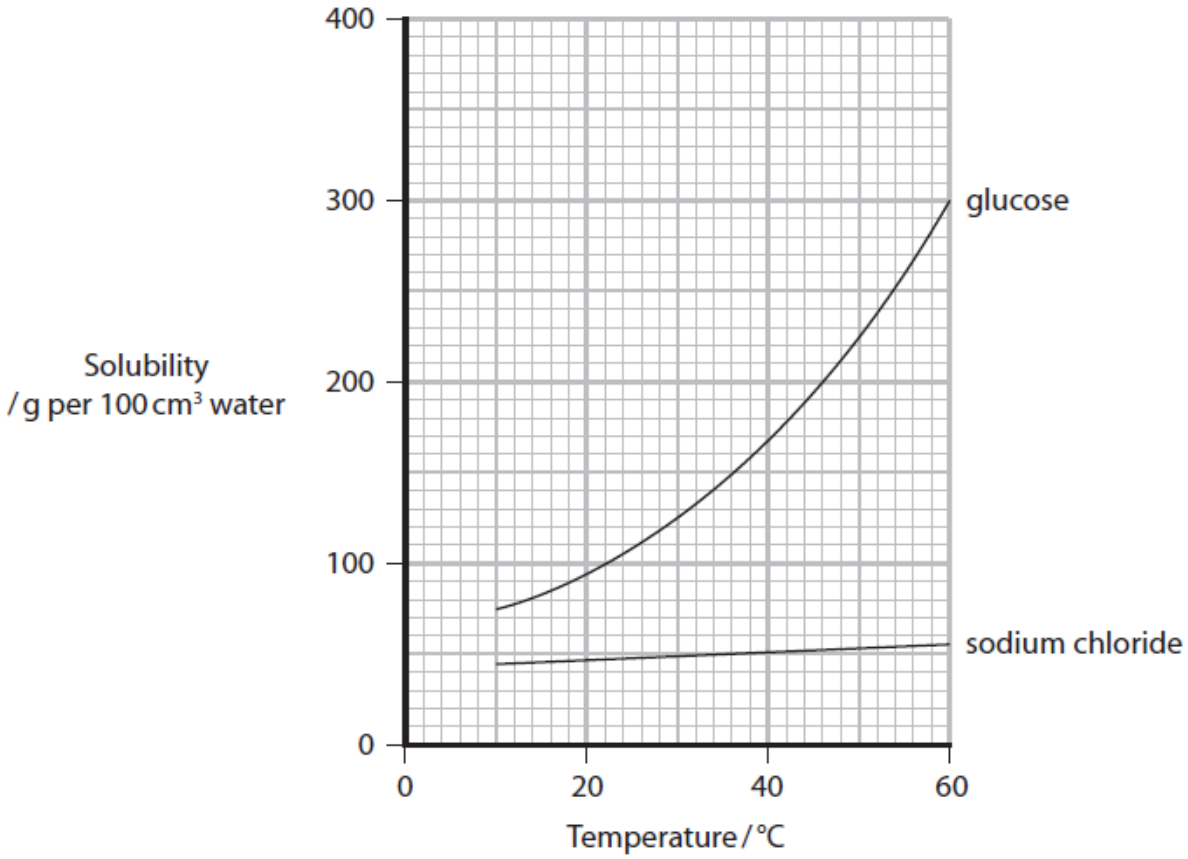
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**(Total for question = 15 marks)**

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)**

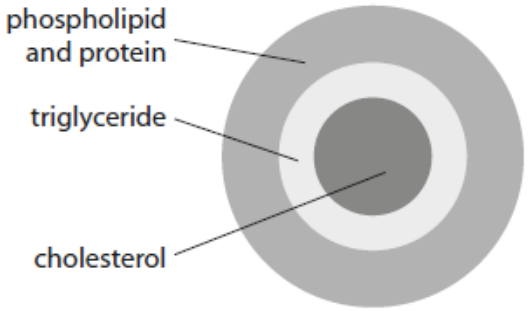
Q21.

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.

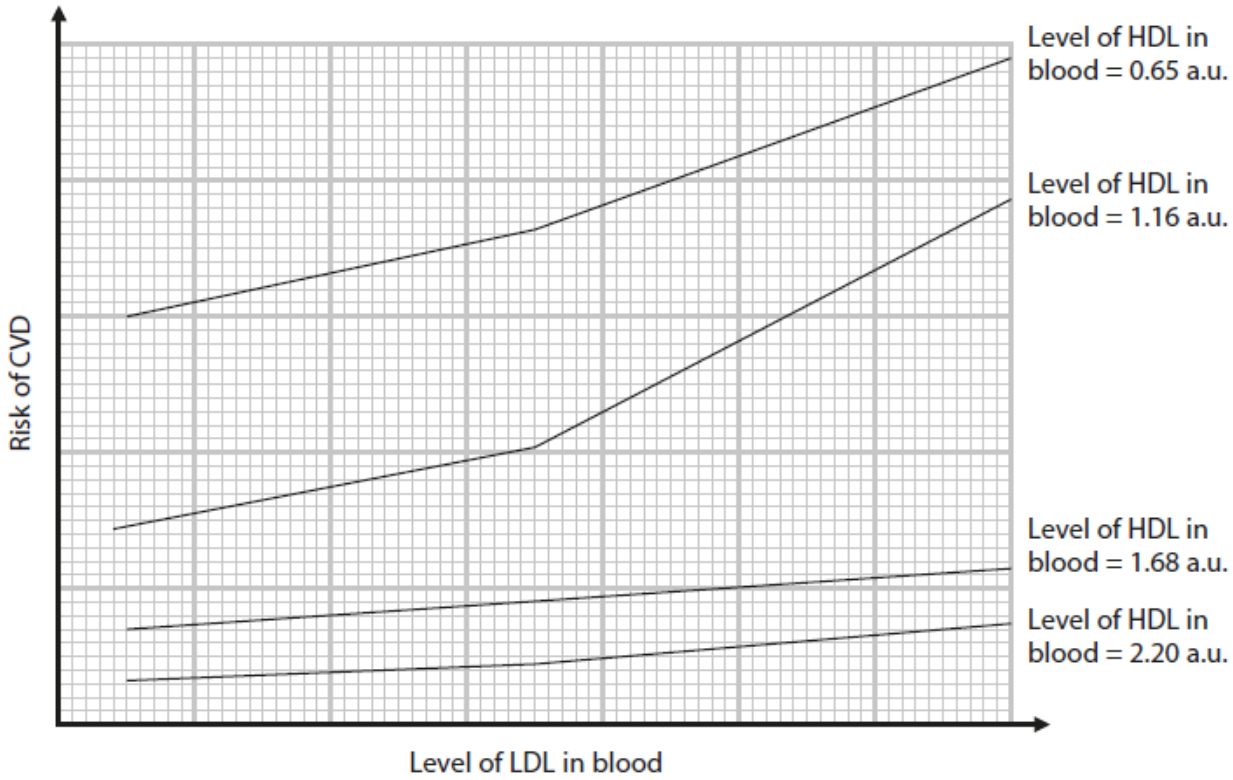
| Diameter of LDL / nm | Volume of LDL / $nm^3$ | Volume of cholesterol / $nm^3$ | Ratio of LDL volume to cholesterol volume |
|---|---|---|---|
| 19 | 3590 | 523 | 7:1 |
| 24 | | 523 | |

(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)**

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**(Total for question = 15 marks)**

Q22.

**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 structures of blood vessels relate to their functions.

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 | $1.3 \times 10^2$ | 28.0 |
| large arteries | 40 | 0.3 | 20.0 | $7.5 \times 10^2$ | 7.8 |
| capillaries | $1.2 \times 10^9$ | $8.0 \times 10^{-4}$ | 0.1 | $3.0 \times 10^5$ | $3.6 \times 10^{-2}$ |
| large veins | 40 | 0.6 | 20.0 | | 1.9 |
| vena cava | 1 | 1.25 | | $1.6 \times 10^2$ | 18.0 |

(a) Complete the table.

Use the formula:

surface area = 2πrl

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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(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)**

☒ **A**



☒ **B**

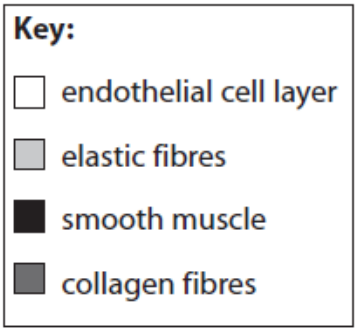


☒ **C**



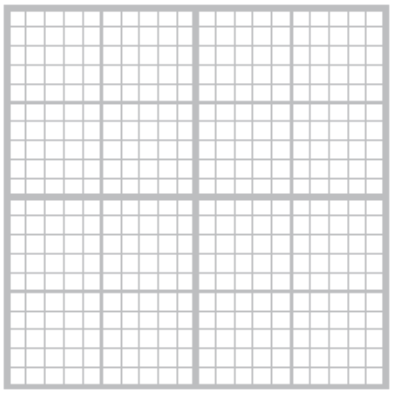
☒ **D**






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

**(1)**



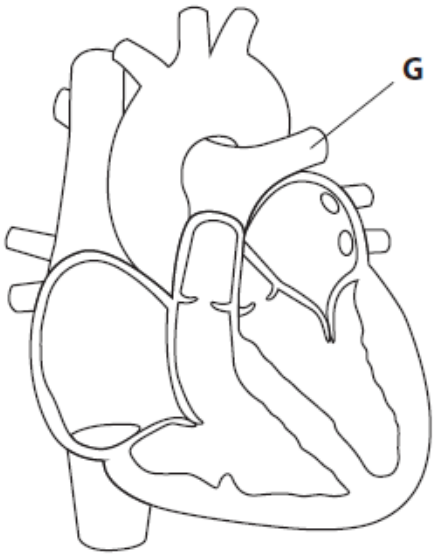
**(Total for question = 10 marks)**

Q23.

**Some questions must be answered with a cross 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 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

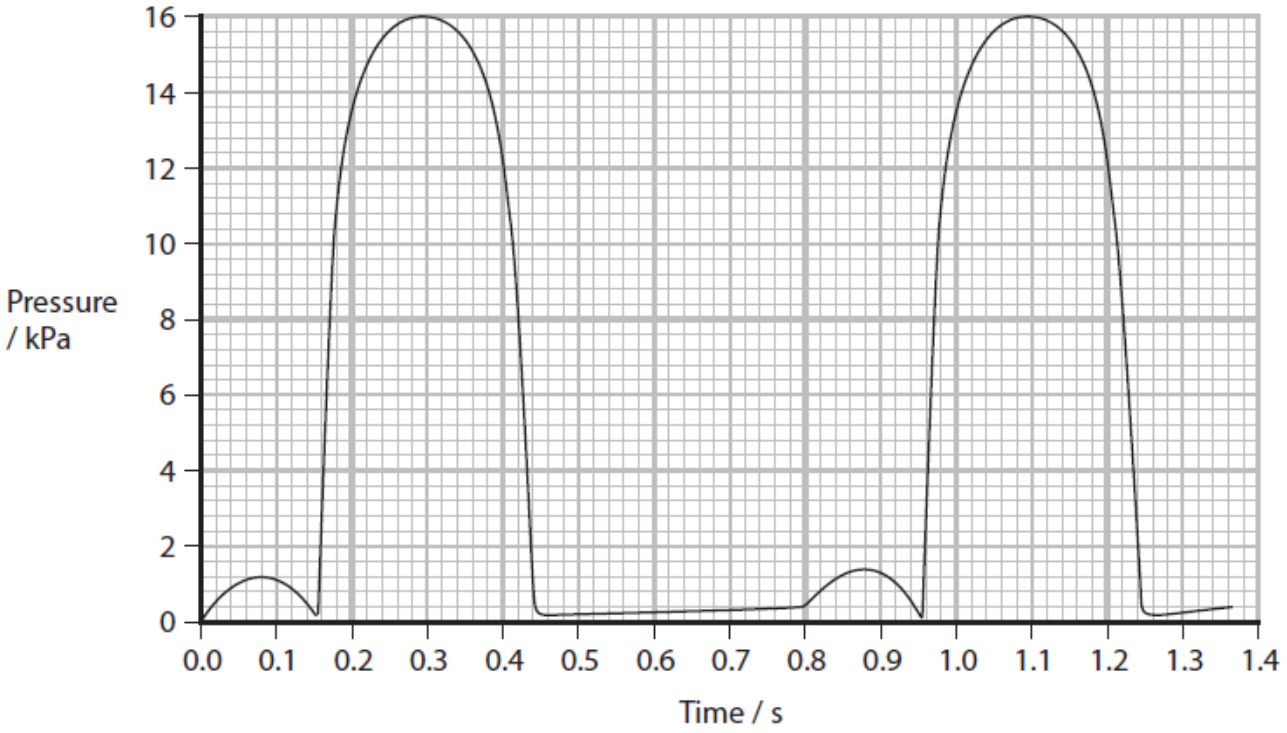
☒ **D** vena cava

(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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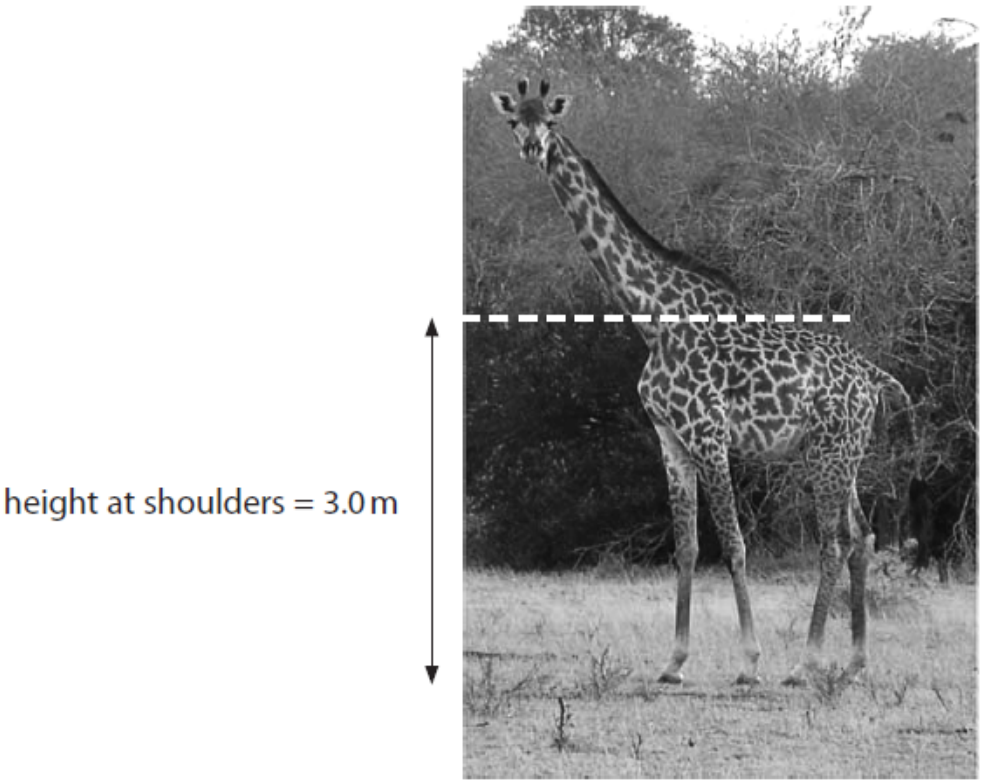
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**(Total for question = 7 marks)**

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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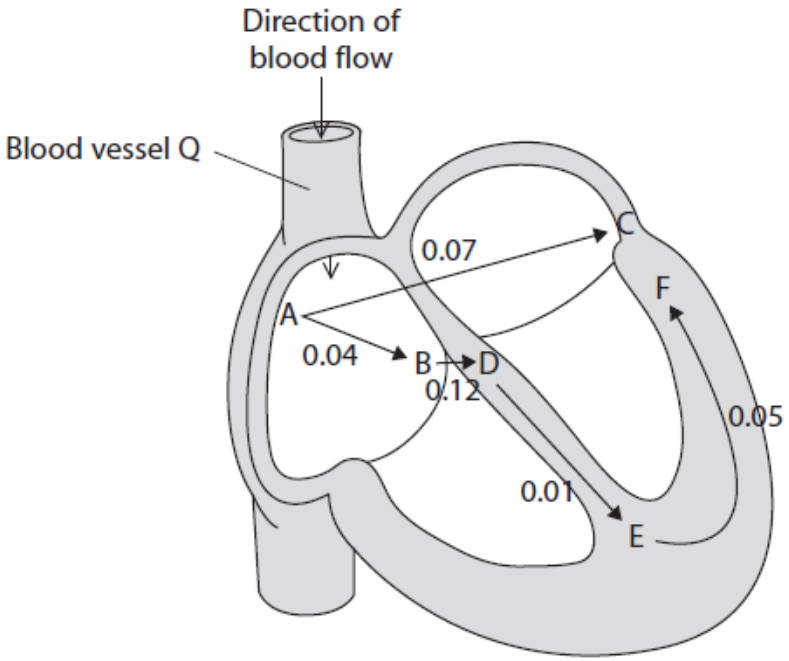
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**(Total for question = 12 marks)**

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

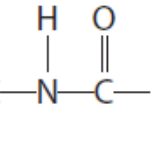
☐ **B** 1:3

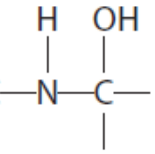
☐ **C** 3:1

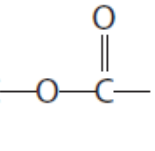
☐ **D** 3:3

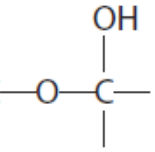
(ii) Which diagram shows the bond that joins a glycerol molecule to a fatty acid in a triglyceride?

**(1)**

☒ **A** 

☒ **B** 

☒ **C** 

☒ **D** 

(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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**(Total for question = 10 marks)**

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

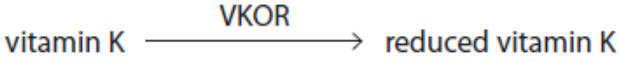
☒ **C** platelet inhibitor

☒ **D** statin

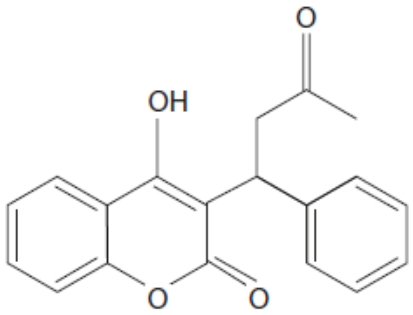
(c) Reduced vitamin K is needed for the synthesis of prothrombin.

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

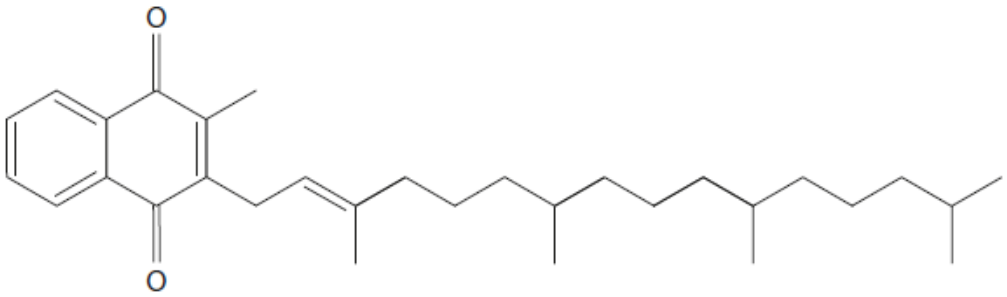
The diagram shows this conversion.



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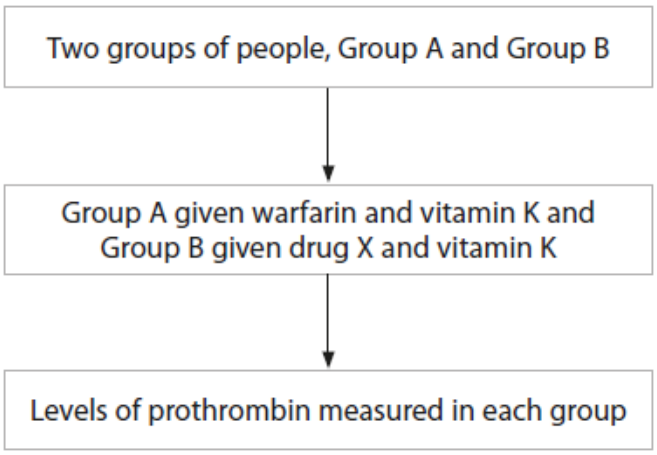
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(d) Other drugs are available that work in a similar way to warfarin.

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.

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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)**