EDEXCEL

UNIT 1 QP

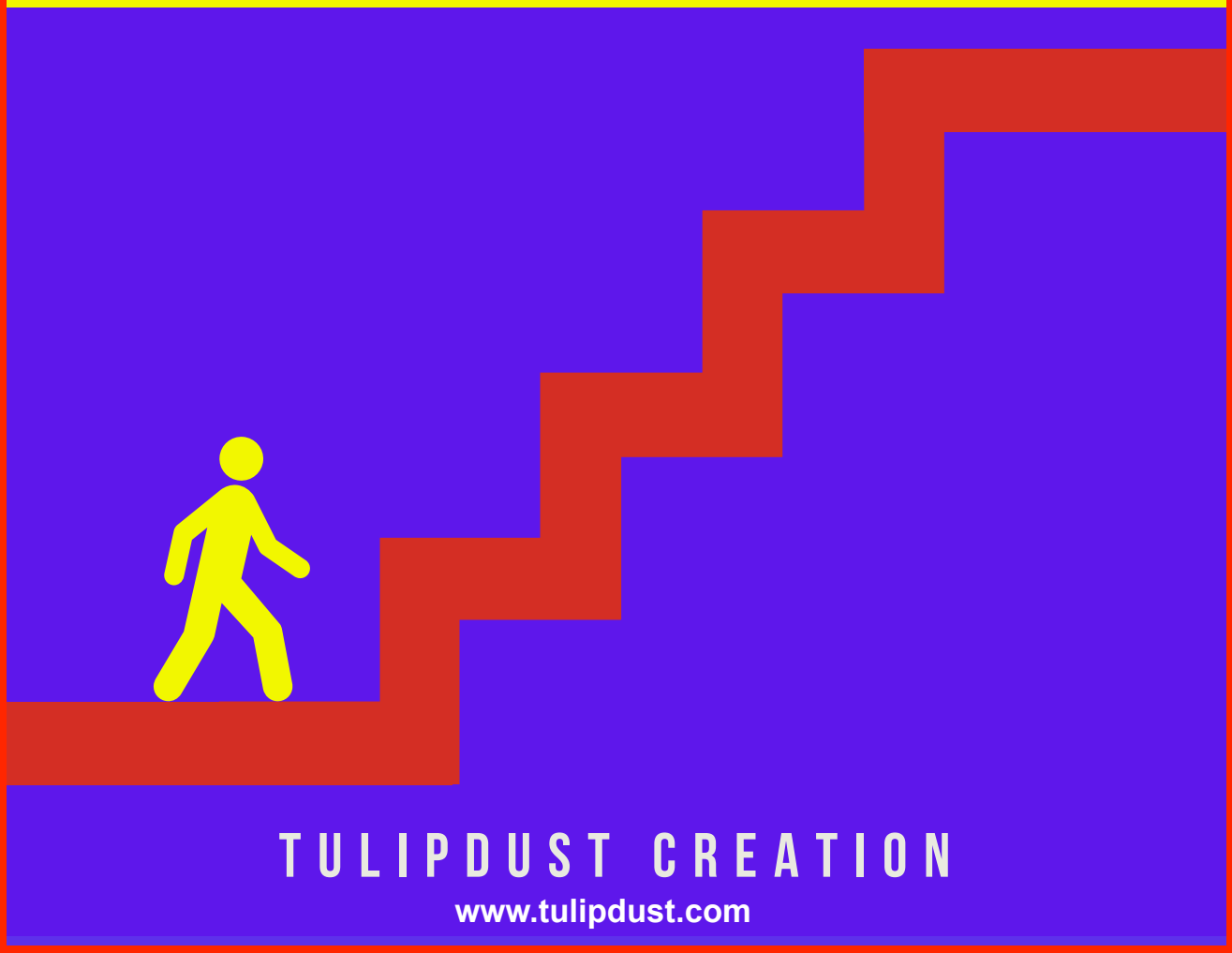
BIOLOGY

PAST PAPERS

2019 - 2024

17 PAPERS | 440 pages | Spiral book

Hard cover | HQ Print



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Candidate surname	Other names

Pearson Edexcel
International Advanced Level

Centre Number | | | | | |

Candidate Number | | | | |

Monday 7 January 2019

Morning (Time: 1 hour 30 minutes) | Paper Reference **WBI11/01**

Biology

International Advanced Subsidiary/Advanced Level
Unit 1: Molecules, Diet, Transport and Health

You must have:
Scientific calculator, ruler, HB pencil

Total Marks

Instructions

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

Information

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Turn over ▶

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Pearson

Answer ALL questions.

Write your answers in the spaces provided.

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

1 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.

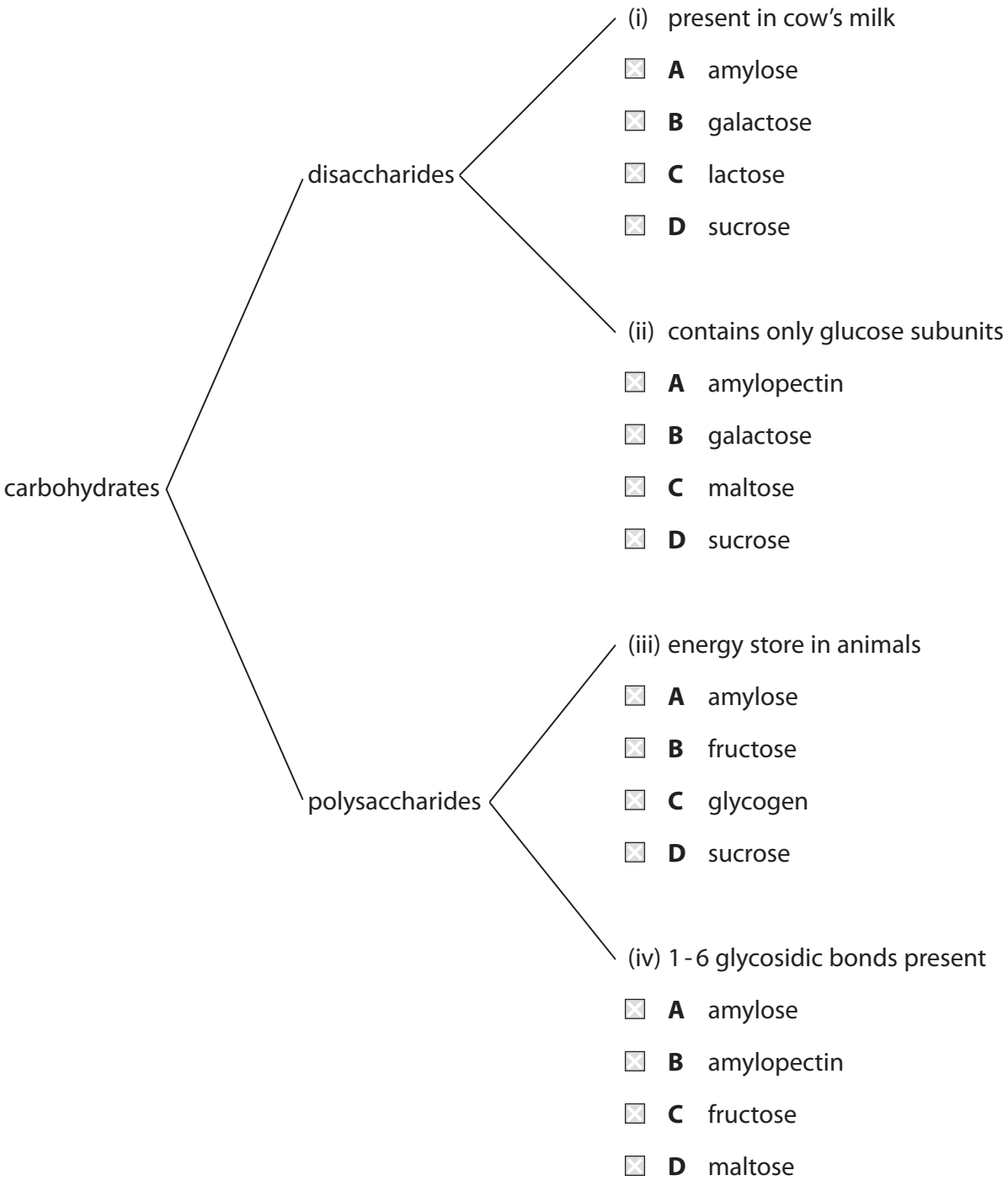
(1)

.....

(b) The diagram shows some information about carbohydrates.

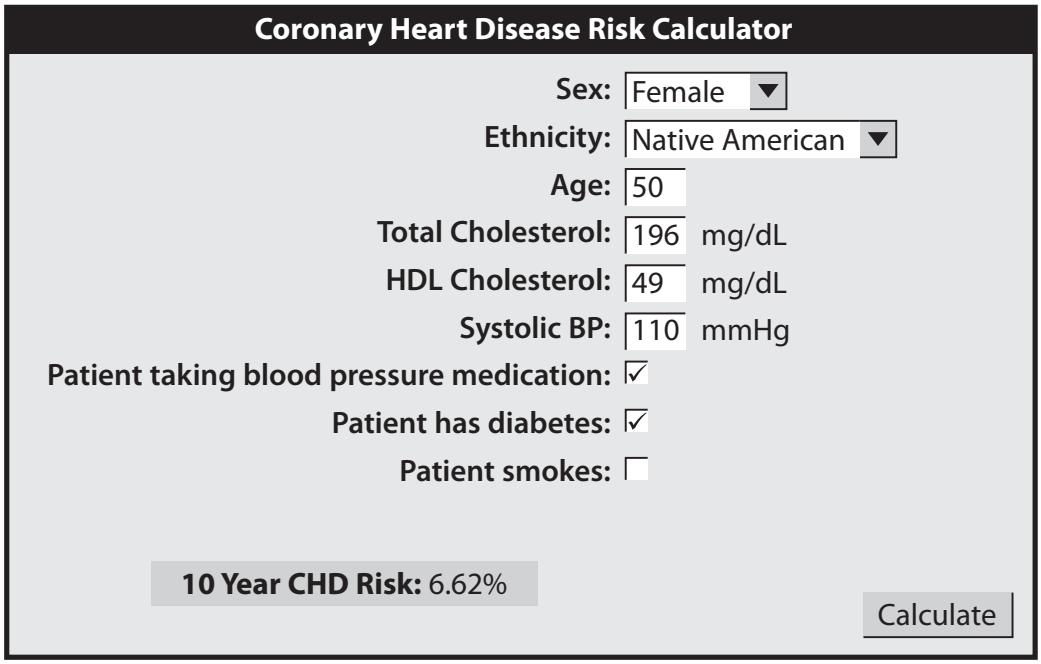
Which carbohydrate is being described in each of (i) to (iv)?

(4)



(Total for Question 1 = 6 marks)

2 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)

(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)

(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 2 = 10 marks)

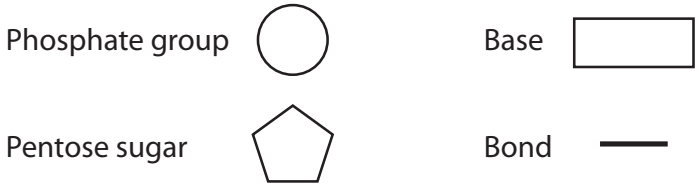
3 Nucleic acids include DNA and RNA.

(a) Each single strand of a DNA molecule is synthesised from mononucleotides.

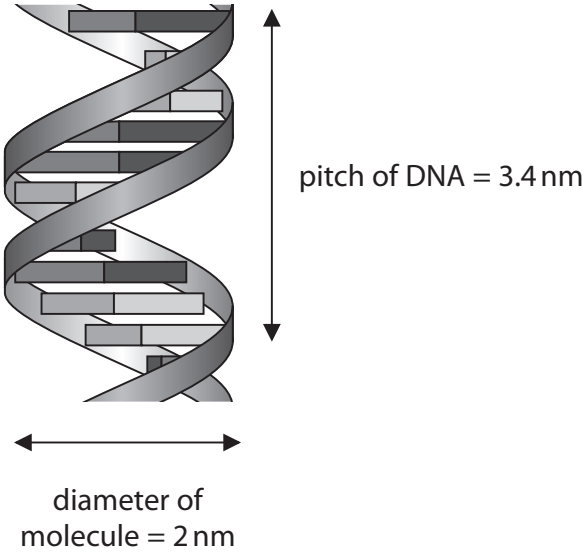
Draw a diagram to show two mononucleotides joined together in a single strand of DNA.

Use the symbols shown for each component in your diagram.

(3)



(b) The diagram represents part of a DNA molecule.



The pitch is the length of one complete turn in the double helix.

There are 10 base pairs in one pitch.

(i) Calculate the distance between one base and the next base on one strand of DNA.

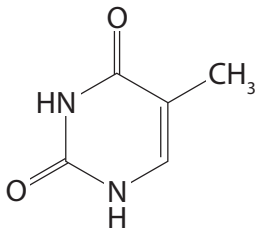
Give your answer to an appropriate number of significant figures.

(1)

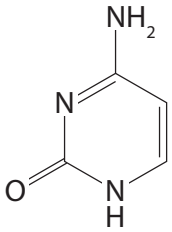
Answer ..... nm

(ii) The diagram shows the structure of thymine and four other bases, **P**, **Q**, **R** and **S**.

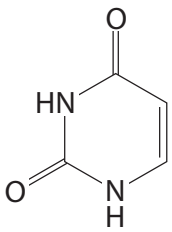
Bases **P** and **S** can form three hydrogen bonds each and bases **Q** and **R** can form two hydrogen bonds each.



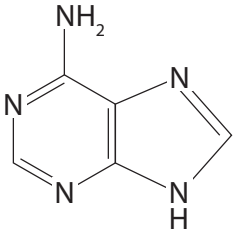
thymine



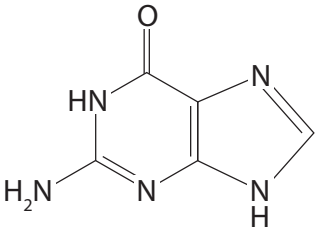
base **P**



base **Q**



base **R**



base **S**

Explain which of the four bases **P**, **Q**, **R** or **S** is adenine.

(2)

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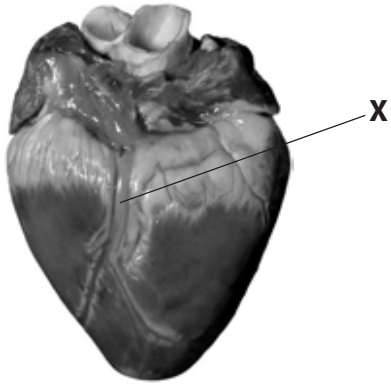
(c) Compare and contrast the structure of messenger RNA (mRNA) with the structure of transfer RNA (tRNA).

(4)

(Total for Question 3 = 10 marks)

4 The photograph shows a mammalian heart.



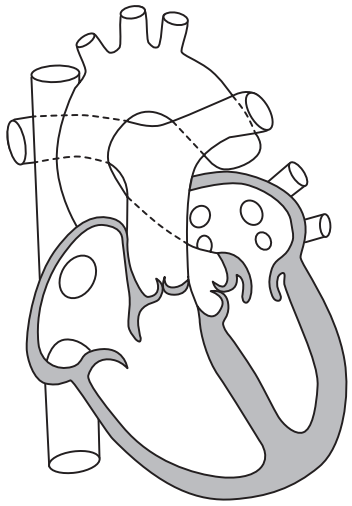
The blood vessel labelled **X** is a branch from the aorta.

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)

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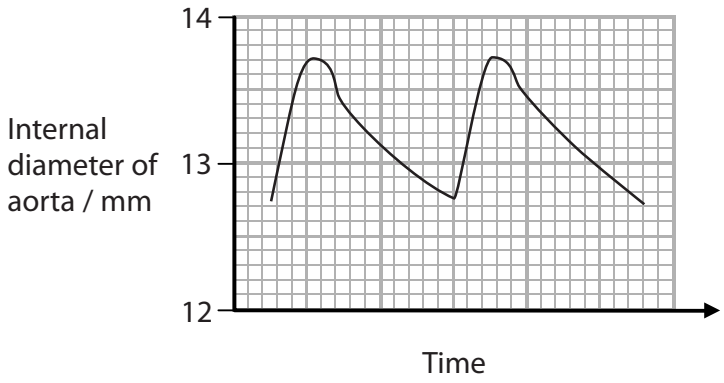
(ii) Draw arrows on the diagram to show the flow of blood through the left side of the heart and into the aorta.

(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.

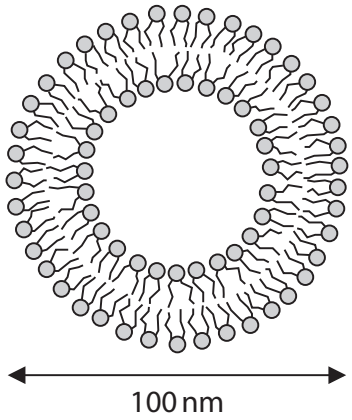
(3)

(Total for Question 4 = 11 marks)

5 Liposomes are spherical structures composed of phospholipids. They can be made by adding phospholipids to water.

Liposomes can be used to study membrane permeability.

(a) The diagram shows a liposome.



(i) Calculate the volume of this liposome, using the formula

$$V = \frac{4}{3}\pi r^3$$

(2)

Answer .....

(ii) Explain the arrangement of phospholipids in liposomes.

(2)

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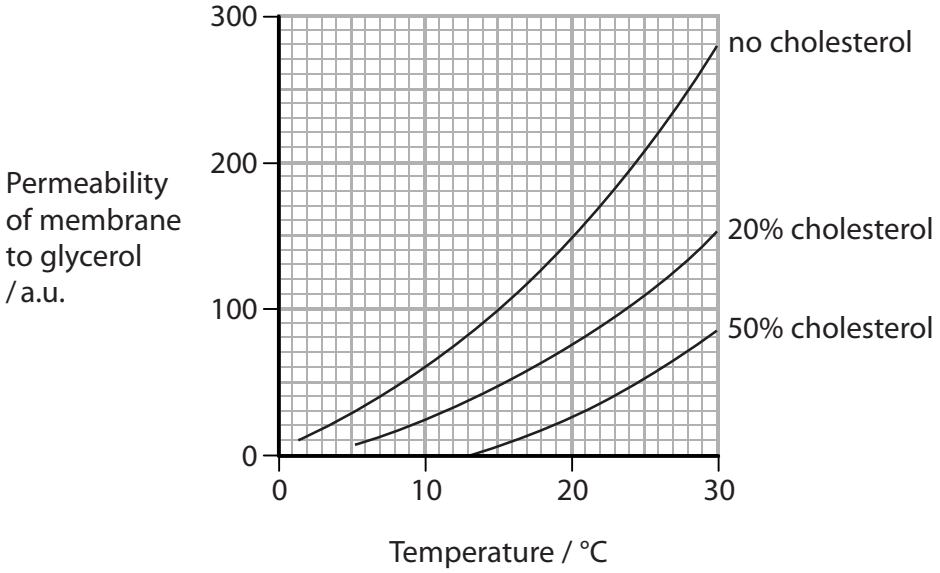
(b) The presence of cholesterol in the membrane affects membrane permeability.

A student investigated the effect of cholesterol on the permeability of liposomes to glycerol at different temperatures.

Liposomes were made by replacing 20% and 50% of the phospholipid with cholesterol.

Liposomes without cholesterol were also made.

The graph shows the results of this investigation.



(i) How does glycerol pass through the liposome membrane?

(1)

☒ **A** active transport

☒ **B** diffusion

☒ **C** endocytosis

☒ **D** osmosis

(ii) Describe the effects of cholesterol and temperature on membrane permeability, as shown in the graph.

(3)

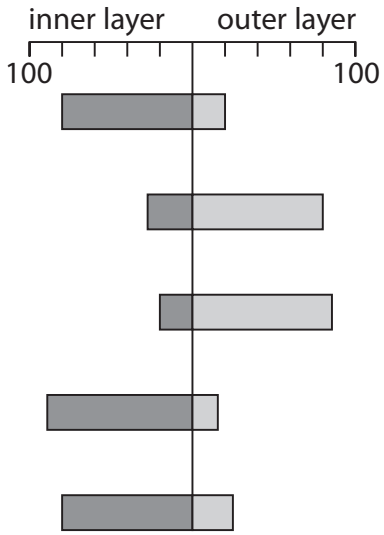
(iii) Explain why cholesterol and temperature affect membrane permeability.

(2)

(Total for Question 5 = 10 marks)

6 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)

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

(4)

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

Explain why thrombin inhibitors affect the time taken for blood to clot.

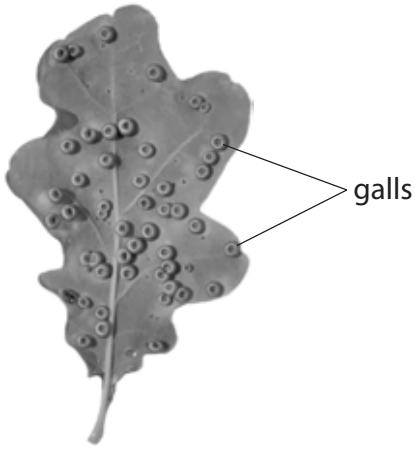
(4)

(Total for Question 6 = 11 marks)

7 Some insects lay eggs inside leaves. This causes the leaves to produce swellings called galls.

The galls supply the developing insects with nutrients and protect them from the external environment.

The photograph shows galls on a leaf.



In an investigation, the concentrations of protein molecules and amino acids found in healthy leaves, leaves with galls and in the galls themselves were determined.

(a) The insects were removed from each gall before the investigation.

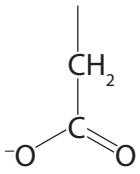
Suggest why the insects were removed from the galls.

(2)

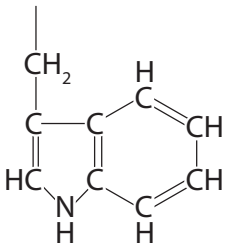
(b) The amino acids were extracted and dissolved in a non-polar organic solvent.

(i) The diagram shows the R group of the amino acids, alanine, aspartate and tryptophan.

alanine



aspartate



tryptophan

Which row of the table describes the solubility of these amino acids in a non-polar organic solvent?

(1)

	Solubility in a non-polar organic solvent		
	Most soluble ⟶		**Least soluble**
☒ **A**	alanine	aspartate	tryptophan
☒ **B**	alanine	tryptophan	aspartate
☒ **C**	aspartate	alanine	tryptophan
☒ **D**	aspartate	tryptophan	alanine

(ii) The solubility of an amino acid can be determined by measuring the maximum mass of the amino acid that dissolves in a known volume of solvent.

The solubility of the amino acid histidine in a solvent is 43.5 g dm^{-3}.

The mass of the amino acid leucine that dissolves in 250 cm^3 of the same solvent is 5.5 g.

Calculate how many times more soluble histidine is than leucine.

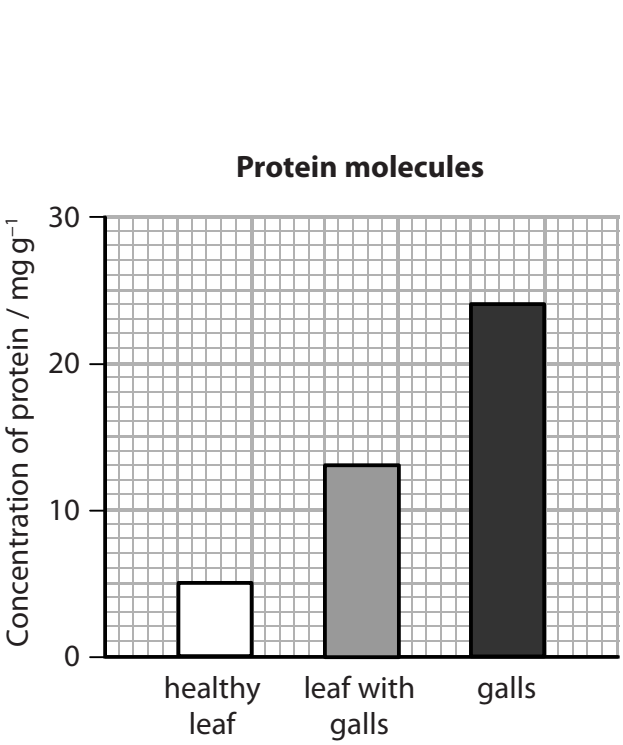
(2)

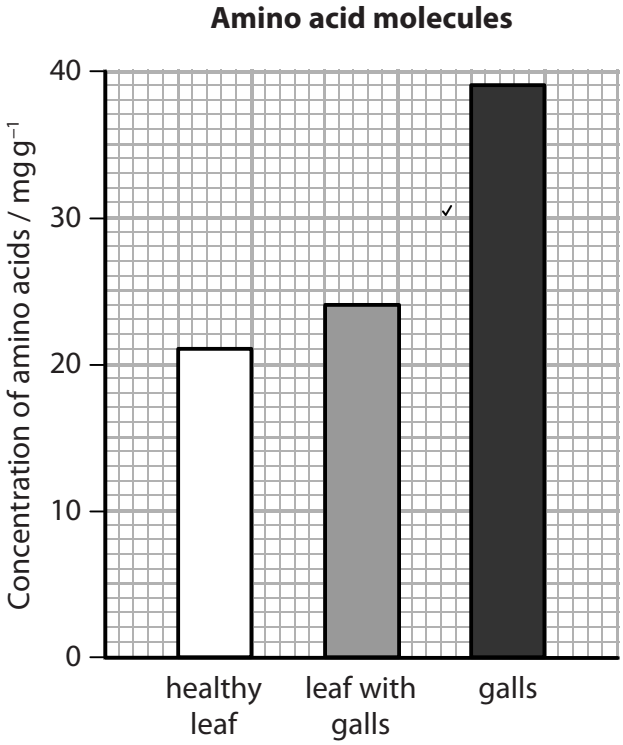
Answer .....

*(c) The gall-forming insects secrete saliva into the plant tissues.

The saliva contains enzymes that change the nutrients in the leaf and cause the galls to form.

The graphs show the concentrations of protein molecules and amino acid molecules in tissues from a healthy leaf, tissues from a leaf with galls and in the galls themselves.





The table shows the abundance of five amino acid molecules.

Amino acid	Abundance in tissues of a healthy leaf	Abundance in tissues of a leaf with galls	Abundance in galls
alanine	++	+	++
arginine	++	–	++
histidine	–	–	++
leucine	+	+	+
tryptophan	–	–	–

Key

++ most abundant

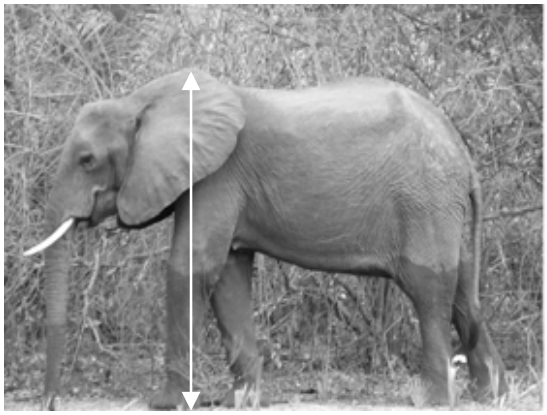
– absent

Explain the results of this investigation. Use the information in both graphs and the table to support your answer.

(6)

(Total for Question 7 = 11 marks)

8 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.

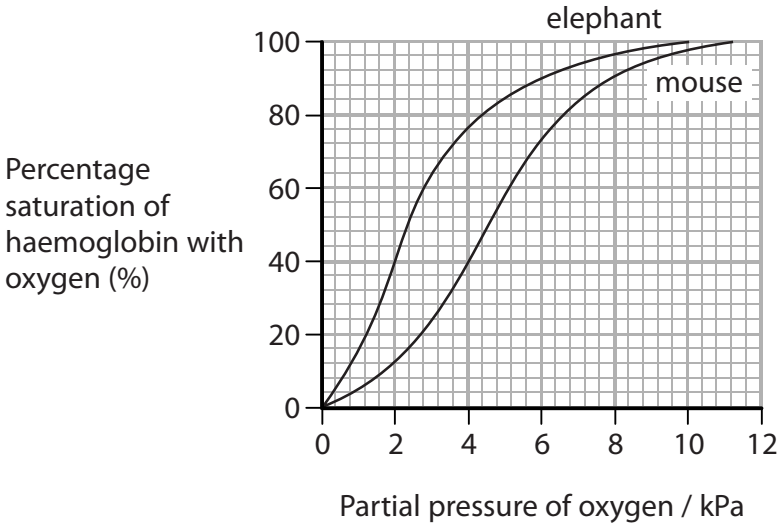
The lungs are attached to the chest cavity wall and diaphragm by collagen fibres.

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

(3)

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

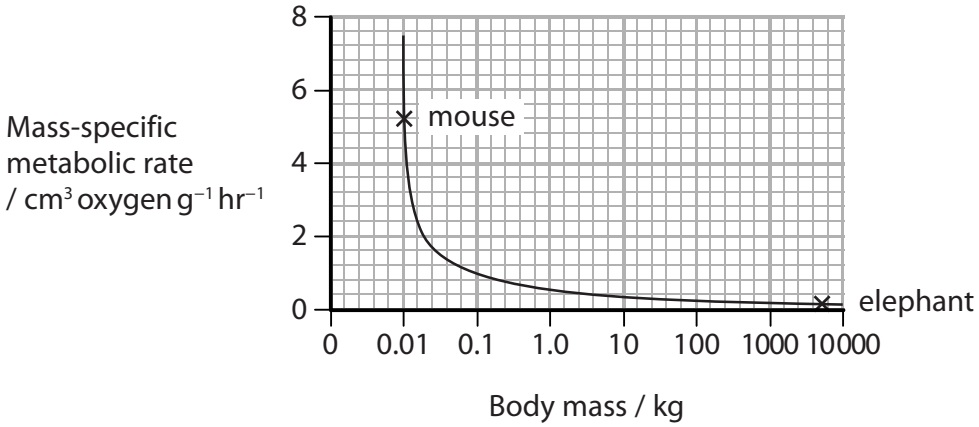
Graph 1



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.

(6)

(Total for Question 8 = 11 marks)

TOTAL FOR PAPER = 80 MARKS

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Pearson Edexcel
International Advanced Level

Centre Number | | | | | |

Candidate Number | | | | |

Tuesday 21 May 2019

Afternoon (Time: 1 hour 30 minutes) | Paper Reference **WBI11/01**

Biology

International Advanced Subsidiary / Advanced Level
Unit 1: Molecules, Diet, Transport and Health

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Pearson

Answer ALL questions.

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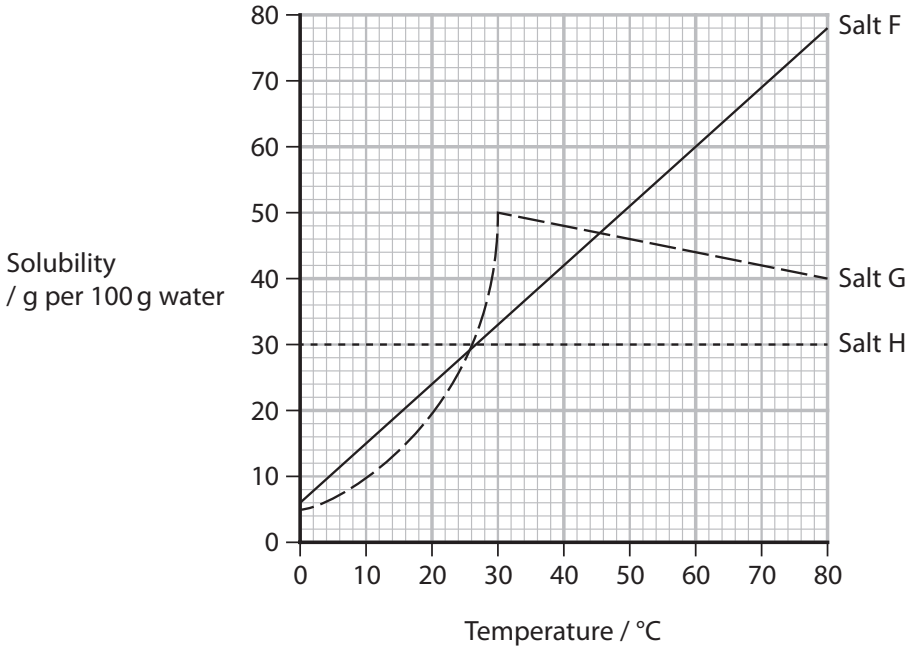
1 Water is important as a solvent for transport in living organisms.

(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)

(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 1 = 6 marks)

2 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

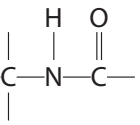
☒ **C** 3:1

☒ **D** 3:3

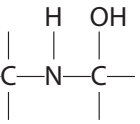
(ii) Which diagram shows the bond that joins a glycerol molecule to a fatty acid in a triglyceride?

(1)

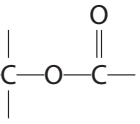
☒ **A**



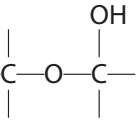
☒ **B**



☒ **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)

(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)

(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)

(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)

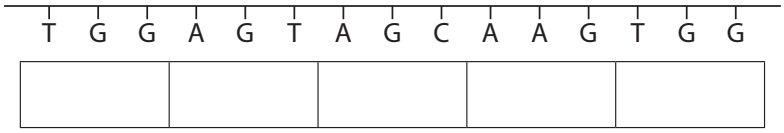
(Total for Question 2 = 10 marks)

3 The sequence of bases in DNA determines the sequence of amino acids in a polypeptide.

The table shows four amino acids and their genetic codes.

Amino acid	Genetic code
alanine (Ala)	GCT or GCC or GCA or GCG
lysine (Lys)	AAA or AAG
serine (Ser)	AGT or AGC or TCT or TCC or TCA or TCG
tryptophan (Trp)	TGG

(a) The diagram shows a DNA base sequence.



(i) Complete the diagram to show the sequence of amino acids coded by this DNA base sequence.

(1)

(ii) Explain why only five amino acids are coded by this sequence of bases.

(2)

(b) Explain why some amino acids, such as alanine, have more than one genetic code.

(3)

(c) Of the 64 possible genetic codes, 61 code for amino acids.

(i) Calculate the percentage of genetic codes that code for amino acids.

Give your answer to four significant figures.

(1)

Answer ..... %

(ii) Explain the role of the other three genetic codes.

(2)

(d) Messenger RNA (mRNA) and transfer RNA (tRNA) are involved in the synthesis of a polypeptide chain from DNA.

Which row of the table shows the codon on mRNA and the anticodon on tRNA that correspond to tryptophan?

(1)

	Codon on mRNA	Anticodon on tRNA
☒ **A**	ACC	TGG
☒ **B**	ACC	UGG
☒ **C**	UCC	AGG
☒ **D**	UCC	TGG

(Total for Question 3 = 10 marks)

4 Meselson and Stahl performed experiments that demonstrated semi-conservative replication of DNA.

(a) (i) State what is meant by the term semi-conservative replication.

(2)

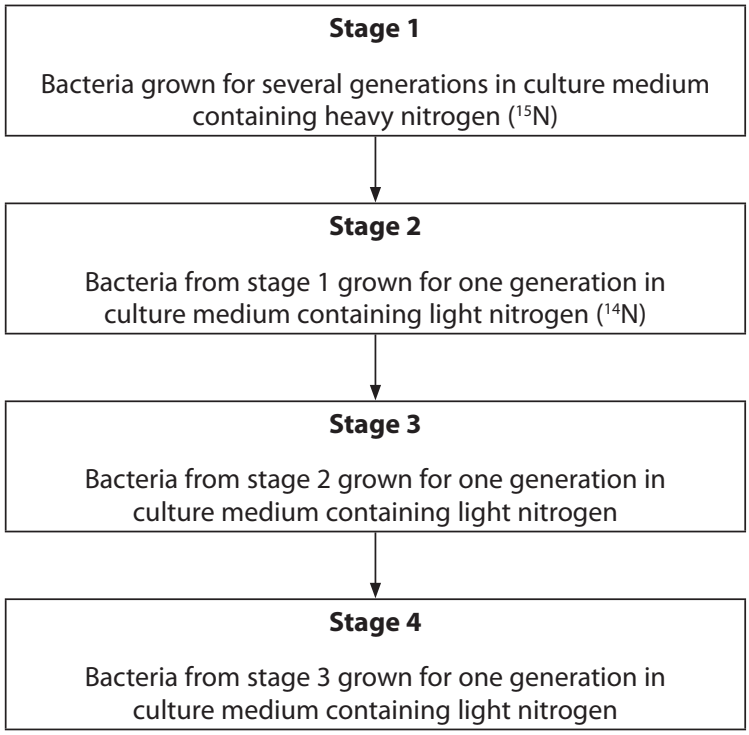
(ii) Name **one** enzyme involved in semi-conservative replication.

(1)

(iii) Explain the importance of semi-conservative replication in the production of new cells.

(2)

(b) The flow chart summarises part of one experiment performed by Meselson and Stahl.



Complete the table to show the percentage of the total number of DNA molecules containing heavy nitrogen only, light nitrogen only or both heavy and light nitrogen, at the end of each stage.

(3)

End of stage	Percentage of DNA molecules containing		
	heavy nitrogen only	light nitrogen only	both heavy and light nitrogen
1			
2			
3			

(Total for Question 4 = 8 marks)

5 Pineapples contain the sugars fructose, glucose and sucrose.

(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.

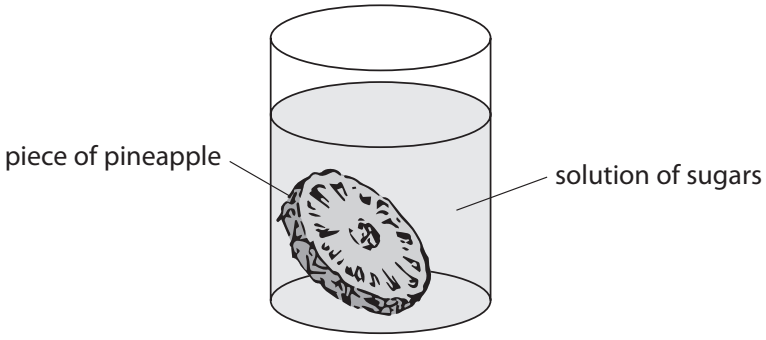
Give your answer in **g dm^{-3}**.

(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)

(Total for Question 5 = 10 marks)

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

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

(3)

(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)

(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

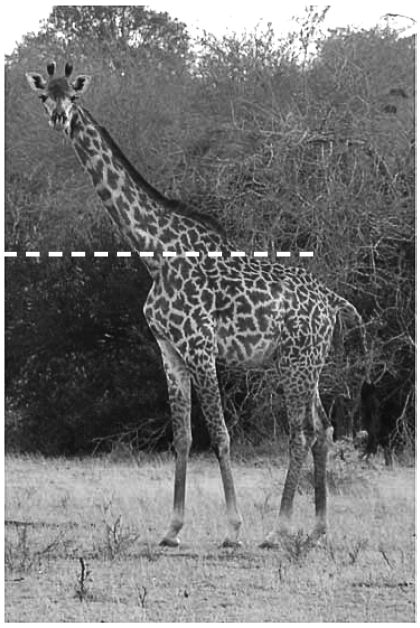
☒ **D** whole milk powder

(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)

(Total for Question 6 = 11 marks)

7 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)

(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)

(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)

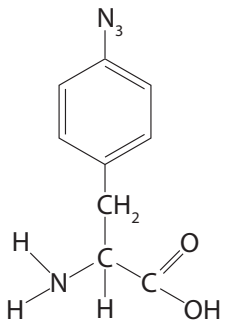
(Total for Question 7 = 12 marks)

8 Silkworms are caterpillars that produce silk. Silk is a fibrous protein that can be used in clothing and in medicine.

Silkworms have been selectively bred to produce a modified silk that could have even more medical uses.

The modified silk is made by these silkworms by inserting a synthetic amino acid, AzPhe, into the protein. This replaces the naturally-occurring amino acid phenylalanine.

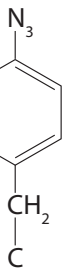
The diagram shows the structure of AzPhe.



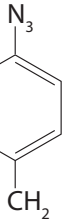
(a) Which of the following diagrams shows the R group only of AzPhe?

(1)

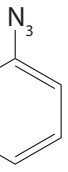
☒ **A**



☒ **B**



☒ **C**



☒ **D**

(b) Only the silkworms that have been selectively bred can use AzPhe in the synthesis of protein.

During translation, AzPhe joins to two other amino acids by condensation reactions.

(i) Name the covalent bond that joins two amino acids in a condensation reaction.

(1)

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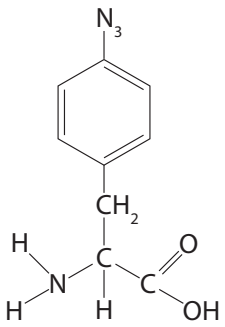
(ii) Draw two circles on the diagram of AzPhe to show which parts of the molecule are lost when AzPhe joins to two other amino acids by condensation reactions.

(2)



(iii) Transfer RNA (tRNA) is involved in translation. The amino acid AzPhe requires a special tRNA molecule during the synthesis of silk.

Suggest why AzPhe is **not** inserted into proteins in silkworms that have not been selectively bred.

(3)

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(c) Part of a silk molecule contains 1100 amino acids. In natural silk, 1% of the amino acids are phenylalanine.

In modified silk, 16% of the phenylalanine molecules are replaced by AzPhe.

(i) Calculate the ratio of phenylalanine to AzPhe in this part of a modified silk molecule.

(2)

Answer .....

(ii) The R group of phenylalanine is smaller than the R group of AzPhe.

Suggest how inserting an amino acid with a larger R group could affect the properties of silk fibres.

(4)

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(Total for Question 8 = 13 marks)

TOTAL FOR PAPER = 80 MARKS

Please check the examination details below before entering your candidate information

Candidate surname	Other names

Pearson Edexcel
International Advanced Level

Centre Number | | | | | |

Candidate Number | | | | |

Tuesday 8 October 2019

Morning (Time: 1 hour 30 minutes) | Paper Reference **WBI11/01**

Biology

International Advanced Subsidiary / Advanced Level
Unit 1: Molecules, Diet, Transport and Health

You must have:
Scientific calculator, ruler, HB pencil

Total Marks

Instructions

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

Information

- The total mark for this paper is 80.
- The marks for **each** question are shown in brackets – *use this as a guide as to how much time to spend on each question.*
- In questions marked with an **asterisk** (*), marks will be awarded for your ability to structure your answer logically, showing how the points that you make are related or follow on from each other where appropriate.

Advice

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

Turn over ▶

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P 6 2 7 9 2 R A 0 1 2 8

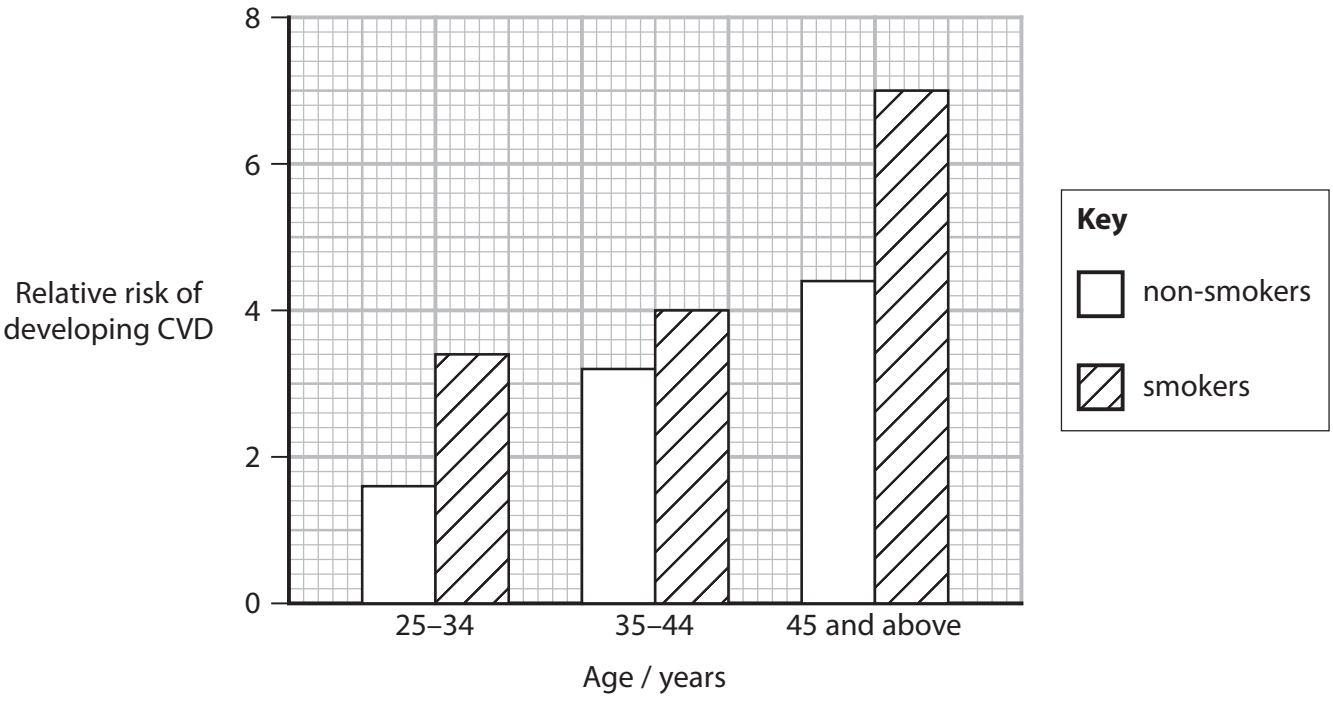
Pearson

Answer ALL questions.

Write your answers in the spaces provided.

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

1 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** 0.571×10^6

☒ **B** 5.71×10^6

☒ **C** 57.1×10^6

☒ **D** 571.00×10^6

(Total for Question 1 = 5 marks)

2 Rabbits can have brown fur or white fur.

A heterozygous rabbit will have brown fur.

(a) Draw a genetic diagram to show the genotypes and corresponding phenotypes of the baby rabbits produced if two heterozygous rabbits were bred together.

(3)

(b) A number of heterozygous pairs of rabbits were bred together and produced 284 baby rabbits.

Calculate the expected number of homozygous brown rabbits, heterozygous brown rabbits and white rabbits produced.

(3)

Number of homozygous brown rabbits .....

Number of heterozygous brown rabbits.....

Number of white rabbits.....

(Total for Question 2 = 6 marks)

3 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.

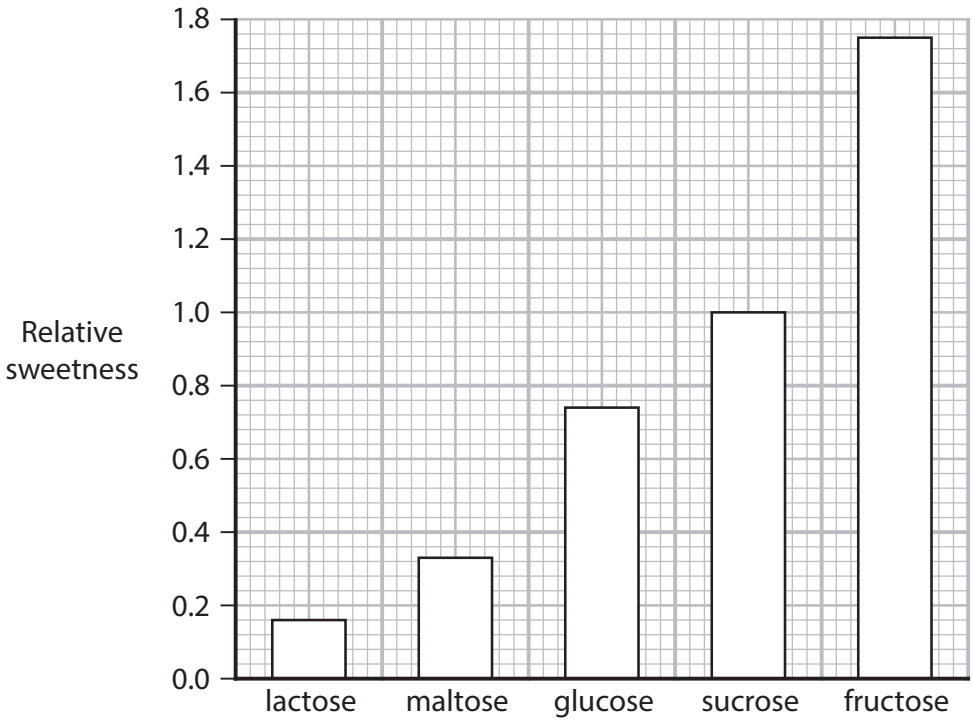
Explain why more males than females are affected with haemophilia A.

(3)

(Total for Question 3 = 9 marks)

4 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.

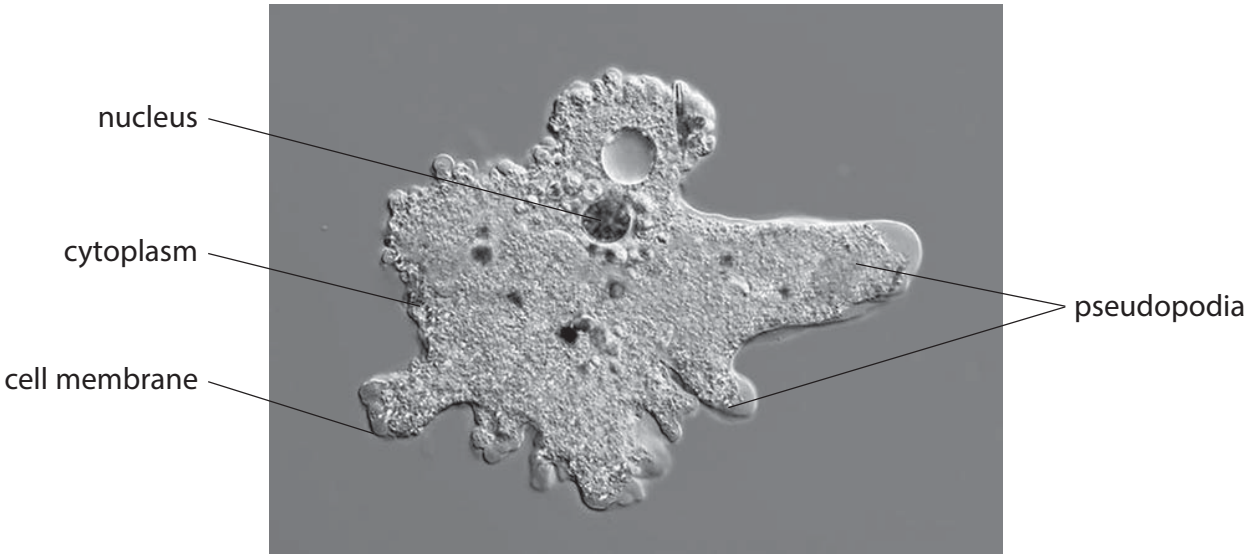
Compare and contrast the structure of amylose with the structure of amylopectin.

(3)

(Total for Question 4 = 10 marks)

5 An amoeba is a single-celled organism that lives in water.

The photograph shows an amoeba, as seen using a light microscope.



Substances in the water can enter the amoeba by a variety of transport mechanisms.

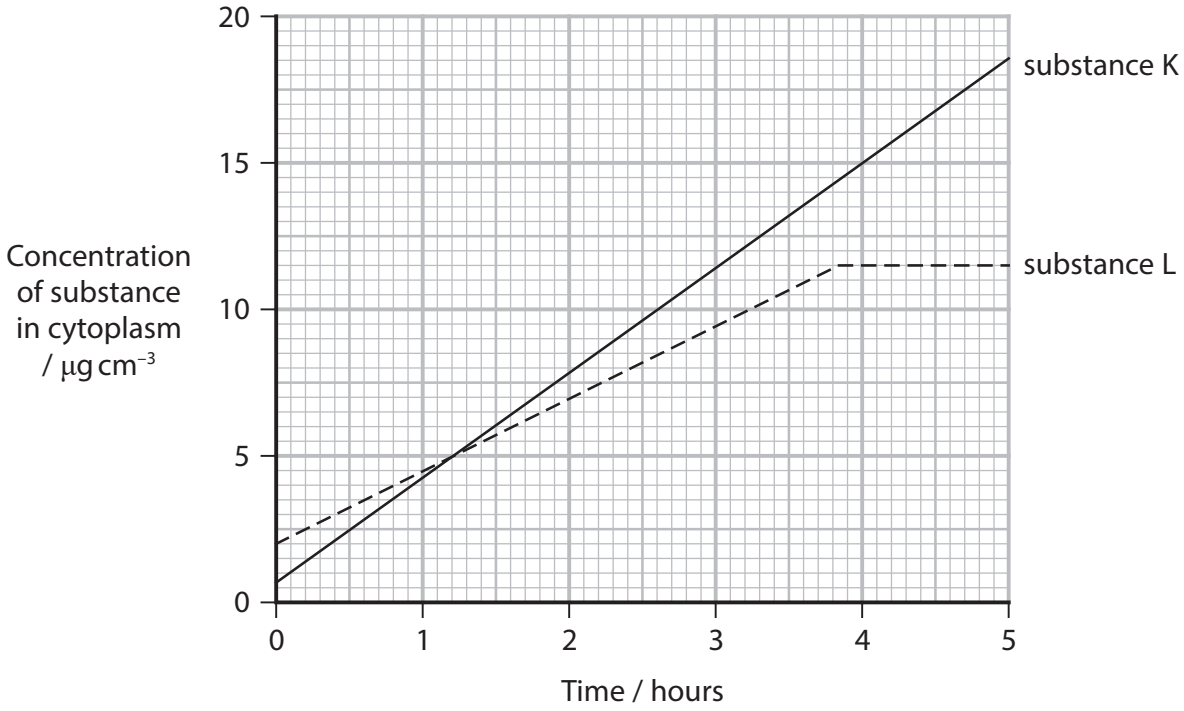
(a) The table shows some features of transport mechanisms.

Which feature is true for active transport only, facilitated diffusion only, both active transport and facilitated diffusion, or not true for both active transport and facilitated diffusion?

(3)

Feature	Transport mechanism			
	active transport only	**facilitated diffusion only**	**both active transport and facilitated diffusion**	**not true for both active transport and facilitated diffusion**
passive process	☒	☒	☒	☒
membrane proteins involved	☒	☒	☒	☒
direction of transport can be up the concentration gradient	☒	☒	☒	☒

(b) The graph shows the uptake of two substances, substance K and substance L, into the cytoplasm of an amoeba in water at a temperature of 18 °C.



(i) Explain the differences in the uptake of substance K and substance L.

(2)

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(ii) On the graph, draw a line to show the uptake of substance L at 10 °C.

(2)

(c) Pseudopodia are formed by cytoplasm flowing towards the membrane and changing its shape.

(i) Explain why the membrane is able to change its shape when cytoplasm flows towards it.

(2)

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(ii) Explain how the uptake of substances would be affected if the amoeba increased its number of pseudopodia.

(2)

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(Total for Question 5 = 11 marks)

6 Errors in DNA replication can give rise to mutations.

The diagram shows the bases in a length of DNA.

Length of DNA	A	T	G	C	T	C	A	T	T	T	A	C	C	A	T	C	G	A
Base number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18

The table shows the genetic code for the amino acids.

Genetic code	Amino acid	Genetic code	Amino acid	Genetic code	Amino acid	Genetic code	Amino acid
AAA AAG	Lysine	CAA CAG	Glutamine	GAA GAG	Glutamic acid	TAC TAT	Tyrosine
AAC AAT	Asparagine	CAT CAC	Histidine	GAC GAT	Aspartic acid	TCA TCC TCG TCT	Serine
ACA ACC ACG ACT	Threonine	CCA CCC CCG CCT	Proline	GCA GCC GCG GCT	Alanine	TGG	Tryptophan
AGA AGG	Arginine	CGA CGC CGG CGT	Arginine	GGA GGC GGG GGT	Glycine	TGC TGT	Cysteine
AGC AGT	Serine	CTA CTC CTG CTT	Leucine	GTA GTC GTG GTT	Valine	TTA TTG	Leucine
ATA ATC ATT	Isoleucine					TTC TTT	Phenylalanine
ATG	Methionine						

The genetic codes TAA, TAG and TGA are stop codons.

(a) State the sequence of the first four amino acids coded for by this length of DNA.

(1)

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(b) A change in a single base can cause a change in the amino acid sequence produced in protein synthesis.

(i) Name the type of each mutation described below.

(2)

Base number 3 becomes cytosine (C) .....

Base number 6 becomes number 5 in the sequence .....

Base number 9 becomes number 10 in the sequence .....

*(ii) Explain the possible effects of these three types of mutation on the amino acid sequence coded for by this length of DNA.

Use the information in the table to support your answer.

(6)

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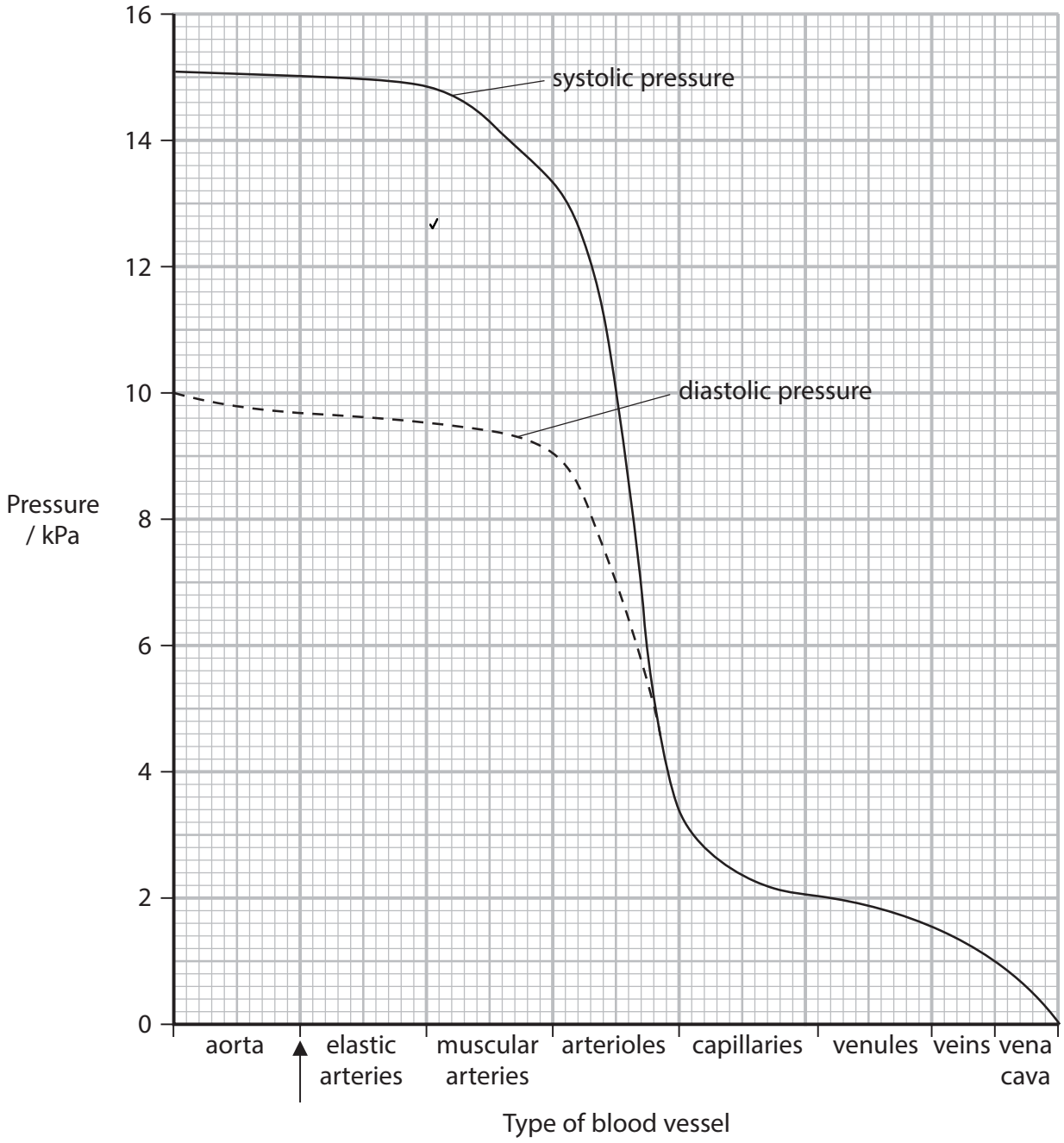
(Total for Question 6 = 9 marks)

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

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

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



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

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

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

(2)

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

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

Estimate the MAP in the elastic arteries for this person.

(2)

Answer ..... kPa

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

Explain how a low MAP could affect a person.

(2)

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

Blood flow can be calculated using the formula

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

Blood flow can also be calculated using the formula

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

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

(1)

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

☒ **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)

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

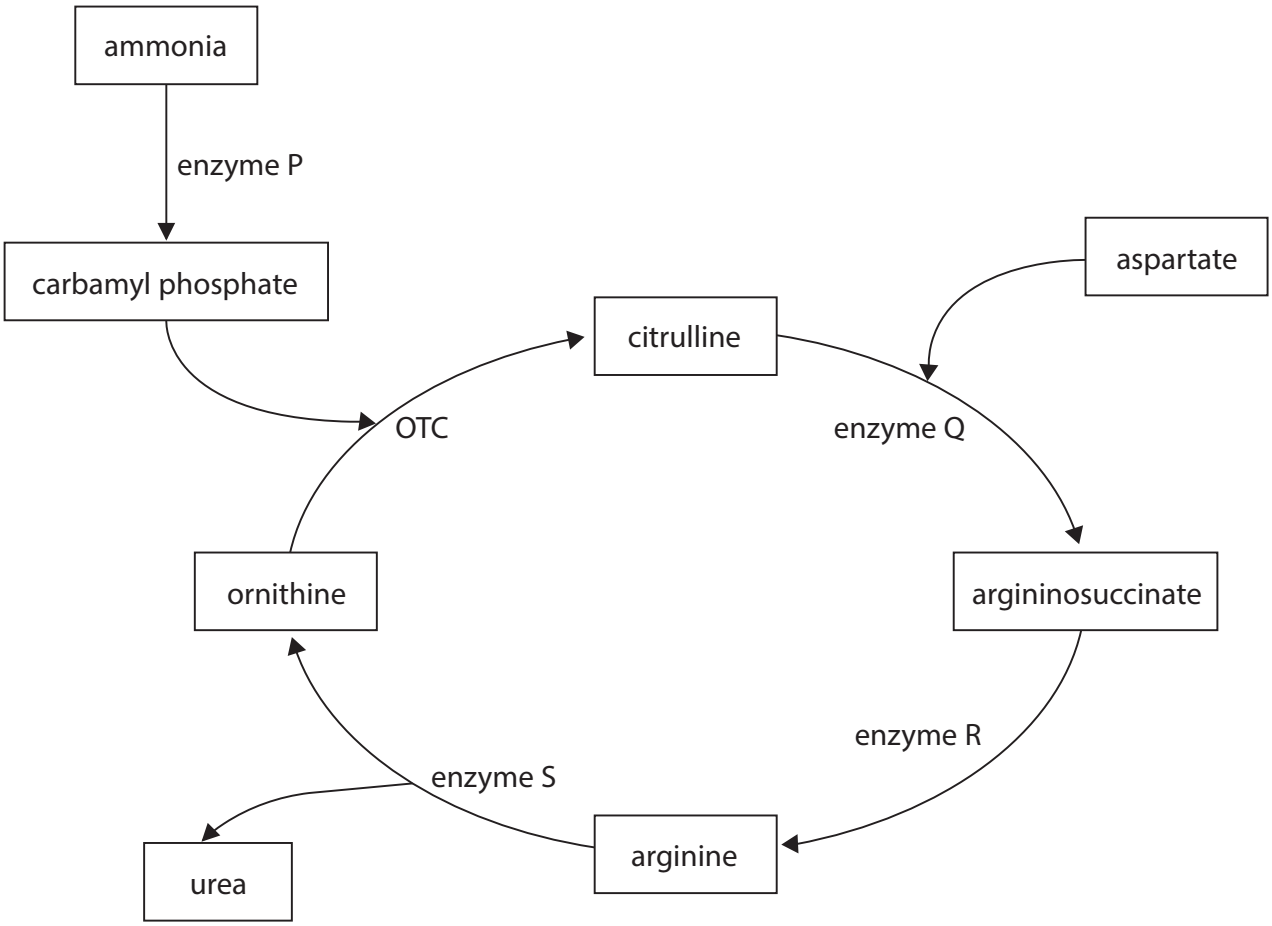
(3)

(Total for Question 7 = 15 marks)

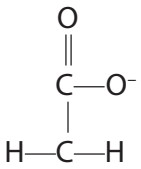
8 The amino acid aspartate is converted into the amino acid arginine in the urea cycle.

The urea cycle involves several enzymes and takes place in the liver.

The diagram shows part of the urea cycle.



(a) The R group of aspartate is



Draw the structure of the amino acid aspartate.

(3)

(b) Explain why several enzymes are involved in the urea cycle.

(3)

(c) Ornithine transcarbamylase (OTC) is one enzyme involved in the urea cycle.

Ornithine transcarbamylase deficiency is an inherited genetic disorder.

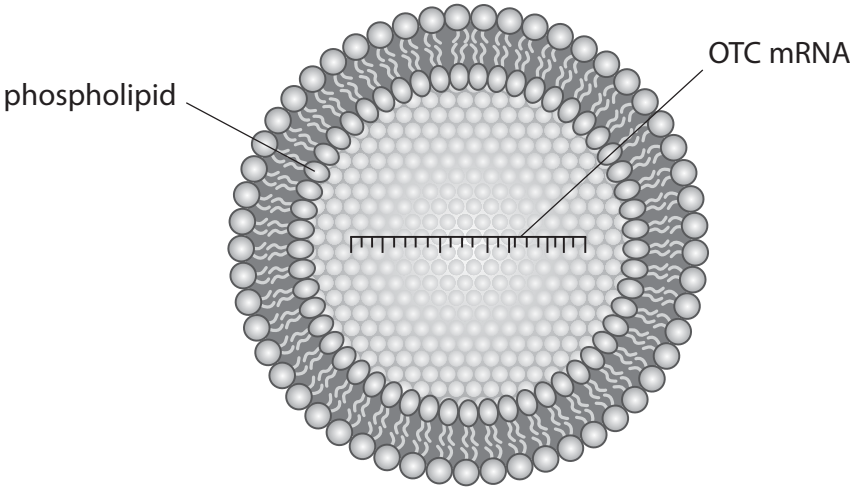
(i) Suggest how a person can be shown to have this disorder.

(3)

*(ii) Targeted mRNA therapy is being developed to treat OTC deficiency in mice.

Targeted mRNA therapy involves injecting mice with phospholipid particles containing OTC mRNA.

These particles, shown in the diagram, target liver cells.



The table shows the results of one study using these particles.

Mice	Concentration of ammonia in blood plasma / μmol dm^{-3}
normal without treatment	50
with OTC deficiency and without treatment	240
with OTC deficiency and with treatment	40

Explain how this treatment works.

Use the information in the diagram of the urea cycle, the diagram of the particle and the table of results to support your answer.

(6)

(Total for Question 8 = 15 marks)

TOTAL FOR PAPER = 80 MARKS

Please check the examination details below before entering your candidate information

Candidate surname	Other names

Pearson Edexcel
International Advanced Level

Centre Number | | | | | |

Candidate Number | | | | |

Tuesday 7 January 2020

Morning (Time: 1 hour 30 minutes) | Paper Reference **WBI11/01**

Biology

International Advanced Subsidiary/Advanced Level
Unit 1: Molecules, Diet, Transport and Health

You must have:
Scientific calculator, ruler, HB pencil

Total Marks

Instructions

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

Information

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- In questions marked with an **asterisk** (*), marks will be awarded for your ability to structure your answer logically, showing how the points that you make are related or follow on from each other where appropriate.

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- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

P60516RA

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P 6 0 5 1 6 R A 0 1 2 8

Pearson

Answer ALL questions.

Write your answers in the spaces provided.

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

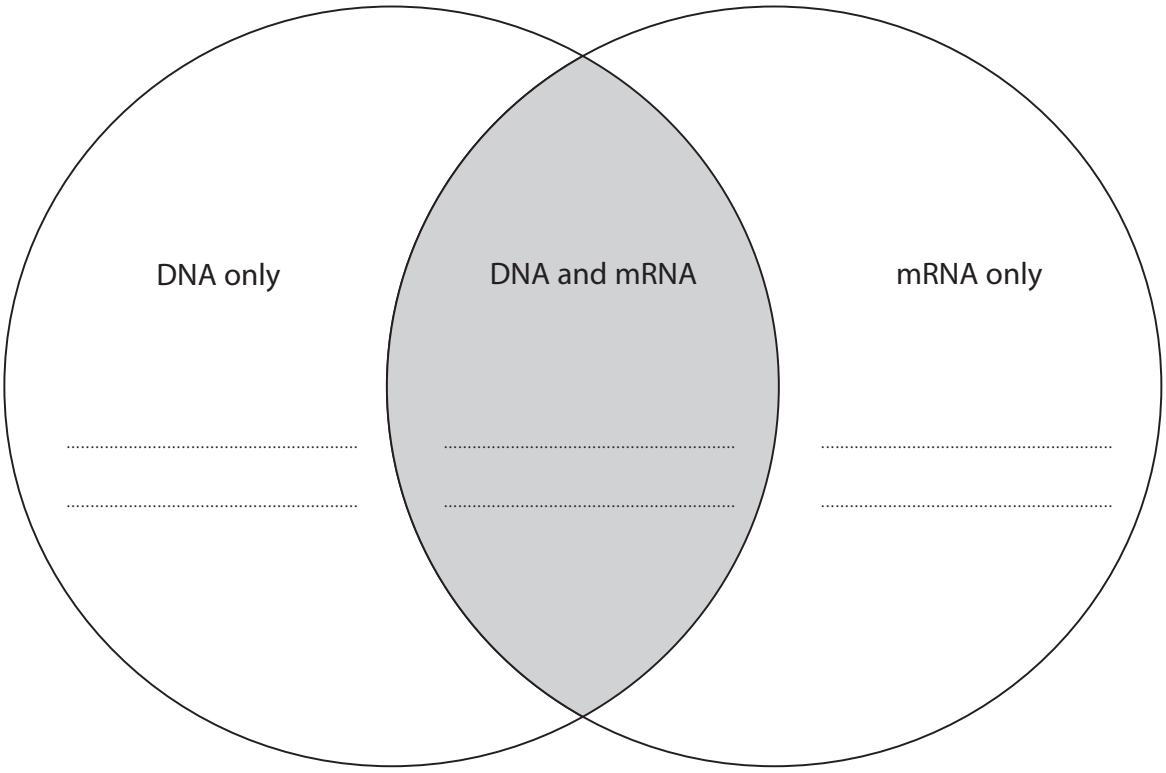
1 Polynucleotides include DNA and messenger RNA (mRNA).

Some components of polynucleotides are found in both DNA and mRNA.
Other components are found only in DNA or in mRNA.

A Venn diagram can be drawn to represent this information. Components found in both DNA and mRNA are written in the part of the diagram where the circles overlap.

Complete the Venn diagram by writing the name of **two** components in each part of the diagram.

(6)

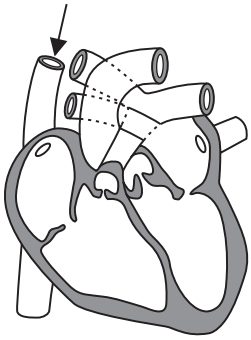


(Total for Question 1 = 6 marks)

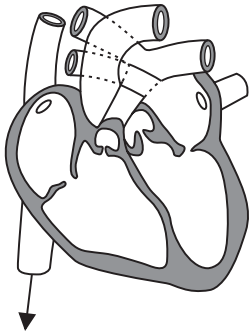
2 Blood flows through the heart during the cardiac cycle.

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

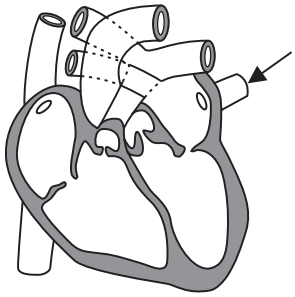
(1)



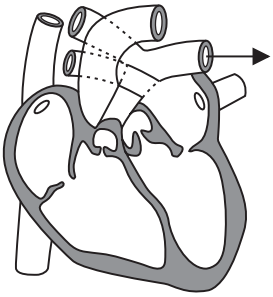
☒ **A**



☒ **C**



☒ **B**



☒ **D**

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

(1)

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

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

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

(3)

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

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

(2)

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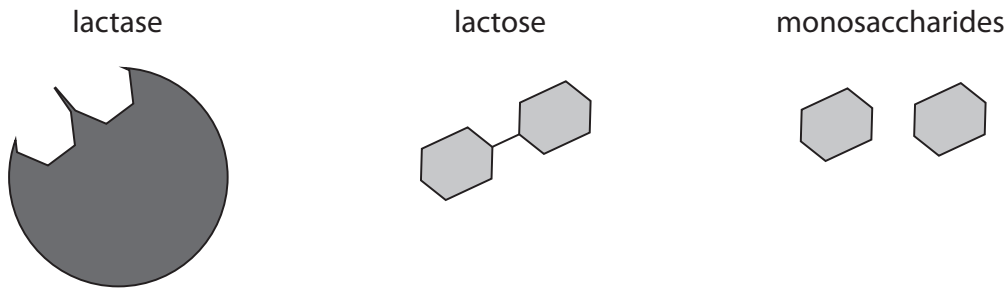
(Total for Question 2 = 7 marks)

3 Lactase is an enzyme that catalyses the hydrolysis of lactose.

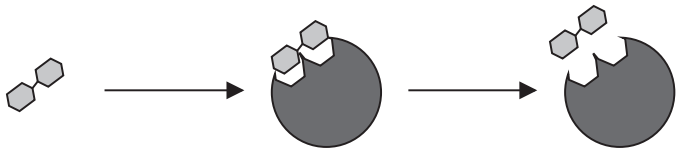
(a) (i) The diagrams show symbols for lactase, lactose and the monosaccharides of lactose.



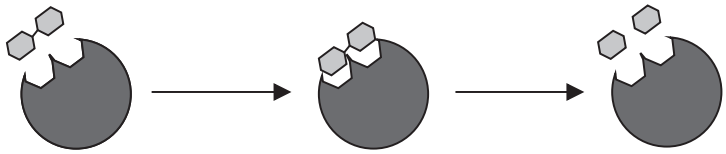
Which diagram shows the sequence of events for the hydrolysis of lactose?

(1)

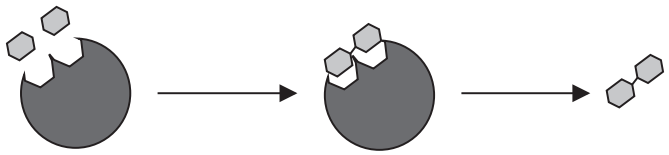
☒ **A**



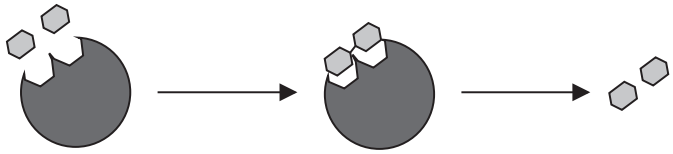
☒ **B**



☒ **C**



☒ **D**



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

(1)

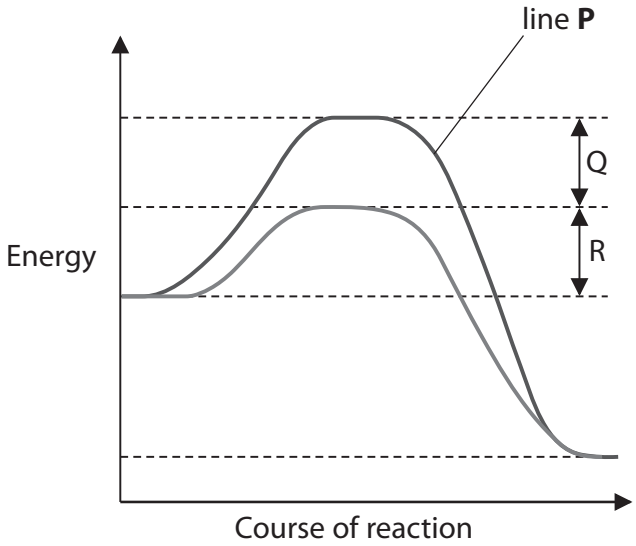
☒ **A** fructose and sucrose

☒ **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.

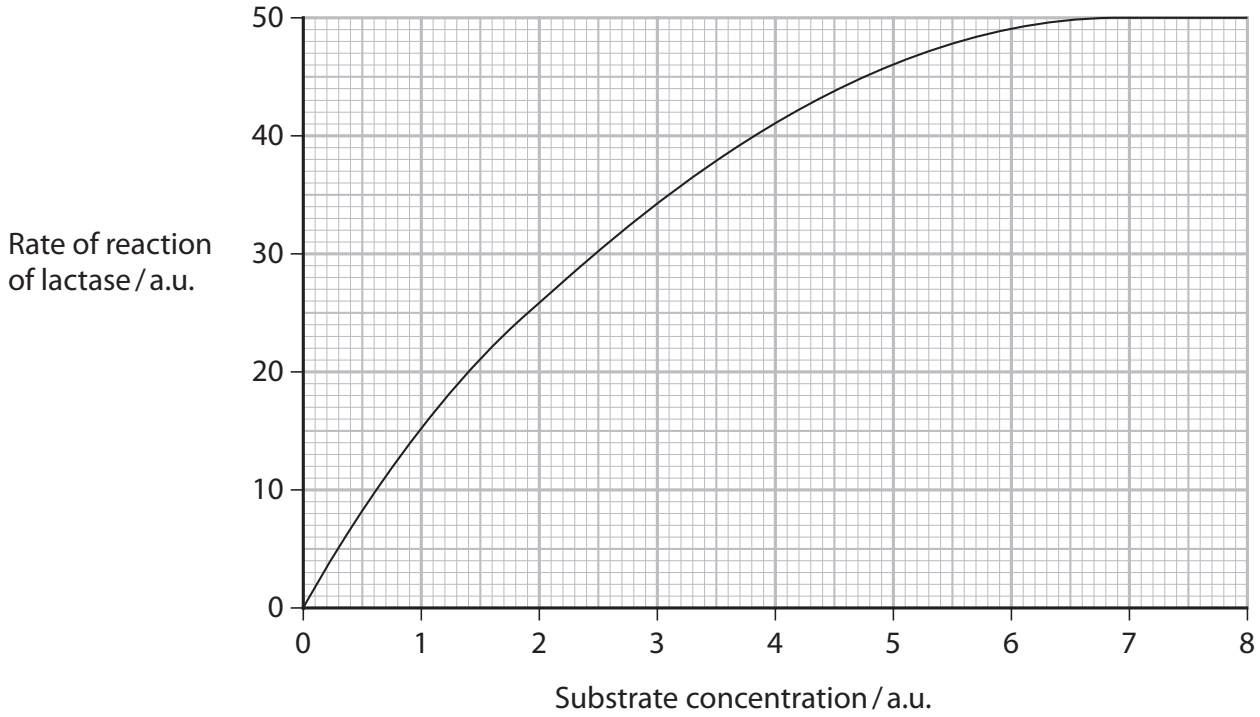


Which row in the table describes line **P** and identifies the letter that shows the decrease in activation energy due to lactase?

(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)

(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.

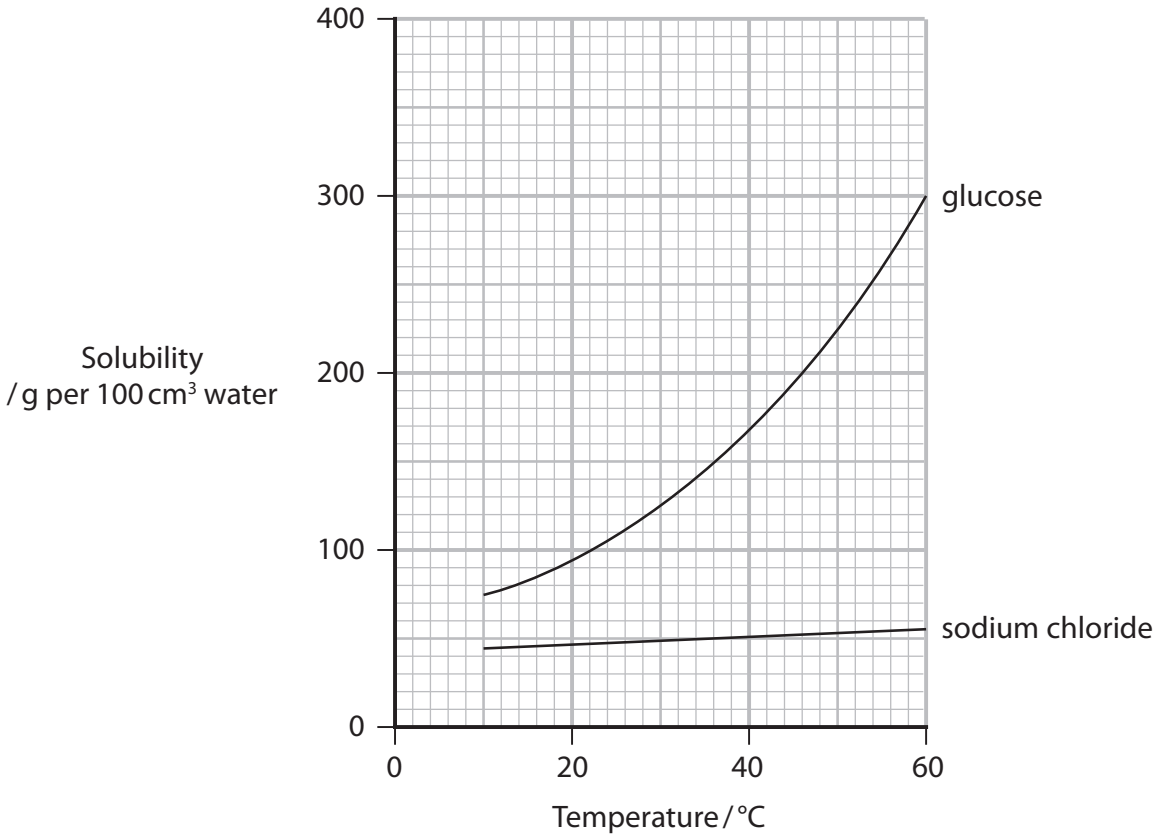
(2)

Answer .....

(Total for Question 3 = 7 marks)

4 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)

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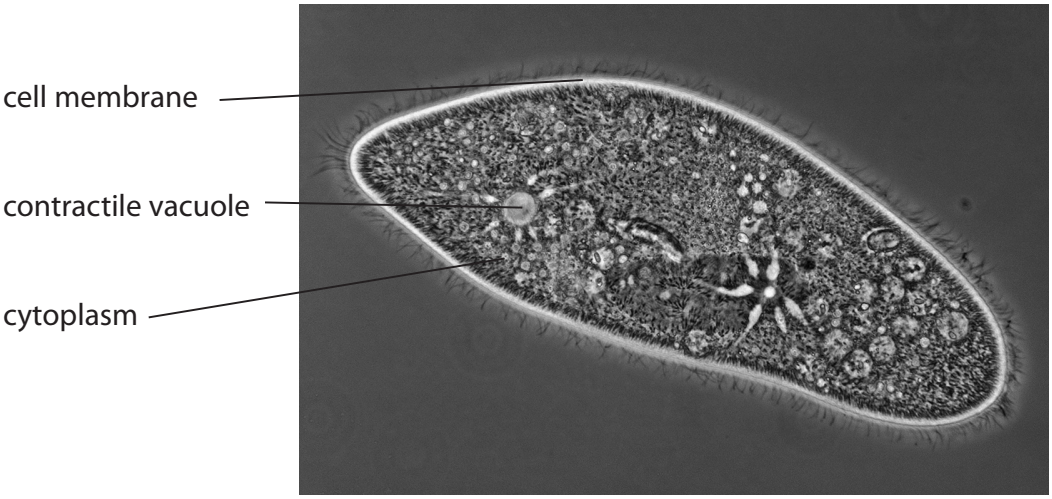
(b) Explain why fatty acids are less soluble in blood than glucose and sodium chloride.

(2)

(Total for Question 4 = 10 marks)

5 Paramecia are single-celled organisms that live in pond water.

The photograph shows a single paramecium as seen using a light microscope.



magnification ×400

Water enters the paramecium. The contractile vacuole pumps water back out of the paramecium.

(a) (i) Explain why water enters the paramecium.

(2)

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(ii) Explain the importance of the contractile vacuole in the paramecium.

(3)

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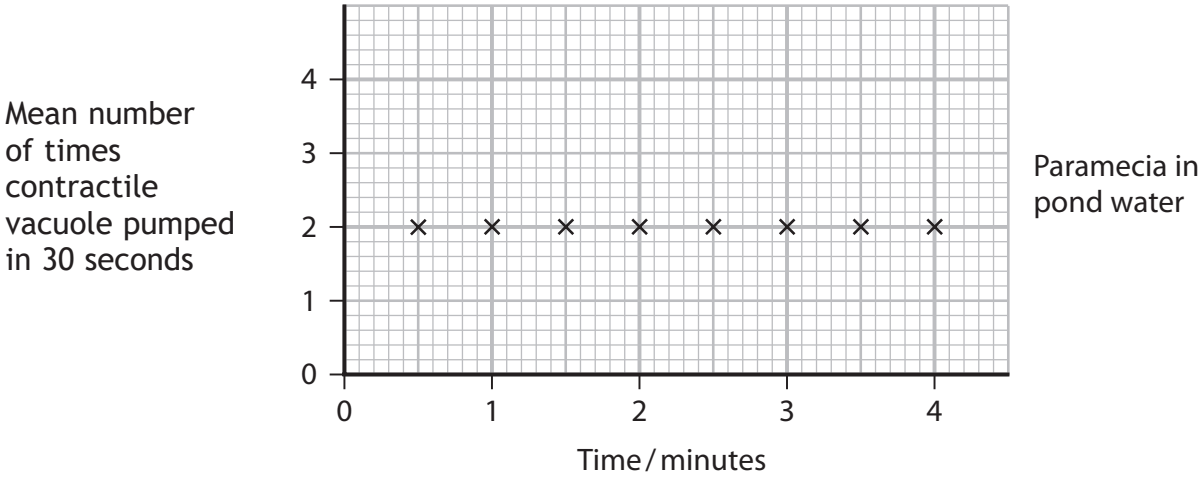
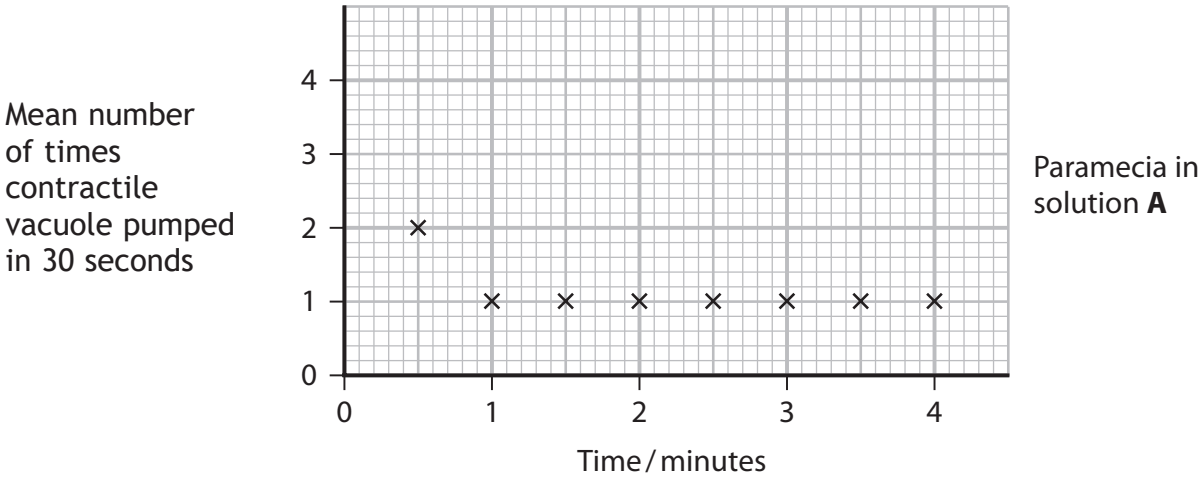
*(b) In an investigation, paramecia were placed in three separate solutions: pond water, solution **A** and solution **B**.

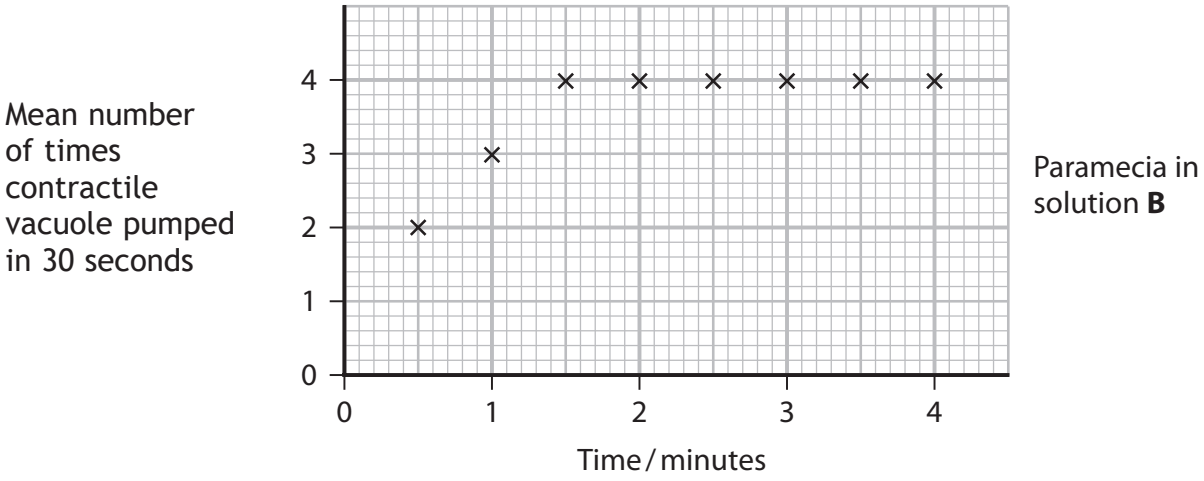
The paramecia were observed using a light microscope.

The number of times that the contractile vacuole pumped water out of the cell in 30-second intervals was recorded.

The graphs show the results of this investigation.







Explain the results of this investigation.

Use the information in the graphs to support your answer.

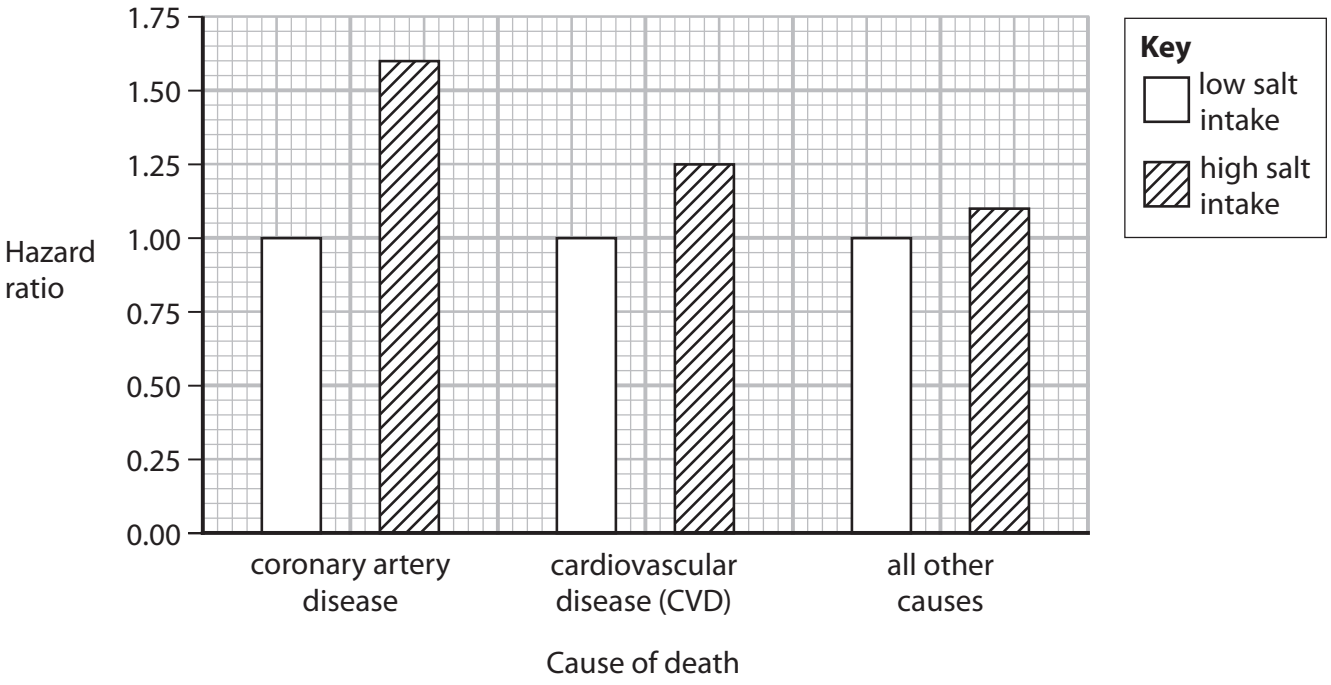
(6)

(Total for Question 5 = 11 marks)

6 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)

1 .....

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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)

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

(2)

1 .....

2 .....

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

(2)

(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)

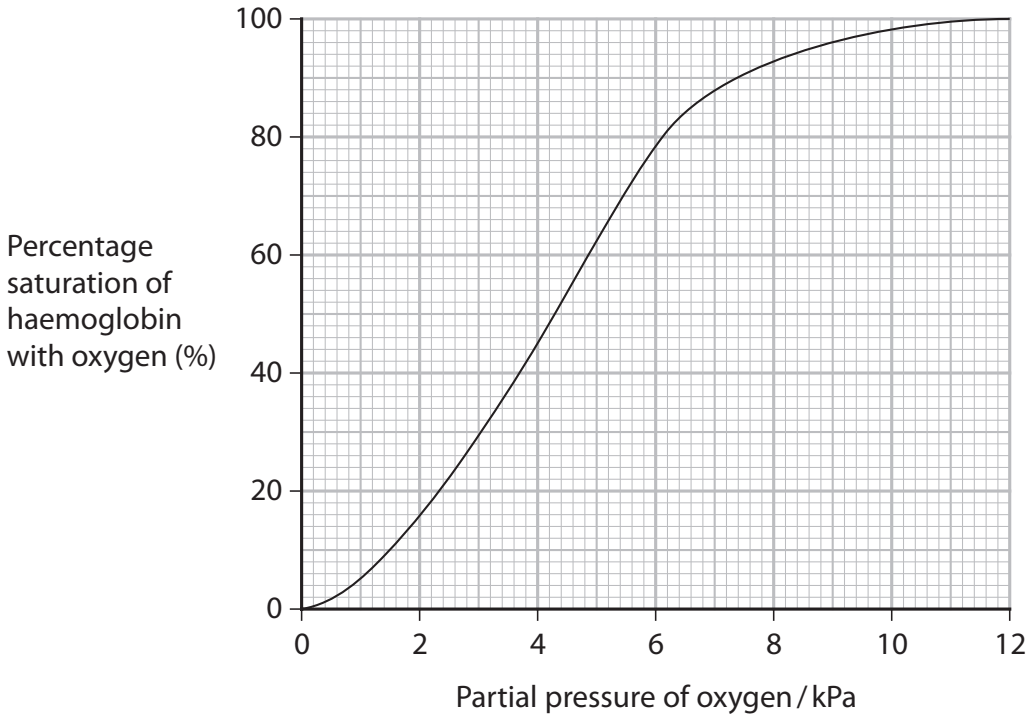
(ii) Suggest why studies of this type are unreliable.

(2)

(Total for Question 6 = 12 marks)

7 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.

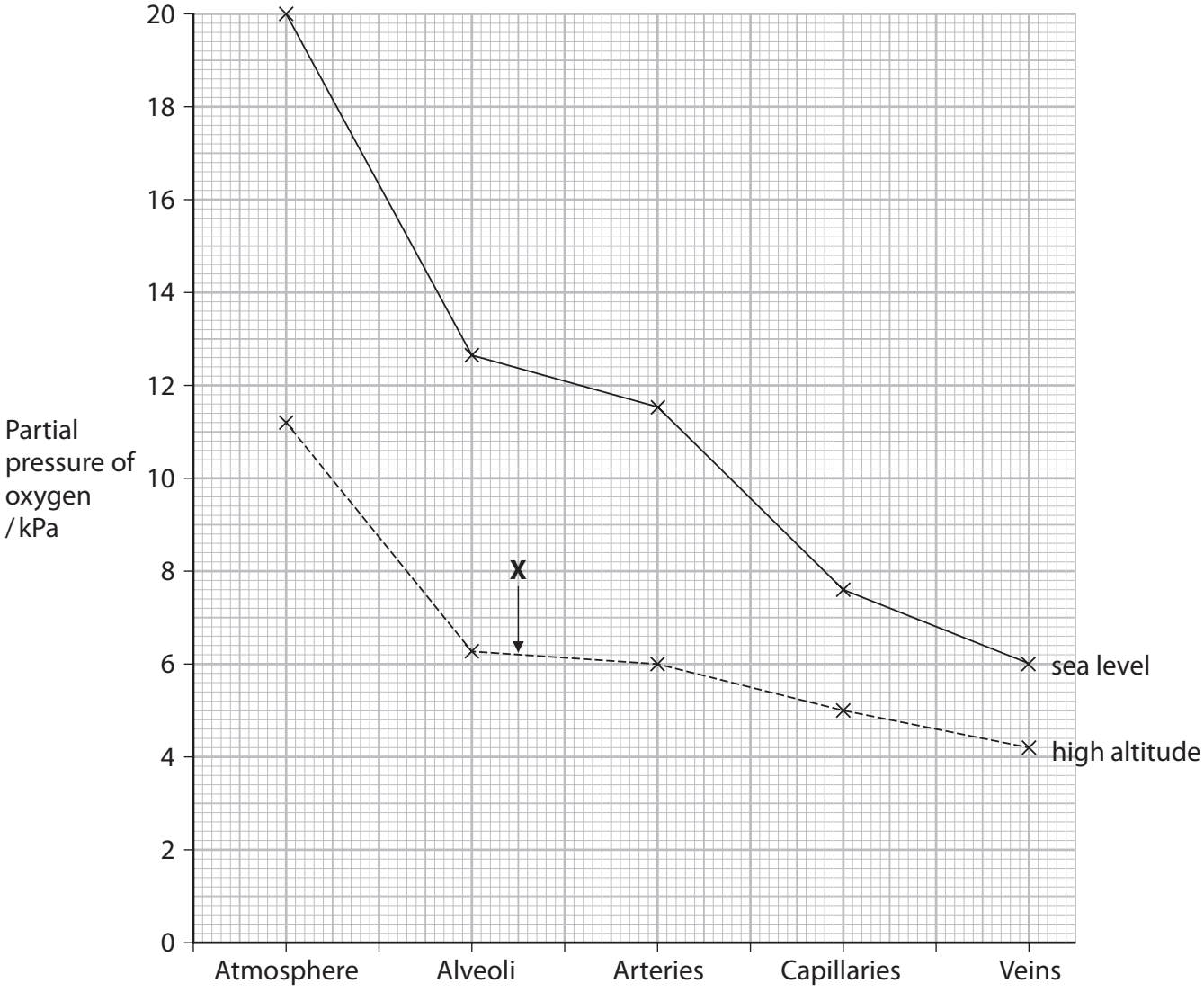
(1)

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

(3)

(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)

(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 ..... %

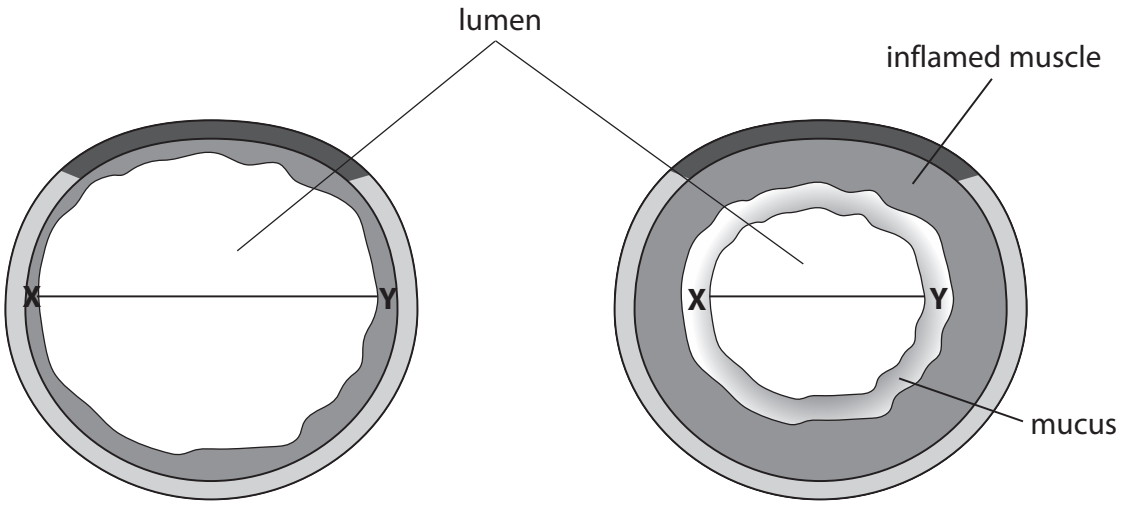
(iv) Explain why the percentage saturation of haemoglobin in a person at high altitude is much lower than in a person at sea level.

(4)

(Total for Question 7 = 13 marks)

8 Cystic fibrosis is an inherited disorder.

(a) The diagrams show a cross section through a trachea from a person without cystic fibrosis and from a person with cystic fibrosis.



Person without cystic fibrosis

Person with cystic fibrosis

(i) Calculate the percentage decrease in the diameter of the lumen of the trachea from a person with cystic fibrosis.

Take your measurements between **X** and **Y** on each diagram.

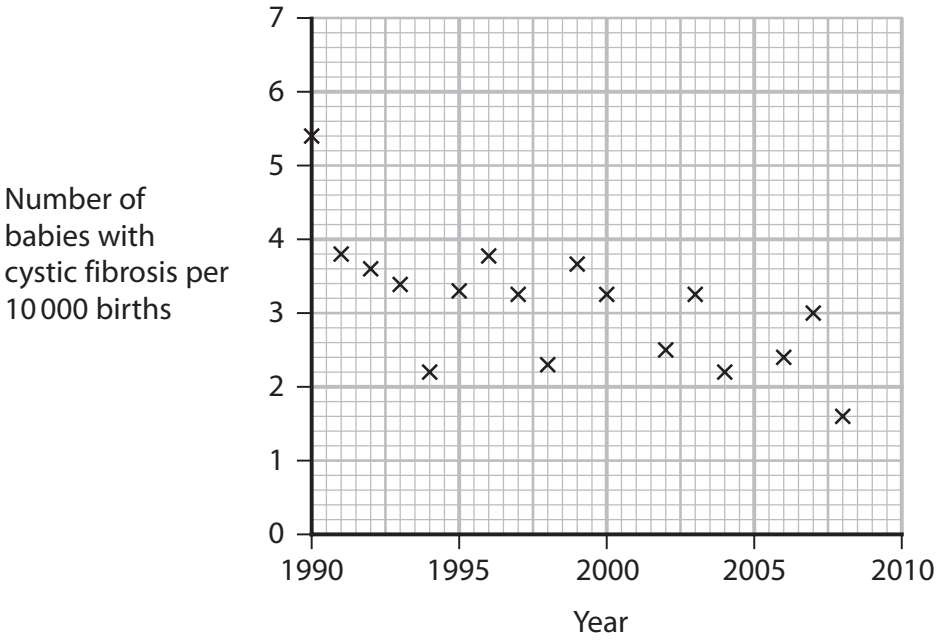
(2)

Answer .....

*(ii) Explain why cystic fibrosis causes the differences shown in the diagrams.

(6)

(b) The graph shows the number of babies with cystic fibrosis per 10 000 births in one country, from 1990 to 2008.



(i) Explain how the identification of carriers, using genetic screening, could have contributed to the downward trend shown in this graph.

(3)

Please check the examination details below before entering your candidate information

Candidate surname	Other names

Pearson Edexcel
International Advanced Level

Centre Number | | | | | |

Candidate Number | | | | |

Thursday 7 May 2020

Morning (Time: 1 hour 30 minutes) | Paper Reference **WBI11/01**

Biology

International Advanced Subsidiary / Advanced Level
Unit 1: Molecules, Diet, Transport and Health

You must have:
Scientific calculator, ruler, HB pencil

Total Marks

Instructions

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Turn over ▶

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P 6 2 4 5 6 A 0 1 3 2

Pearson

Answer ALL questions.

Write your answers in the spaces provided.

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

1 The primary structure of a protein determines its secondary structure and its three-dimensional structure.

(a) Read through the following account of the primary structure of a protein.

(5)

Complete the account by writing the most appropriate word or words on the dotted lines.

The primary structure of a protein is the specific sequence of amino acids joined together by ..... bonds.

These bonds are formed between the ..... group of one amino acid and the ..... group of an adjacent amino acid by a ..... reaction.

These bonds are formed during the stage of protein synthesis called ..... .

(b) The table describes the types of bond that hold the secondary and the three-dimensional structures together.

Which type of bonding is true for each structure?

(2)

Structure	Hydrogen bonds only	Ionic bonds only	Both hydrogen and ionic bonds	Neither of these bonds
secondary structure	☒	☒	☒	☒
three-dimensional structure	☒	☒	☒	☒

(Total for Question 1 = 7 marks)

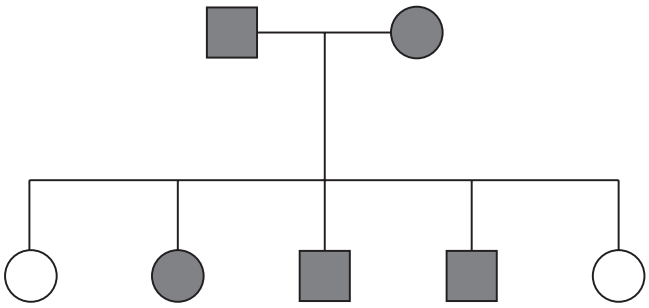
2 Most Bengal tigers are orange with black stripes but there is a very small number of Bengal tigers that are white with black stripes.

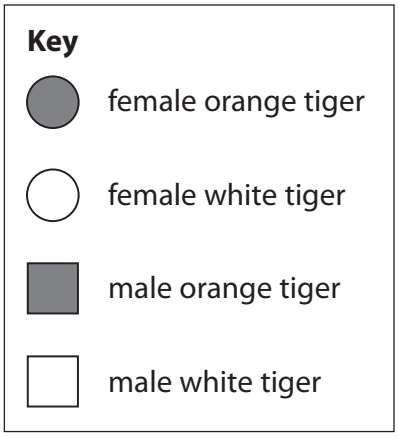
The photograph shows a white Bengal tiger with black stripes.

(Source: Caroline Wilcox)

White tiger offspring are produced by two Bengal tigers that each carry at least one recessive allele for a gene affecting coat colour.

The pedigree diagram shows the phenotypes in one family of tigers, bred in captivity.





(a) The phenotype is affected by the genotype.

State what is meant by the term **genotype**.

(1)

.....

.....

.....

(b) State the probability that the next tiger born to these two parents will be female.

(1)

(c) Determine the expected phenotypic ratio of orange tigers to white tigers born to the parents shown in this pedigree diagram.

Use a genetic diagram to support your answer.

(3)

Answer .....

(d) The incidence of white tigers in the wild is 1 in 10 000 Bengal tigers.

There are approximately 6000 Bengal tigers in captivity, 200 of which are white.

Calculate the incidence of white tigers in captivity.

(1)

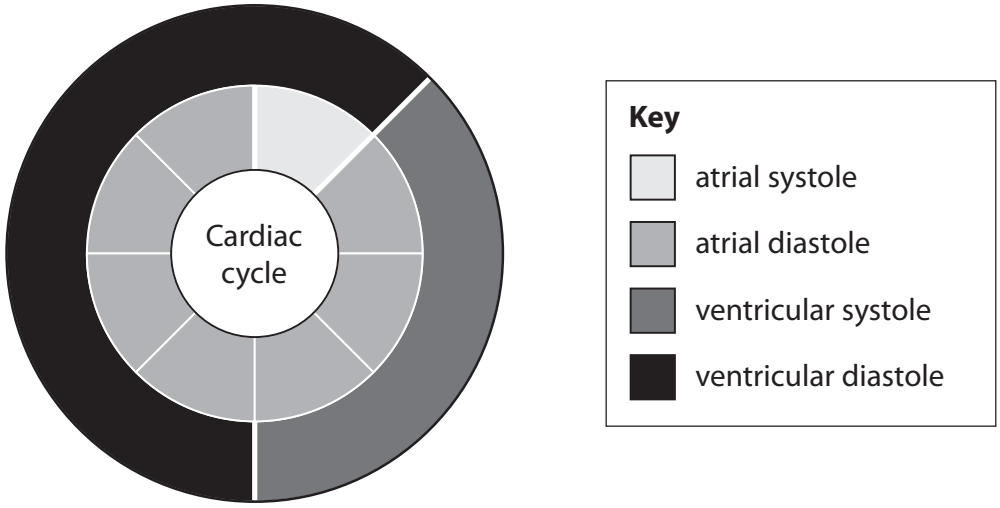
Answer .....

(Total for Question 2 = 6 marks)

3 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)

(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)

.....

.....

(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)

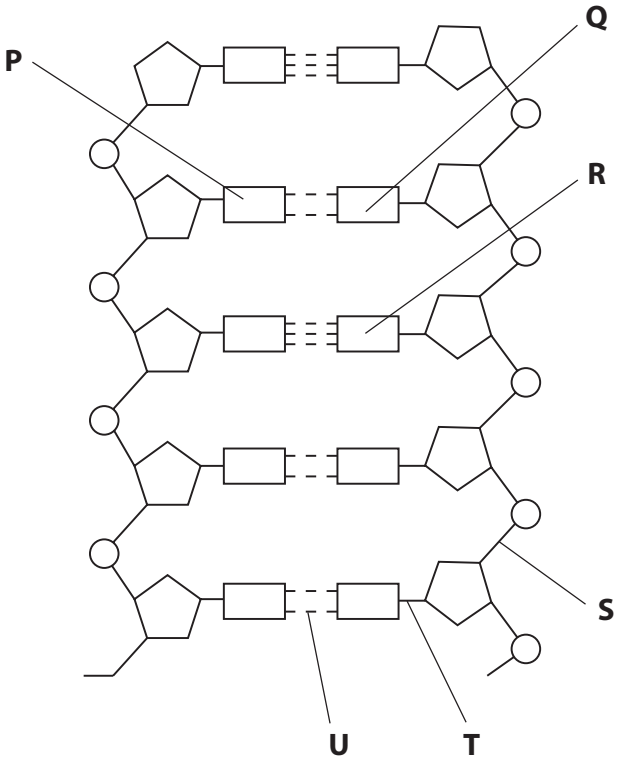
Answer ..... beats per minute

(Total for Question 3 = 9 marks)

4 The polynucleotide DNA is composed of mononucleotides linked together.

Two polynucleotides form a DNA molecule.

(a) The diagram shows part of a DNA molecule.



(i) Draw a circle around **one** mononucleotide that includes the base labelled **R**.

(1)

(ii) Which row of the table identifies the bonds labelled **S**, **T** and **U**?

(1)

	S	T	U
☒ **A**	hydrogen	phosphodiester	covalent
☒ **B**	hydrogen	covalent	phosphodiester
☒ **C**	phosphodiester	hydrogen	covalent
☒ **D**	phosphodiester	covalent	hydrogen

(iii) The base labelled **P** is adenine.

Which is the base labelled **Q**?

(1)

☒ **A** cytosine

☒ **B** guanine

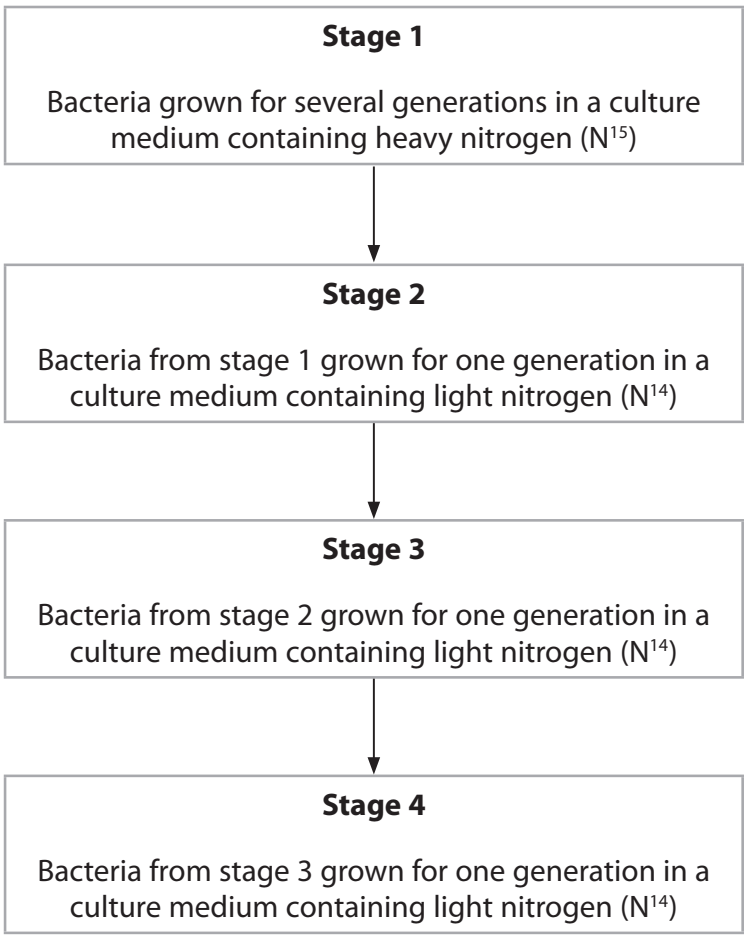
☒ **C** thymine

☒ **D** uracil

(b) Meselson and Stahl carried out experiments that provided evidence for the semi-conservative replication of DNA.

Heavy nitrogen (N^{15}) and light nitrogen (N^{14}) were used in these experiments.

The flow chart summarises part of one experiment performed by Meselson and Stahl.



After each stage, a sample of DNA was taken from the bacteria and the DNA molecules separated using a density gradient in a tube.

The heavier DNA molecules form bands lower down the gradient than the lighter DNA molecules.

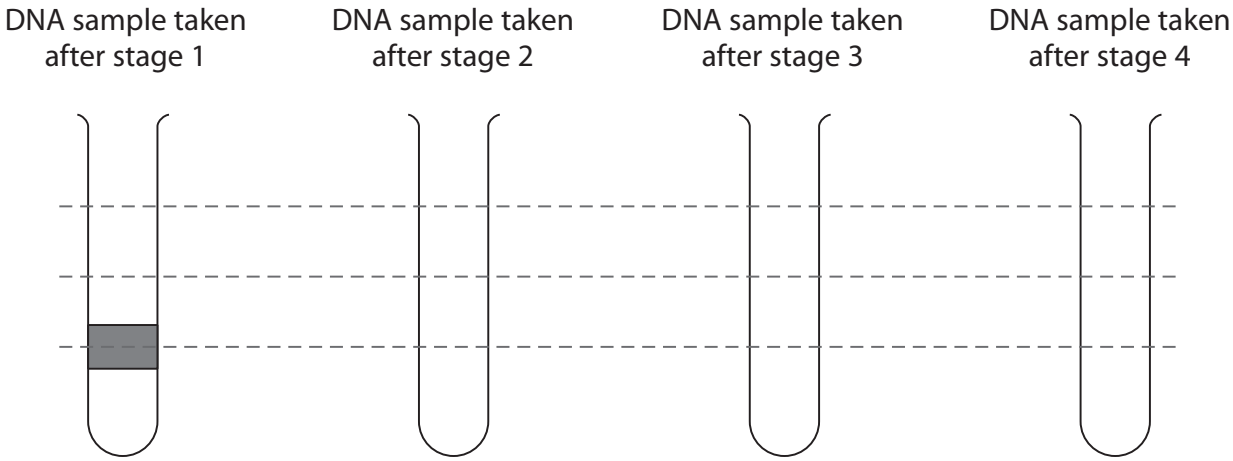
The height of each band is proportional to the percentage of DNA molecules in the sample.

(i) Complete the diagram to show the results of this experiment.

Use the dotted lines to help you to position the bands on the diagram.

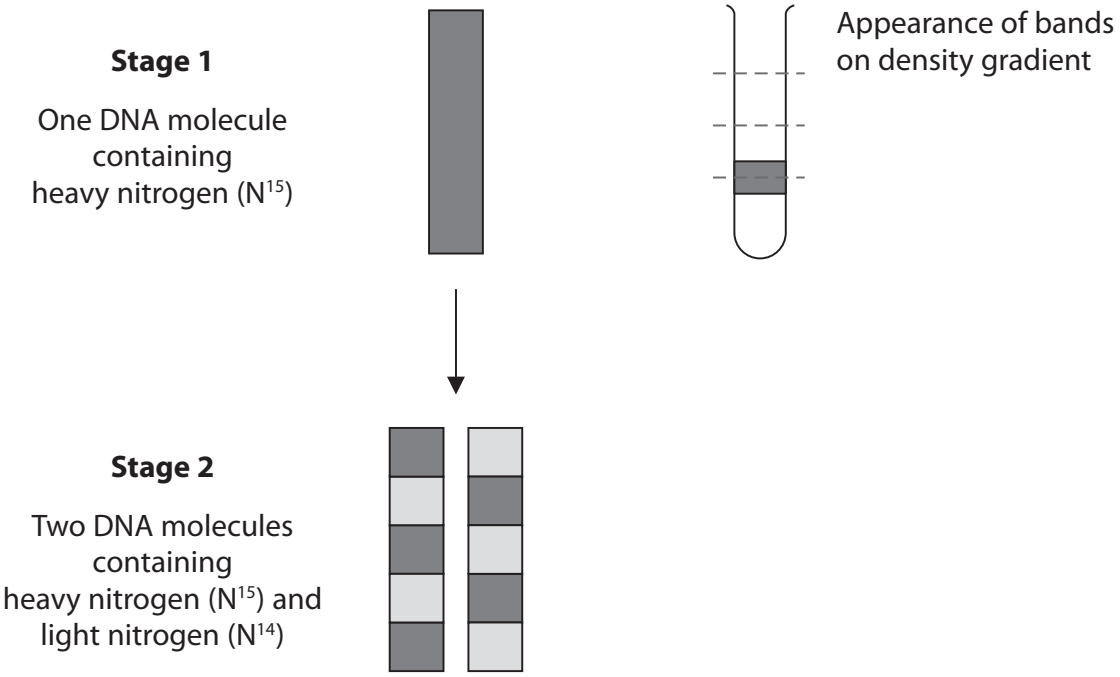
The first one has been done for you.

(5)



(ii) The experiments of Meselson and Stahl disproved the dispersive theory of DNA replication.

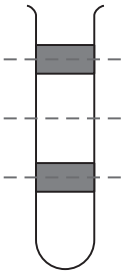
The diagram shows the expected results if the dispersive theory was correct.



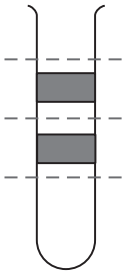
Which diagram would show the bands of DNA molecules on the density gradient at stage 2, if the dispersive theory was correct?

(1)

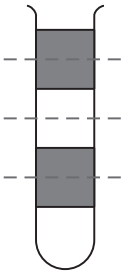
☒ **A**



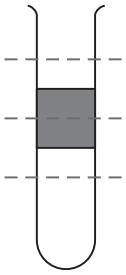
☒ **B**



☒ **C**



☒ **D**



(Total for Question 4 = 9 marks)

5 Obesity increases the risk of cardiovascular disease (CVD).

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

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

(1)

1 .....

2 .....

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

Glucomannan is a branched polysaccharide similar in structure to amylopectin.

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

(1)

☒ **A** 1-4 only

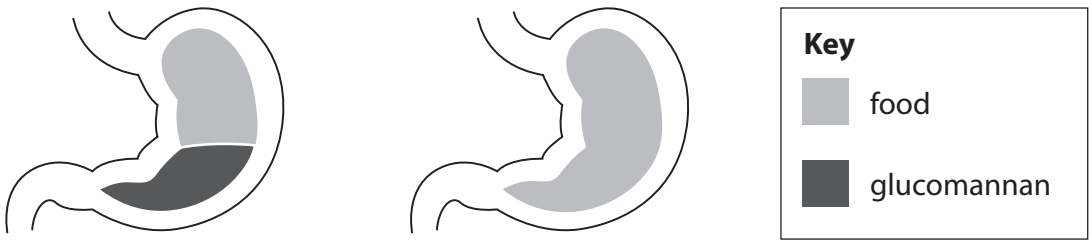
☒ **B** 1-6 only

☒ **C** both 1-4 and 1-6

☒ **D** neither 1-4 nor 1-6

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

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



Suggest how glucomannan aids weight loss.

(1)

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

Explain why glucomannan could cause a gain in weight.

(2)

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

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

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

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

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

Determine the extent to which this study supports this claim.

(3)

(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)

1 .....

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2 .....

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(Total for Question 5 = 10 marks)

6 A gene contains the genetic code for the sequence of amino acids in a polypeptide chain.

The table shows the genetic codes found in DNA.

Genetic code	Amino acid	Genetic code	Amino acid	Genetic code	Amino acid	Genetic code	Amino acid
AAA AAG	Lysine	CAA CAG	Glutamine	GAA GAG	Glutamic acid	TAC TAT	Tyrosine
AAC AAT	Asparagine	CAT CAC	Histidine	GAC GAT	Aspartate	TCA TCC TCG TCT	Serine
ACA ACC ACG ACT	Threonine	CCA CCC CCG CCT	Proline	GCA GCC GCG GCT	Alanine	TGG	Tryptophan
AGA AGG	Arginine	CGA CGC CGG CGT	Arginine	GGA GGC GGG GGT	Glycine	TGC TGT	Cysteine
AGC AGT	Serine	CTA CTC CTG CTT	Leucine	GTA GTC GTG GTT	Valine	TTA TTG	Leucine
ATA ATC ATT	Isoleucine					TTC TTT	Phenylalanine
ATG	Methionine						

The genetic codes TAA, TAG and TGA are stop codons, that do not code for amino acids.

*(a) Explain the nature of the genetic code.

Use information in the table to support your answer.

(6)

(b) The diagram shows the sequence of nucleotide bases in part of a DNA template (antisense) strand.

Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Base	A	T	G	G	C	T	T	G	C	C	C	G	A	T	C	C	T	A

(i) Give the sequence of amino acids that is coded for by these bases.

(1)

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(ii) Explain the possible effects on a protein if there is a substitution mutation in the 9th base in this DNA strand.

Use information in the table to support your answer.

(5)

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(Total for Question 6 = 12 marks)

7 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)

(b) Which type of treatment is warfarin?

(1)

☒ **A** anticoagulant

☒ **B** antihypertensive

☒ **C** platelet inhibitor

☒ **D** statin

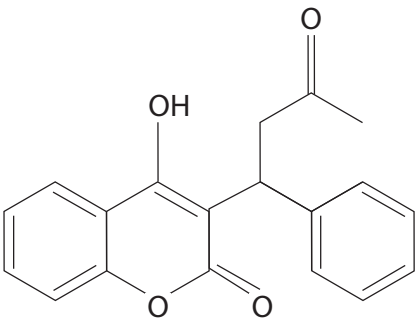
(c) Reduced vitamin K is needed for the synthesis of prothrombin.

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

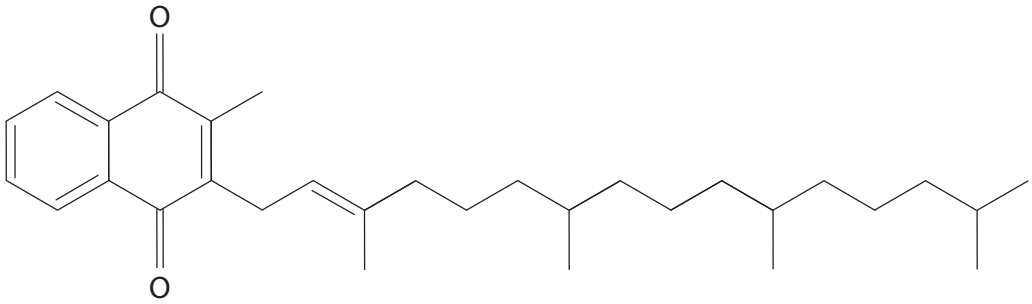
The diagram shows this conversion.

$$\text{vitamin K} \xrightarrow{\text{VKOR}} \text{reduced vitamin K}$$

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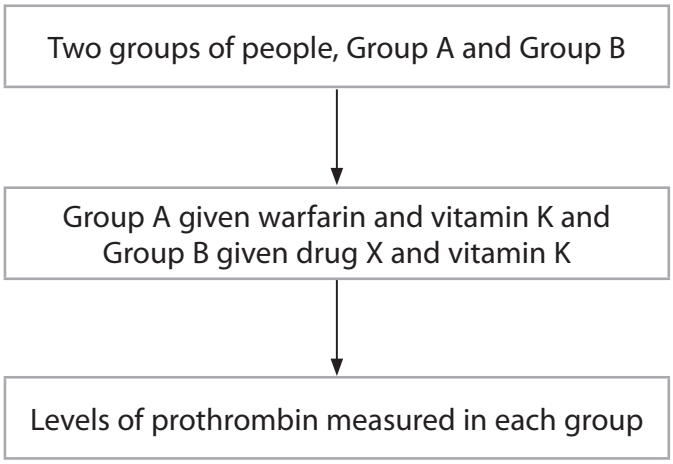
(d) Other drugs are available that work in a similar way to warfarin.

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



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

(4)

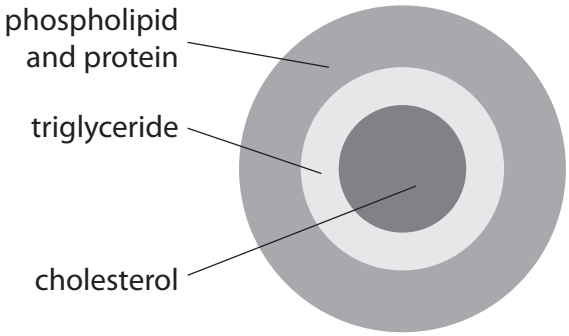
(Total for Question 7 = 12 marks)

8 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)

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

(3)

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

The table shows some information about LDLs.

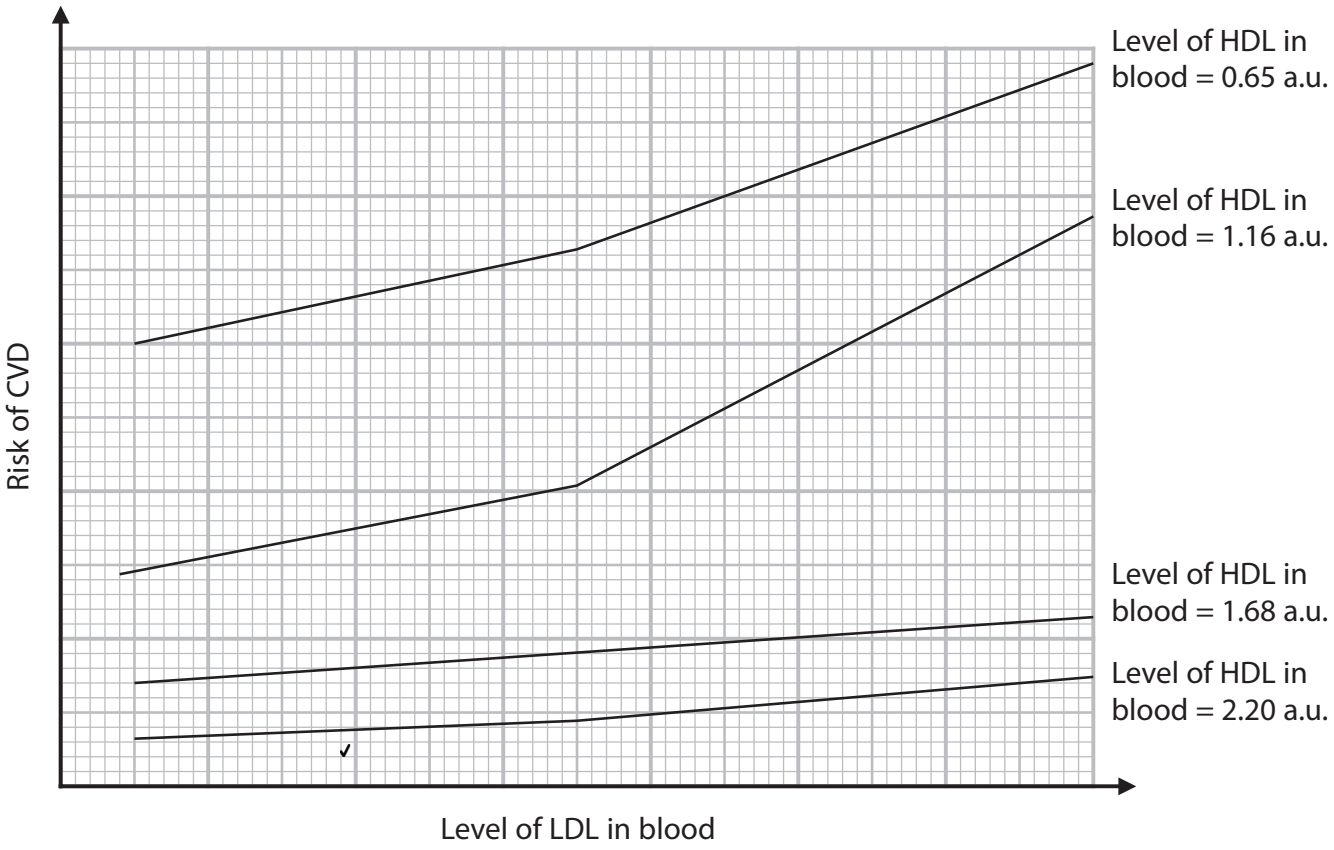
Diameter of LDL / nm	Volume of LDL / nm^3	Volume of cholesterol / nm^3	Ratio of LDL volume to cholesterol volume
19	3590	523	7 : 1
24		523	

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

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

(3)

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



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

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

(6)

(Total for Question 8 = 15 marks)

TOTAL FOR PAPER = 80 MARKS

Please check the examination details below before entering your candidate information

Candidate surname	Other names

Centre Number | Candidate Number

Pearson Edexcel International Advanced Level

Time 1 hour 30 minutes

Paper reference **WBI11/01**

Biology

Advanced Subsidiary

January 2021

UNIT 1: Molecules, Diet, Transport and Health

You must have:
Scientific calculator, ruler, HB pencil

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided – *there may be more space than you need.*
- Calculators may be used.
- You must **show all your working out** with **your answer clearly identified** at the **end of your solution**.

Information

- The total mark for this paper is 80.
- The marks for **each** question are shown in brackets – *use this as a guide as to how much time to spend on each question.*
- Any diagrams may NOT be accurately drawn, unless otherwise indicated.
- In questions marked with an **asterisk** (*), marks will be awarded for your ability to structure your answer logically showing how the points that you make are related or follow on from each other where appropriate.

Advice

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

Turn over ▶

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P 6 9 4 9 8 A 0 1 2 8

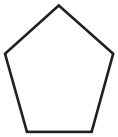
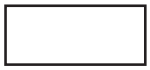
Pearson

Answer ALL questions. Write your answers in the spaces provided.

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

1 Both DNA and RNA are polynucleotides.

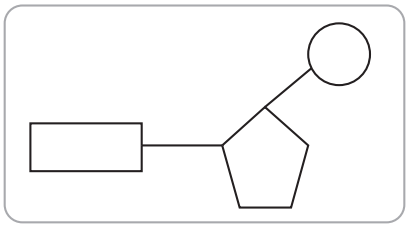
(a) The table shows how the components of polynucleotides can be represented.

Component	Representation
sugar	
phosphate group	
cytosine or thymine	
adenine or guanine	
covalent bond	
hydrogen bond	

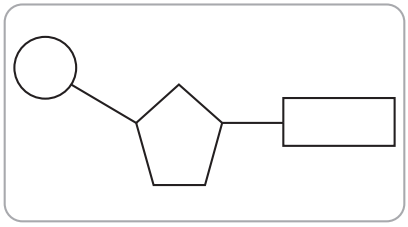
(i) Which diagram shows a mononucleotide?

(1)

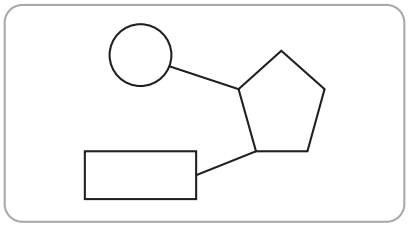
☒ **A**



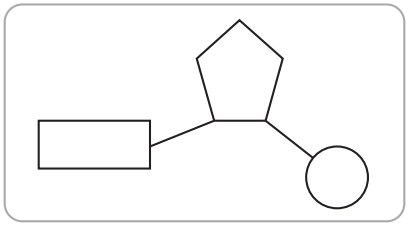
☒ **B**



☒ **C**



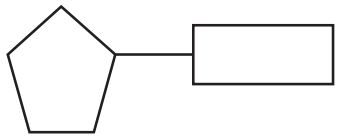
☒ **D**



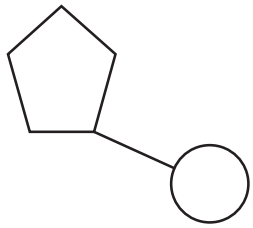
(ii) Which diagram shows two components joined by a phosphodiester bond?

(1)

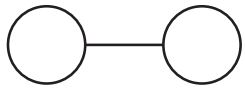
☒ **A**



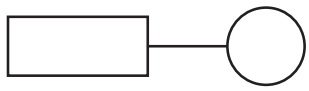
☒ **B**



☒ **C**



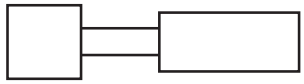
☒ **D**



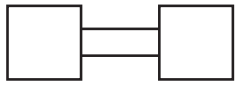
(iii) Which diagram shows complementary base pairing?

(1)

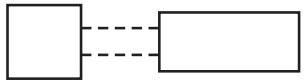
☒ **A**



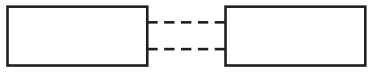
☒ **B**



☒ **C**



☒ **D**



(b) The diagram shows a sequence of bases in a DNA template (antisense) strand.

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

(i) The table shows some statements about the new complementary DNA strand and the mRNA strand synthesised using this sequence of bases.

For each statement, put **one** cross ☒ in the appropriate box, in each row, to show the correct statement about these strands.

(3)

Statement	both the new complementary DNA strand and the mRNA strand	only the new complementary DNA strand	only the mRNA strand	neither strand
The number of guanines will be the same as in the template strand	☒	☒	☒	☒
The number of thymines will be the same as the number of adenines in the template strand	☒	☒	☒	☒
There will be no adenine present	☒	☒	☒	☒

(ii) Name the process that synthesises a mRNA strand using the DNA template strand.

(1)

.....

(Total for Question 1 = 7 marks)

2 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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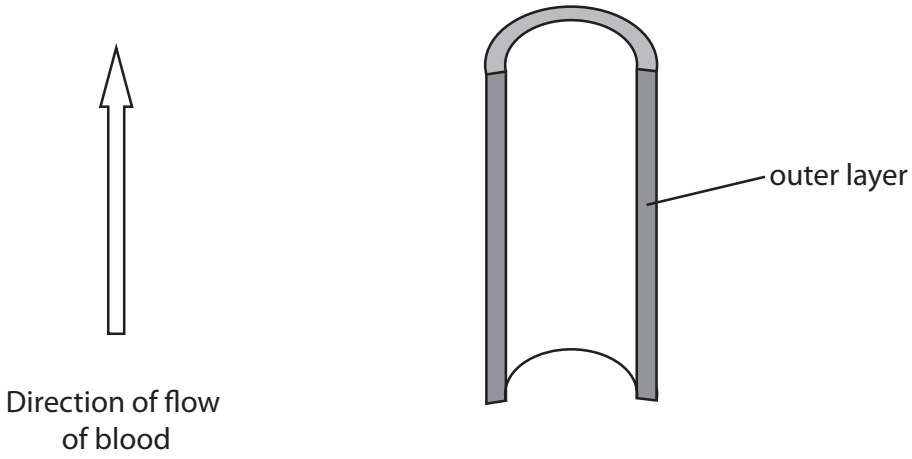
(c) Blood returns to the heart through the veins.

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 2 = 7 marks)

3 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 Glerke 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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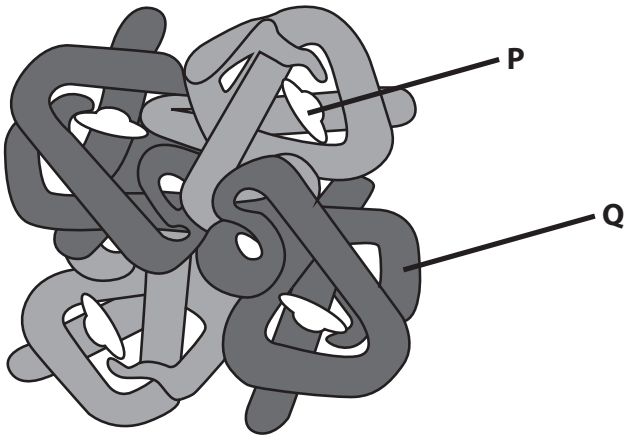
(Total for Question 3 = 9 marks)

4 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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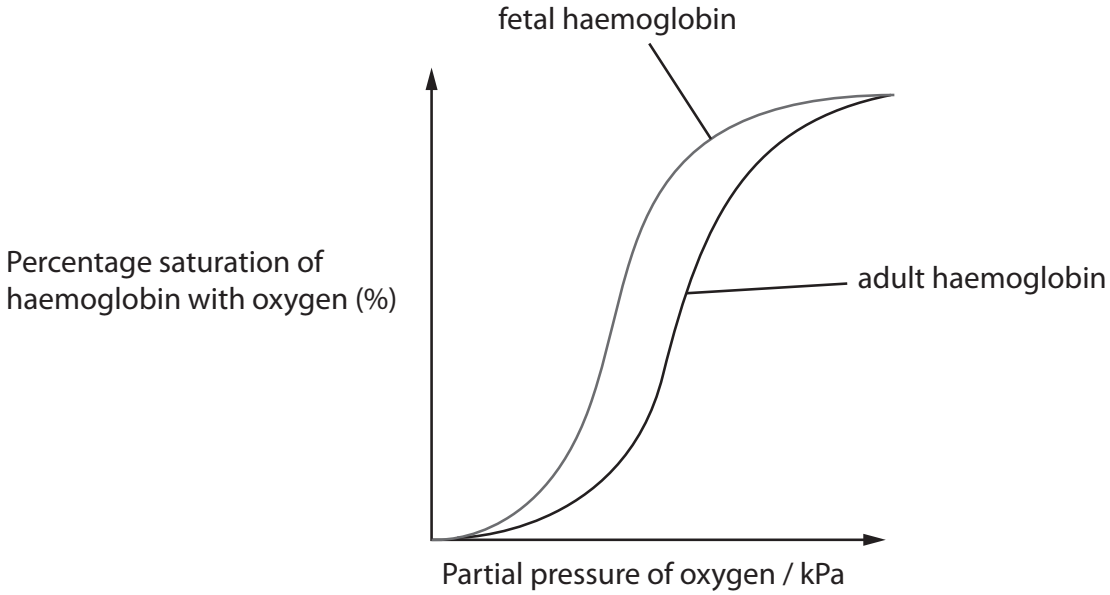
(b) The graph shows the oxygen dissociation curves of adult and fetal haemoglobin.



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

(2)

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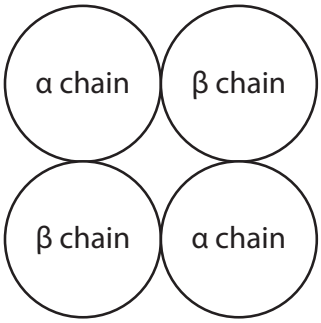
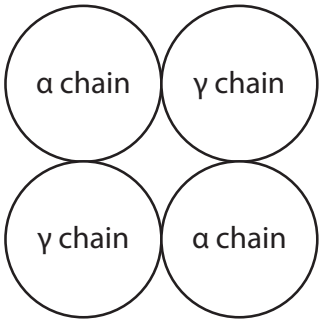
(ii) The structures of adult and fetal haemoglobin are different.

The diagram shows the structure of adult and fetal haemoglobin.



Adult haemoglobin



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.

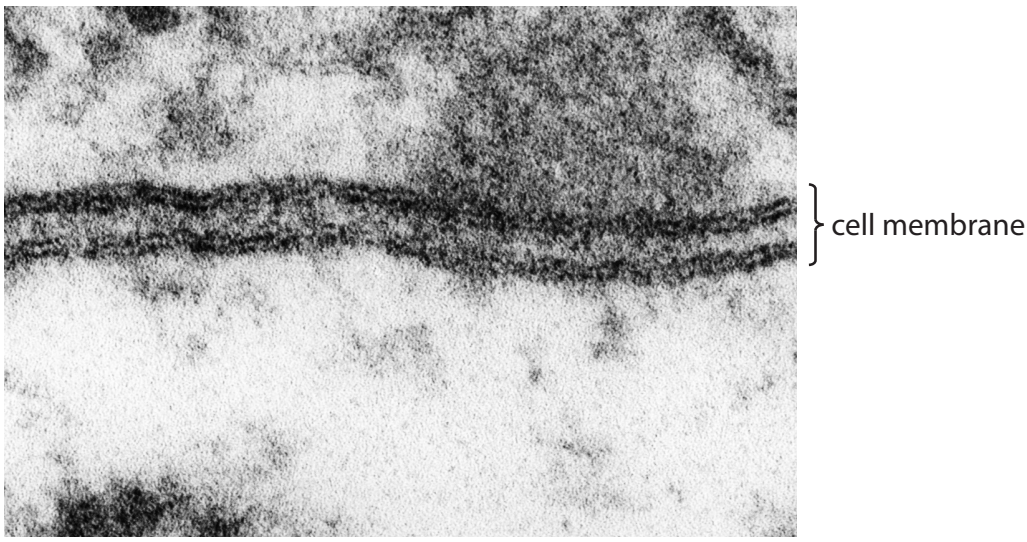
(2)

Answer ..... %

(Total for Question 4 = 7 marks)

5 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.

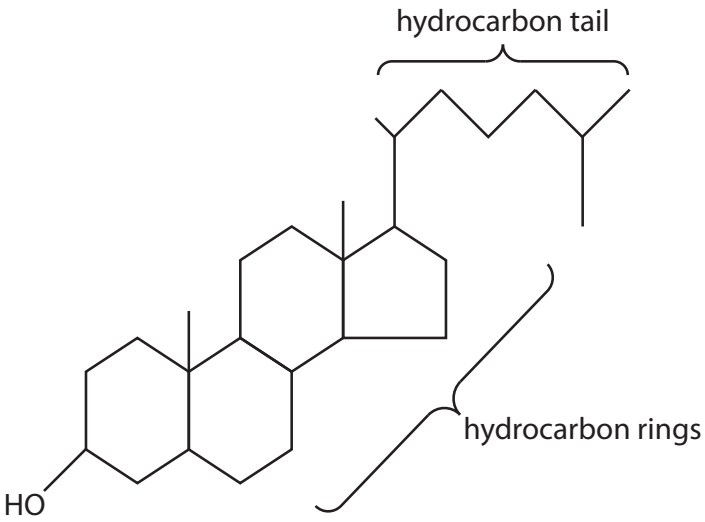
Use the information given to support your answer.

(3)

(b) Cell membranes contain cholesterol.

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

The diagram shows a cholesterol molecule.

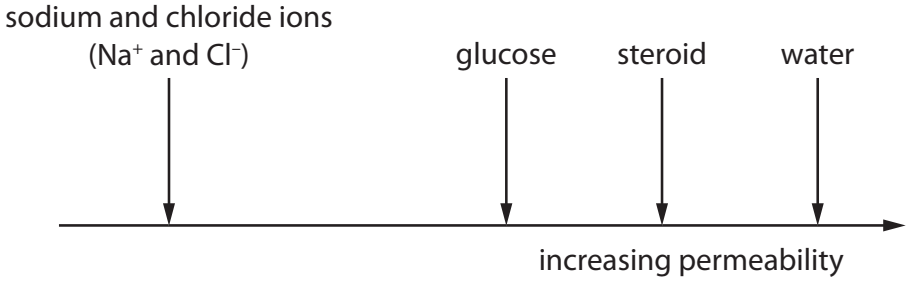


Explain the location of cholesterol in cell membranes.

Use the information in the diagram to support your answer.

(3)

(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)

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

(4)

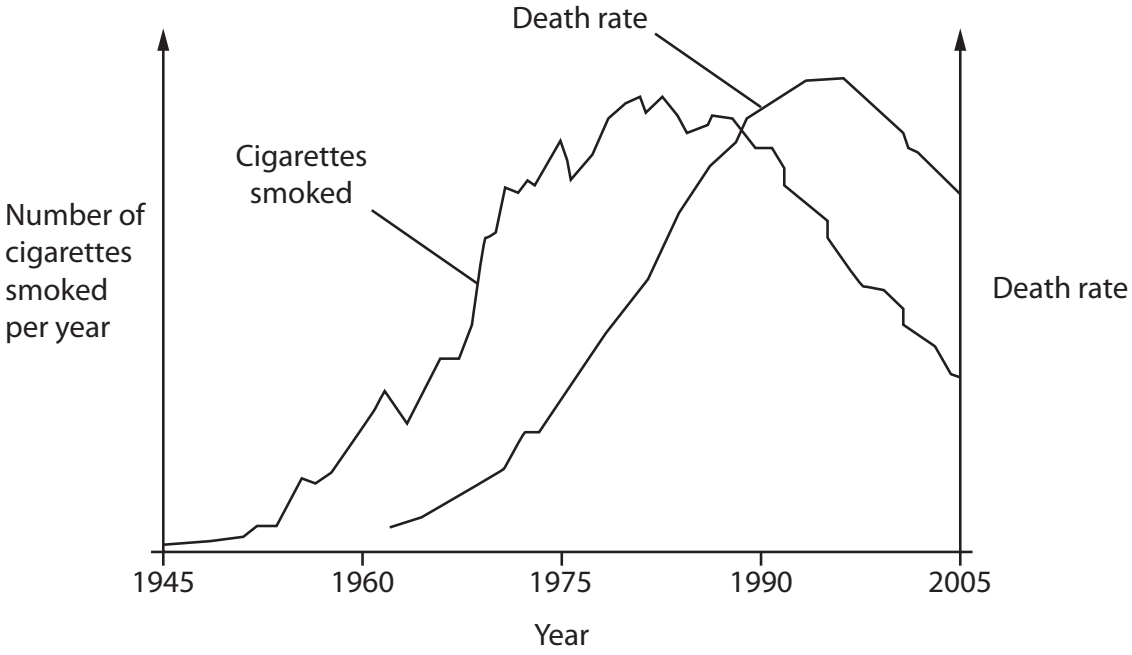
(Total for Question 5 = 12 marks)

6 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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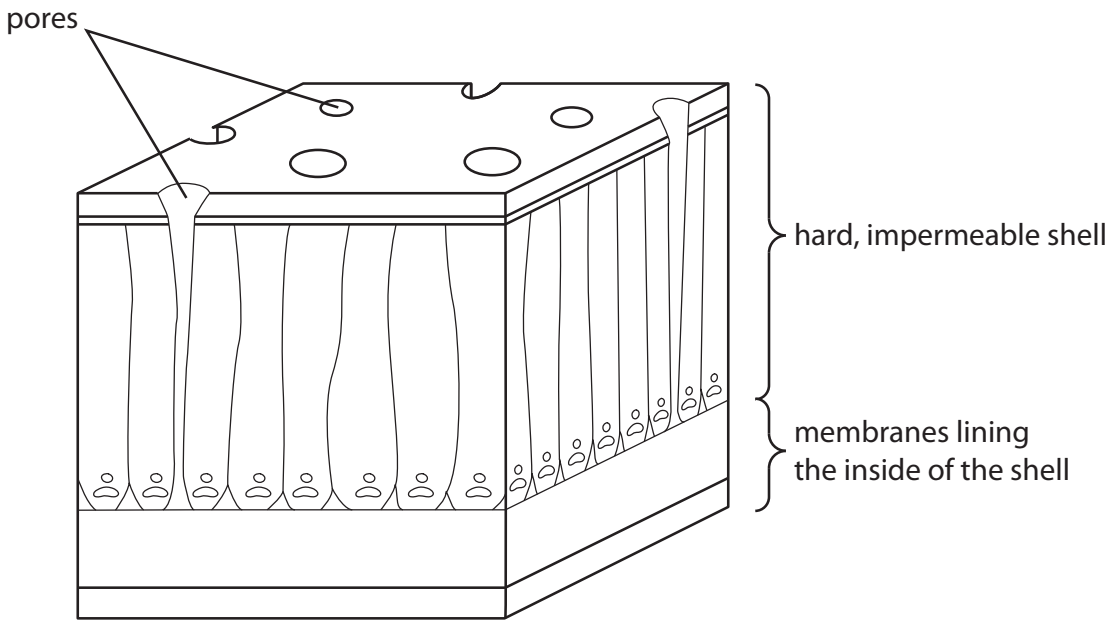
(b) Bird embryos develop inside hard-shelled eggs.

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.

(6)

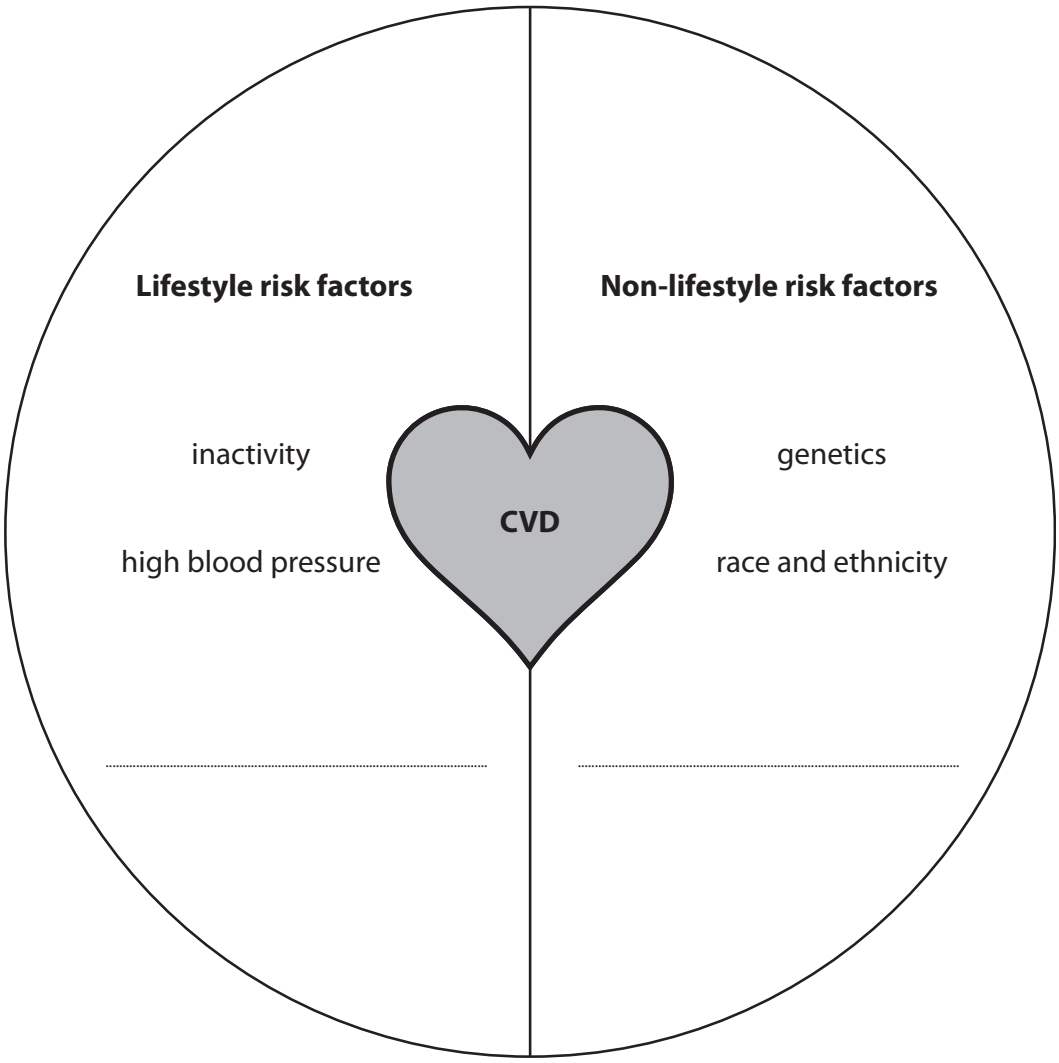
(Total for Question 6 = 10 marks)

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

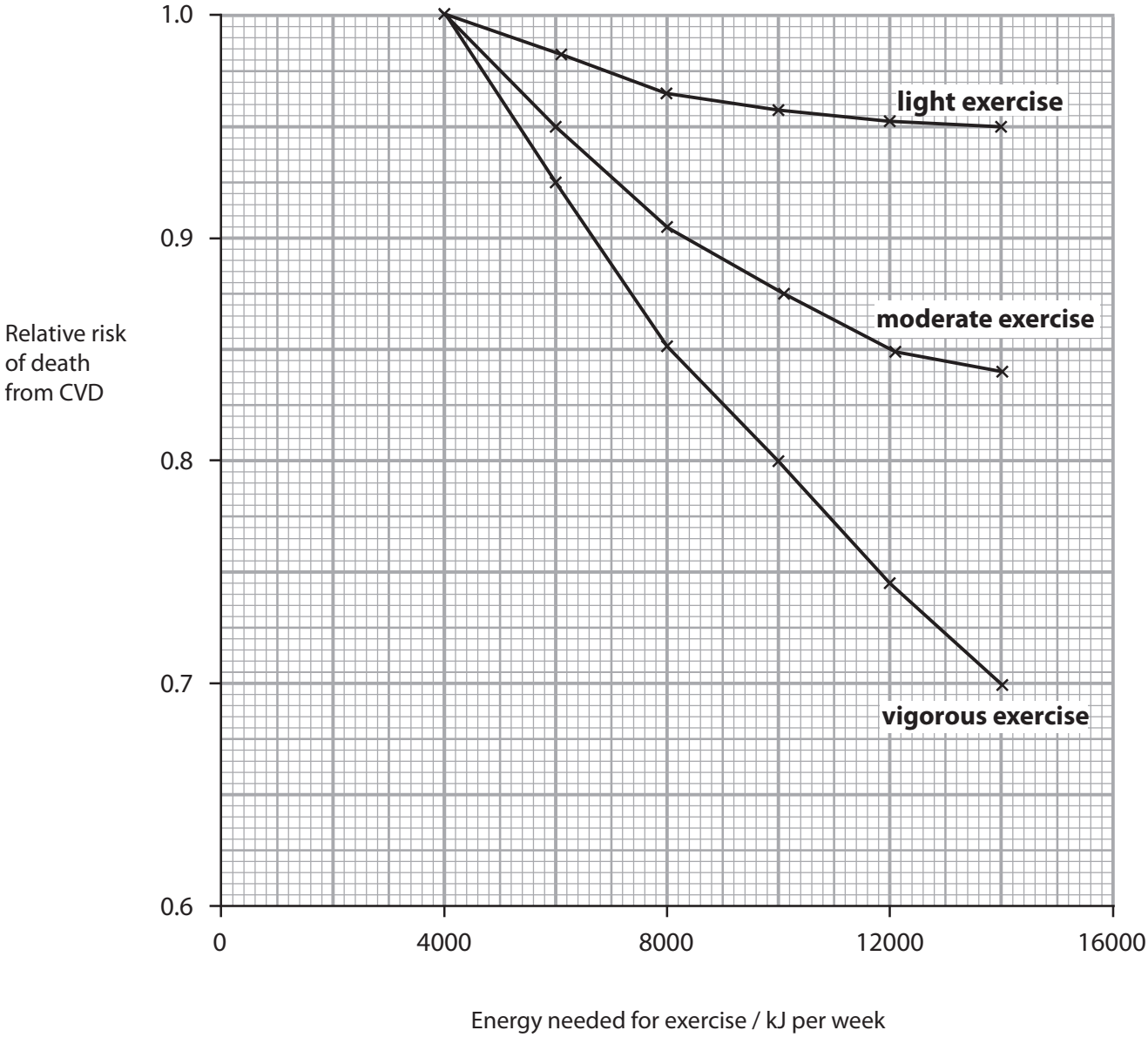
(a) The diagram shows some factors that increase the risk of CVD.

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.

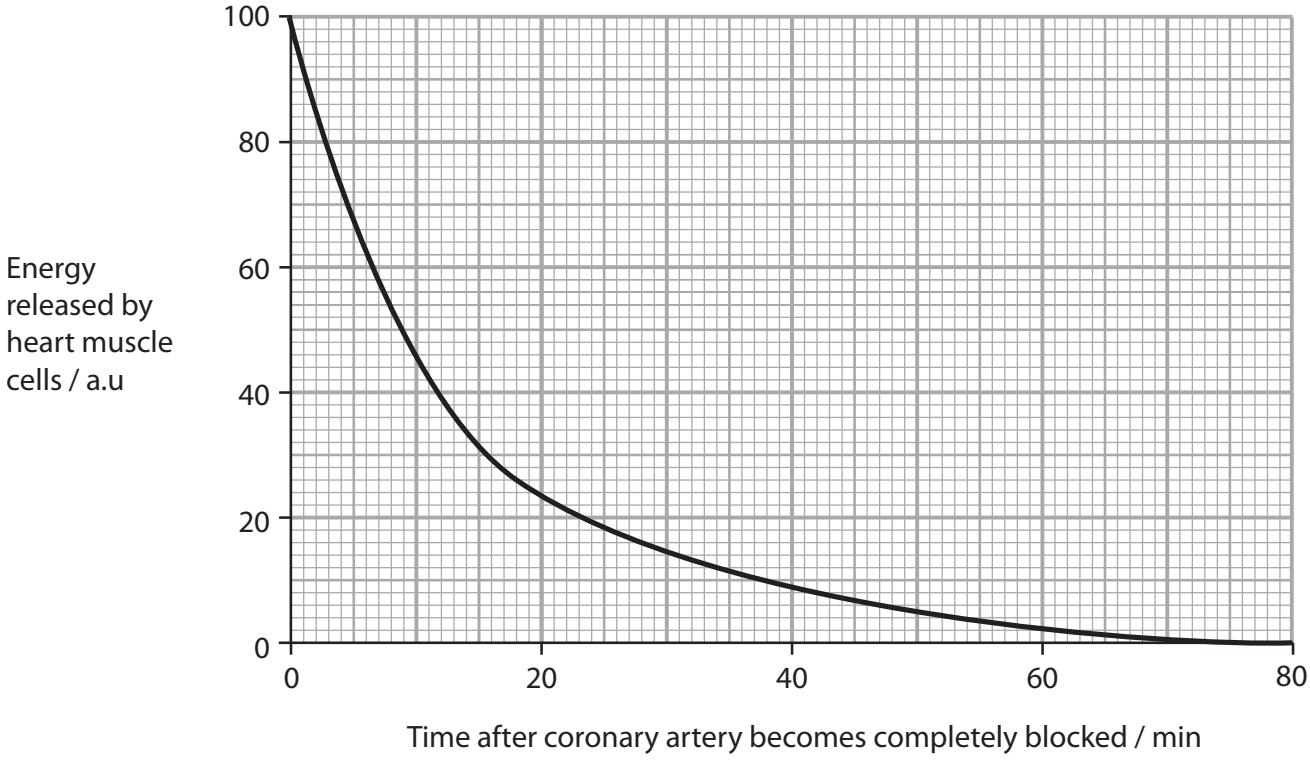
(3)

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

(3)

*(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)

(Total for Question 7 = 15 marks)

8 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)

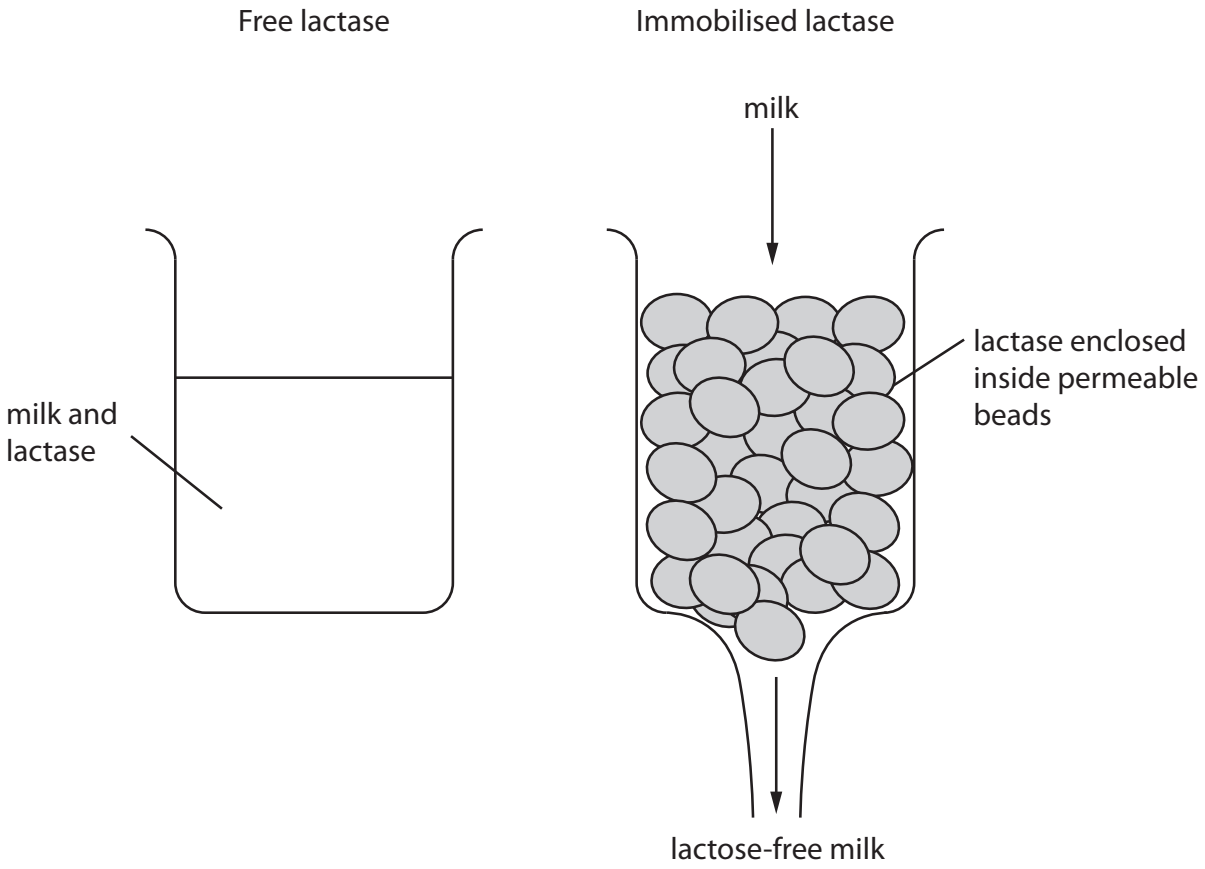
(b) People with lactose intolerance can drink lactose-free milk.

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)

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

Include appropriate units in your answer.

(2)

(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)

(Total for Question 8 = 13 marks)

TOTAL FOR PAPER = 80 MARKS

Please check the examination details below before entering your candidate information

Candidate surname	Other names

Centre Number | Candidate Number

Pearson Edexcel International Advanced Level

Time 1 hour 30 minutes

Paper reference **WBI11/01**

Biology

May 2021

Advanced Subsidiary

UNIT 1: Molecules, Diet, Transport and Health

You must have:
Scientific calculator, ruler, HB pencil

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided – *there may be more space than you need.*
- Calculators may be used.
- You must **show all your working out** with **your answer clearly identified** at the **end of your solution**.

Information

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- Any diagrams may NOT be accurately drawn, unless otherwise indicated.
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- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

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Q:1/1/1/

P 7 0 9 6 0 A 0 1 2 8

Pearson

Answer ALL questions. Write your answers in the spaces provided.

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

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

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

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

(4)

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

(b) Triglycerides are lipids.

Describe how an unsaturated triglyceride is synthesised.

(3)

(Total for Question 1 = 7 marks)

2 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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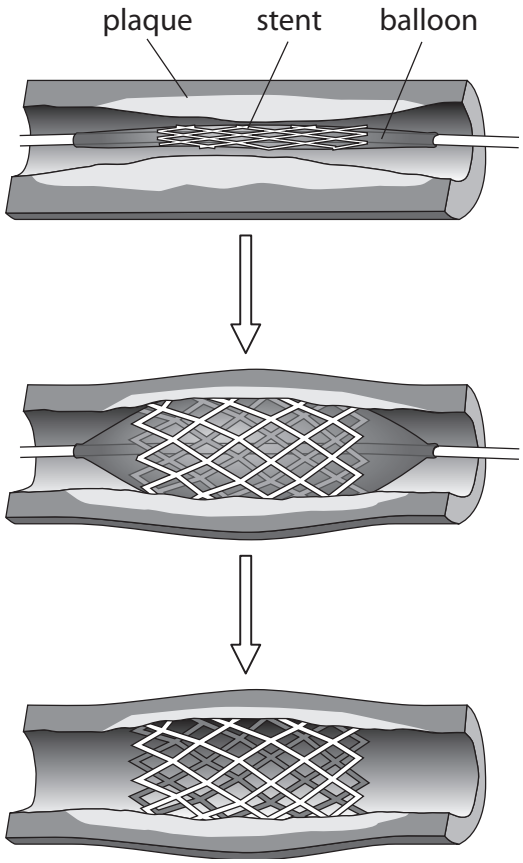
(Total for Question 2 = 6 marks)

3 Stents are used in the treatment of atherosclerosis.

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



An uninflated balloon and narrow stent are inserted into the diseased coronary artery.

The balloon is inflated, expanding the stent.

The balloon is deflated and removed, leaving the expanded stent in place.

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

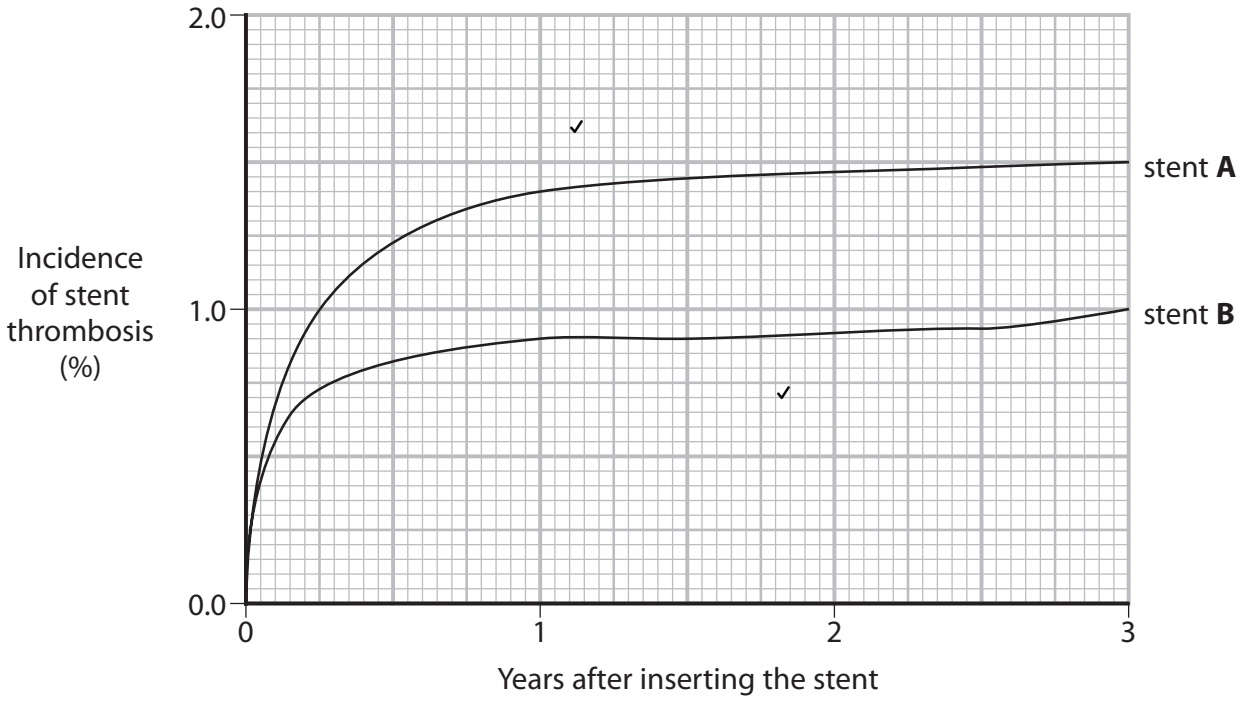
(3)

(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)

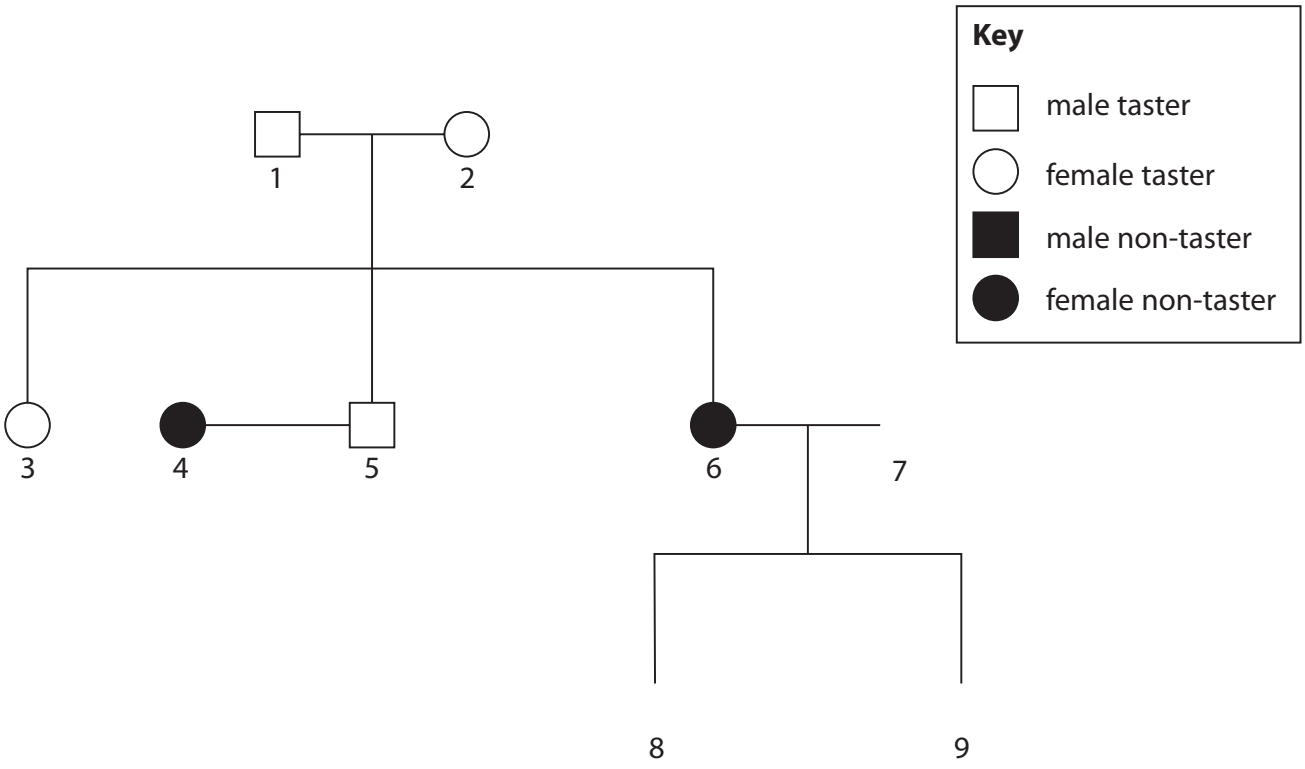
.....

(Total for Question 3 = 9 marks)

4 Phenylthiocarbamide (PTC) is a chemical that has a very bitter taste to some individuals (tasters).

The ability to taste PTC is determined by a gene that codes for a bitter-taste receptor on the tongue.

The pedigree diagram shows some of the tasters and non-tasters in a family.



(a) Complete the diagram to show the following information:

(1)

- individual 7 as a male taster
- individual 8 as a male non-taster
- individual 9 as a female taster.

(b) Describe the difference between each of the following pairs of terms, using the information in the pedigree diagram to illustrate your answer.

(i) Gene and allele

(2)

(ii) Genotype and phenotype

(2)

(c) Explain which is the dominant allele.

Use the information in the pedigree diagram to support your answer.

(2)

(d) Explain why this gene is unlikely to be located on the X chromosome.

Use the information in the pedigree diagram to support your answer.

(2)

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(Total for Question 4 = 9 marks)

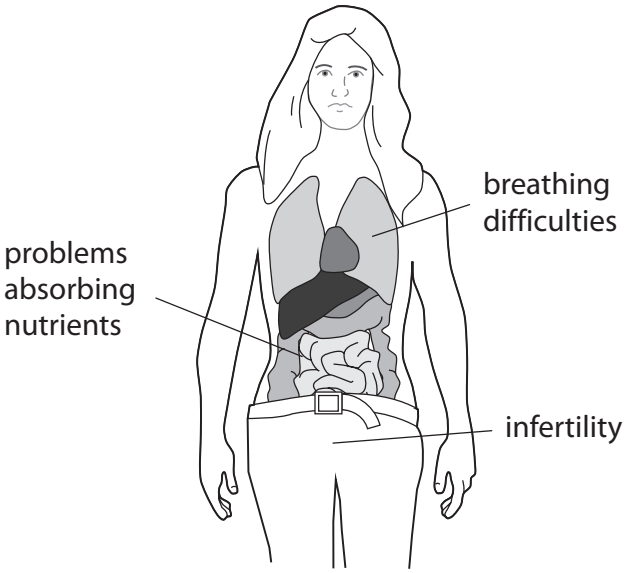
5 People with cystic fibrosis produce very thick, sticky mucus.

Cystic fibrosis is caused by mutations in a gene coding for the CFTR protein.

(a) Explain why a mutation in this gene results in the production of very thick, sticky mucus.

(3)

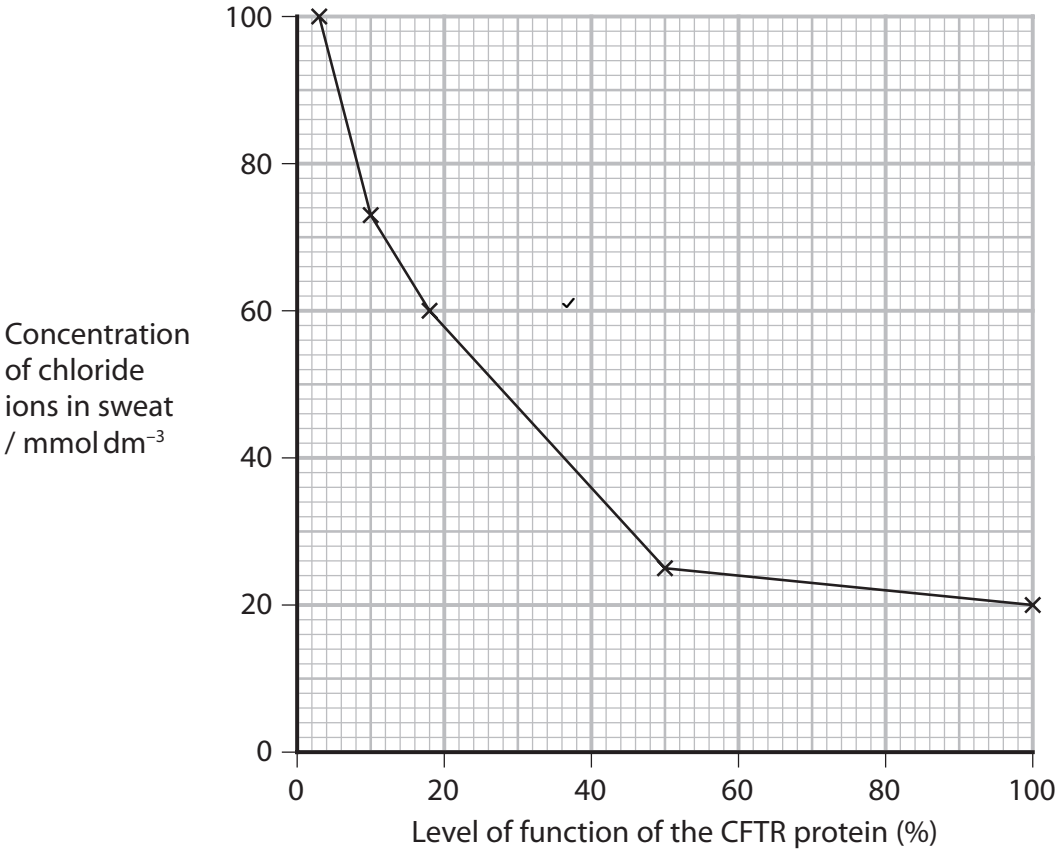
(b) The diagram shows some health problems associated with cystic fibrosis, in a female.



Explain why very thick, sticky mucus results in these health problems.

(5)

(c) The graph shows the correlation between the concentration of chloride ions in sweat and the level of function of the CFTR protein.



Individuals diagnosed with cystic fibrosis have a level of function of the CFTR protein of 18% or less.

(i) Which is the change in concentration of chloride ions in the sweat of an individual when the level of function of CFTR protein decreased from 100% to 18%?

(1)

☒ **A** 15 mmol dm^{-3}

☒ **B** 35 mmol dm^{-3}

☒ **C** 40 mmol dm^{-3}

☒ **D** 80 mmol dm^{-3}

(ii) Cystic fibrosis results from different mutations in the CFTR gene.

Explain how the graph provides evidence that cystic fibrosis results from different mutations in the CFTR gene.

(2)

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(Total for Question 5 = 11 marks)

6 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.

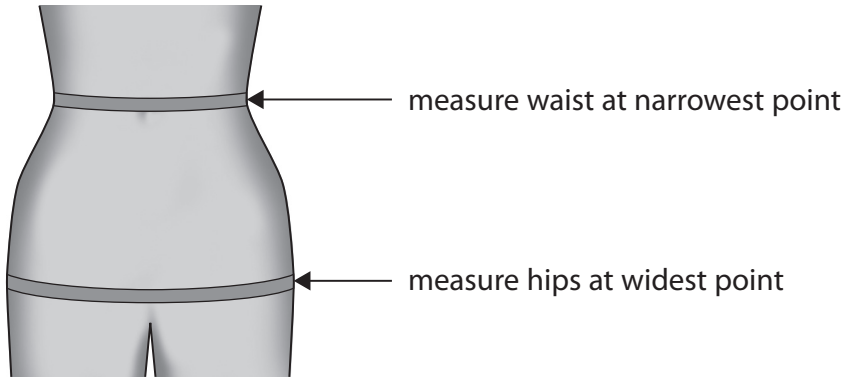
(3)

Answer ..... kg

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

(2)

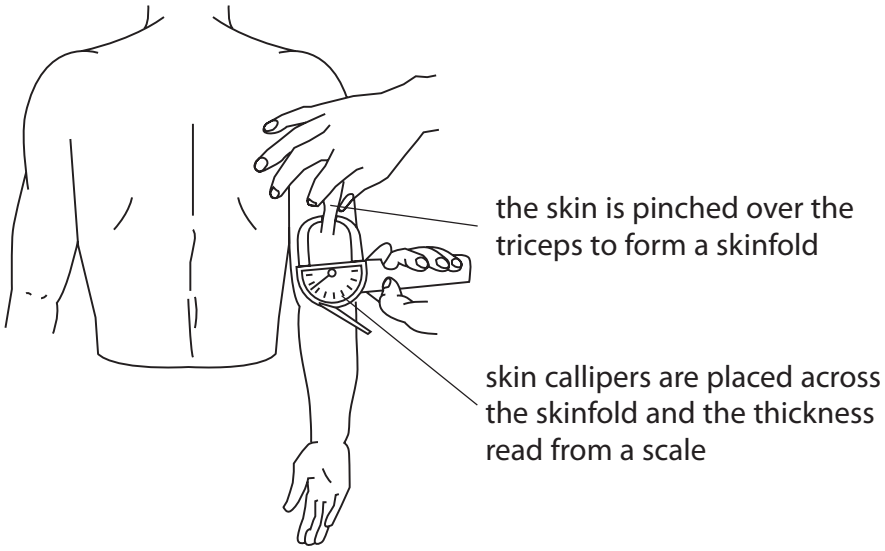
(iv) The diagram shows how the waist and hip measurements should be taken, using a tape measure.



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

(2)

(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 6 = 11 marks)

7 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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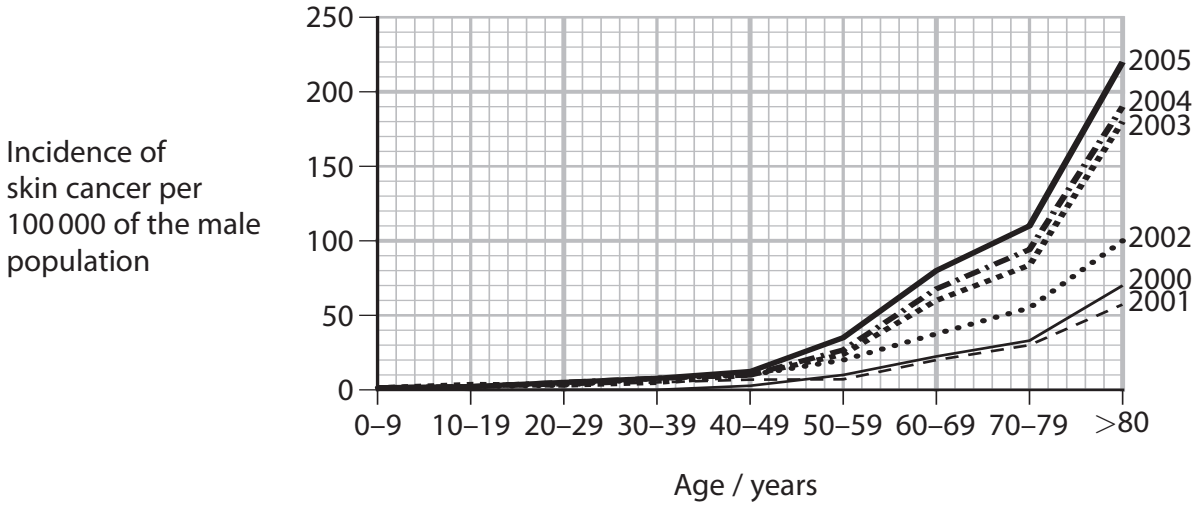
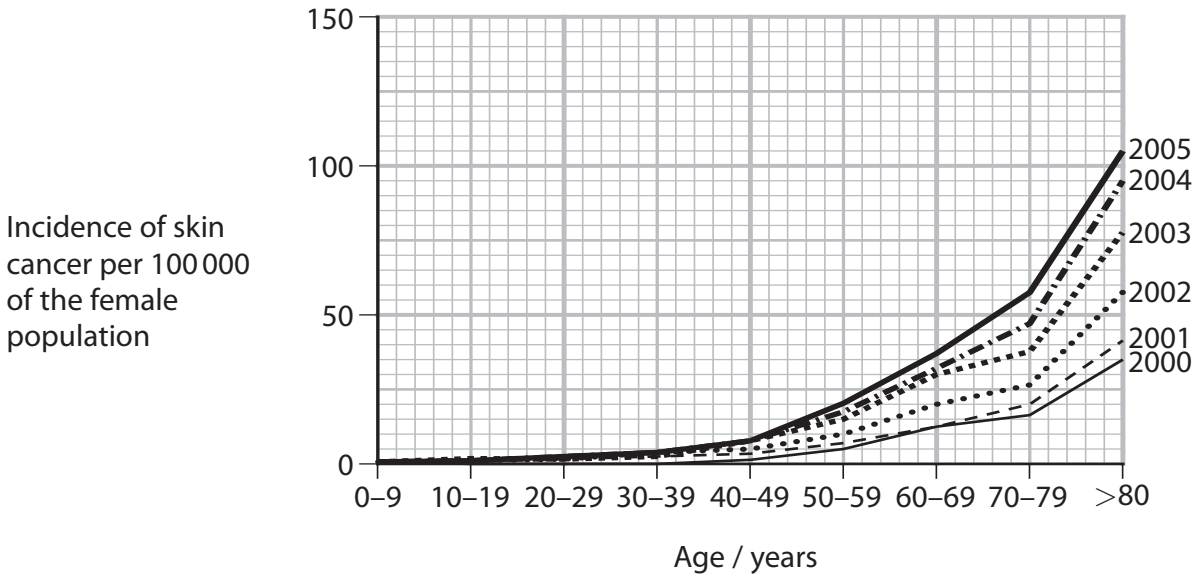
(b) Exposure to ultraviolet light is associated with the development of skin cancer.

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





(i) The graphs show some correlations.

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

(1)

(ii) Describe the correlations shown by these graphs.

(3)

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

(3)

*(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

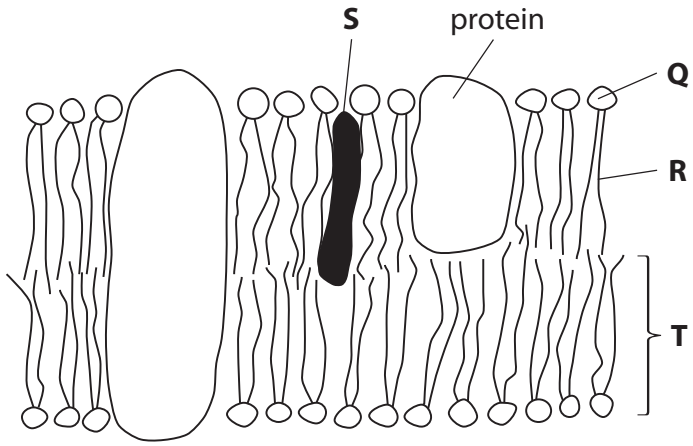
Criticise the design of this study.

(6)

(Total for Question 7 = 14 marks)

8 The structure of the cell membrane affects the properties of the cell membrane.

The diagram shows the structure of part of a cell membrane.



(a) (i) The magnification of this diagram is 1×10^7.

The structure labelled **T** is 2 units long.

What is this unit?

(1)

- ☒ **A** cm
- ☒ **B** mm
- ☒ **C** μm
- ☒ **D** nm

(ii) Which structures contain a phosphate group?

(1)

- ☒ **A** **Q** and **R**
- ☒ **B** **Q** and **T**
- ☒ **C** **R** and **S**
- ☒ **D** **S** and **T**

(iii) Which ratio of the structures affects the fluidity of this membrane?

(1)

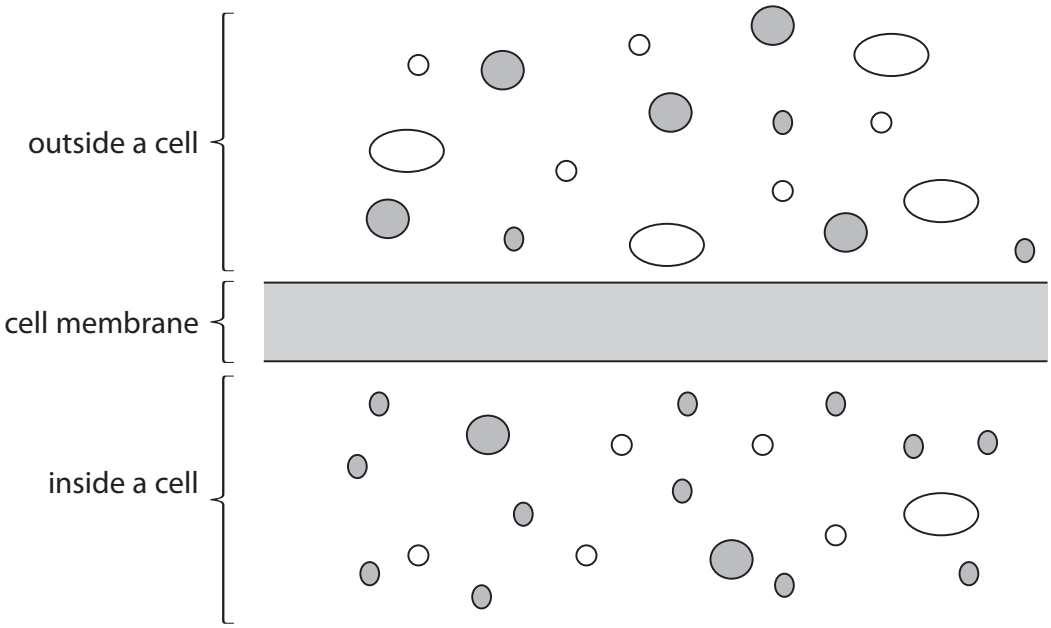
- ☒ **A** **Q**:**T**
- ☒ **B** **R**:**Q**
- ☒ **C** **R**:**T**
- ☒ **D** **S**:**T**

(b) Explain the role of the primary structure in determining the properties of the protein labelled in the diagram.

(4)

*(c) The diagram and table give information about some molecules found inside and outside a cell.

Molecule	Key	Description
E	○	small dipolar molecule consisting of two hydrogen atoms and one oxygen atom
F	●	large polar molecule
G	⬭	non-polar molecule
H	●	small polar molecule



Explain why each of these molecules **enters** the cell by a different mechanism.

Use the information in the table and the diagram to support your answer.

(6)

(Total for Question 8 = 13 marks)

TOTAL FOR PAPER = 80 MARKS

Please check the examination details below before entering your candidate information

Candidate surname	Other names

Centre Number | Candidate Number

Pearson Edexcel International Advanced Level

Time 1 hour 30 minutes

Paper reference **WBI11/01**

Biology October 2021

Advanced Subsidiary
UNIT 1: Molecules, Diet, Transport and Health

You must have:
Scientific calculator, ruler, HB pencil

Total Marks

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Turn over ▶

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B:1/1/1/1/

P 7 1 8 4 5 A 0 1 2 8

Pearson

SECTION A

Answer ALL questions. Write your answers in the spaces provided.

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

1 Mutations can give rise to cancer.

(a) What is a mutation?

(1)

☒ **A** a change in the amino acid sequence in DNA

☒ **B** a change in the amino acid sequence in a protein

☒ **C** a change in the base sequence in DNA

☒ **D** a change in the base sequence in a protein

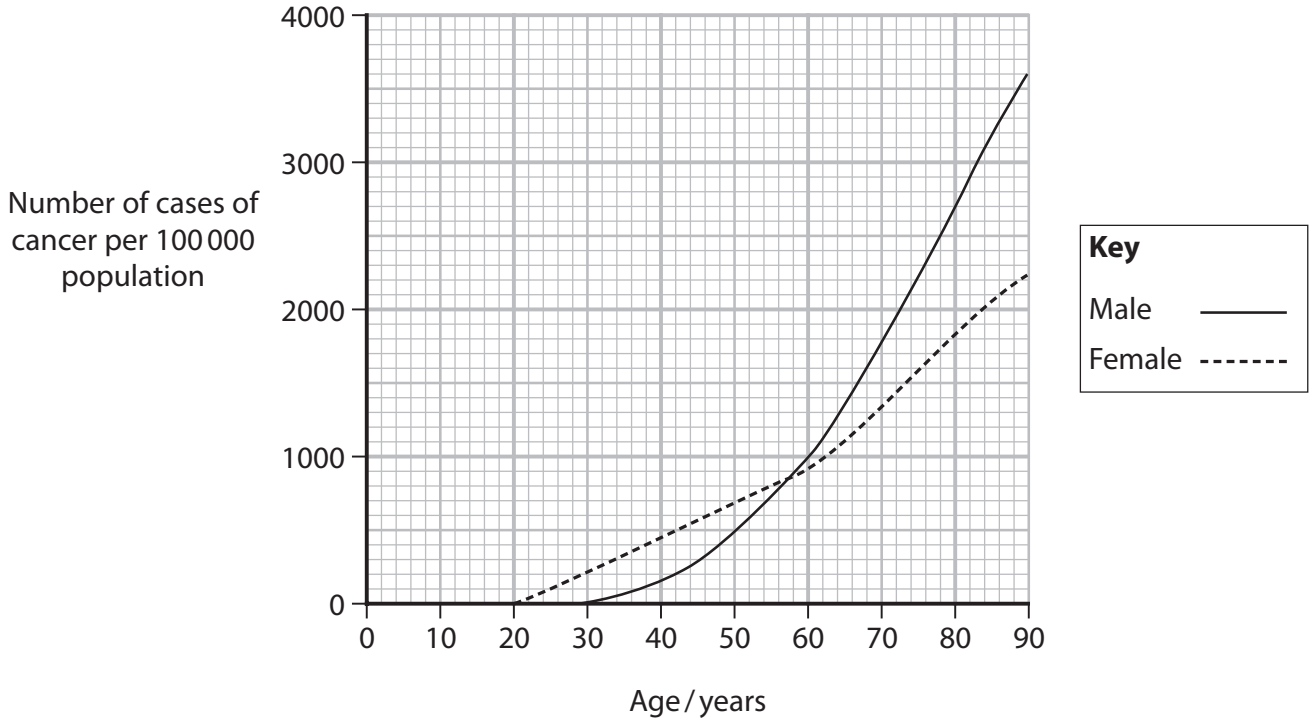
(b) Name **two** types of mutation.

(1)

1 .....

2 .....

(c) The graph shows the number of cases of one type of cancer in a human population.



Describe the effect of age and sex on the number of cases of cancer.

(3)

(Total for Question 1 = 5 marks)

2 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

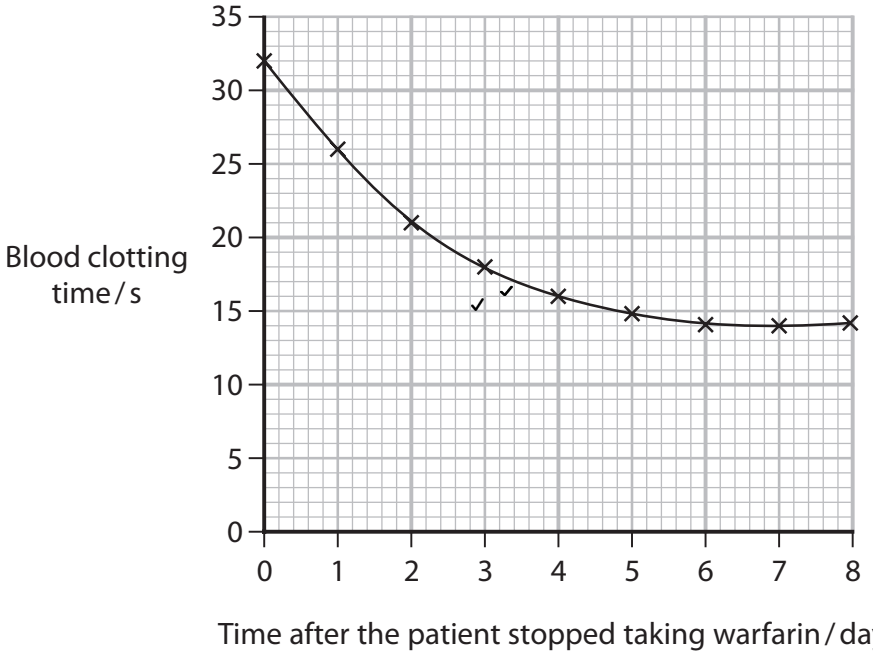
☒ **B** an antihypertensive

☒ **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 .....

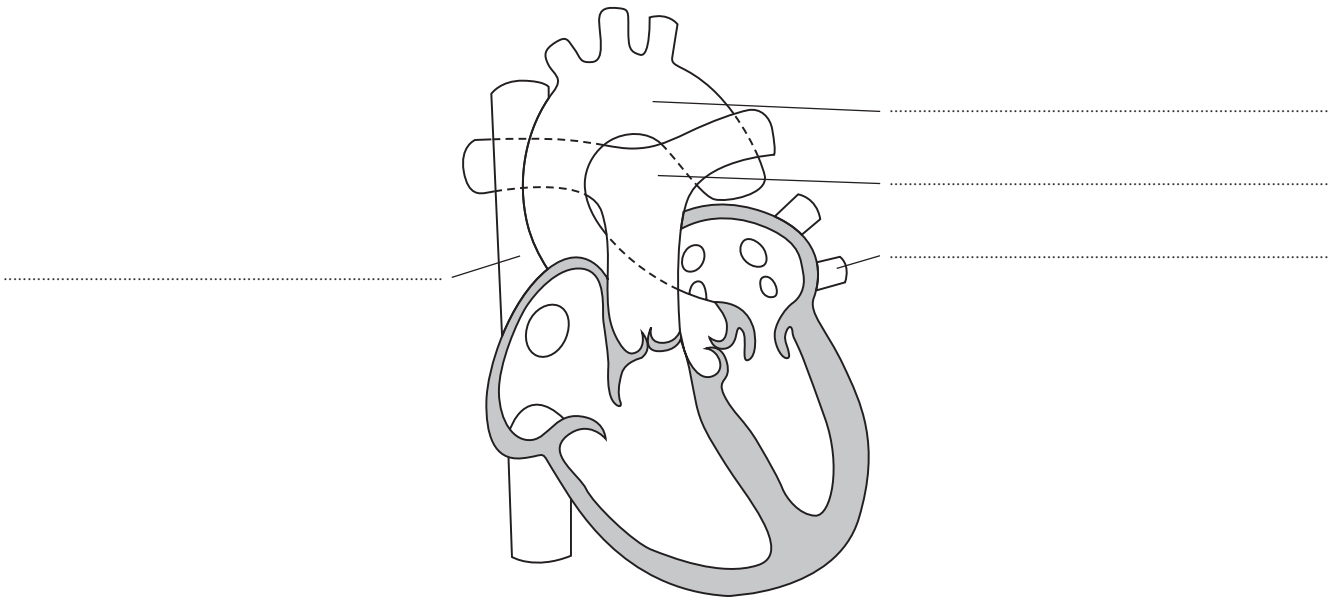
(Total for Question 2 = 6 marks)

3 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)



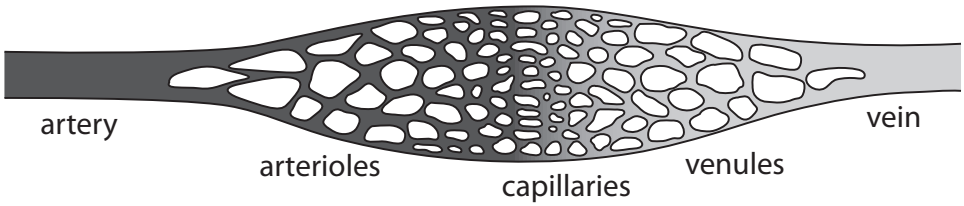
(b) The table shows some structures and the types of blood vessel that they are found in.

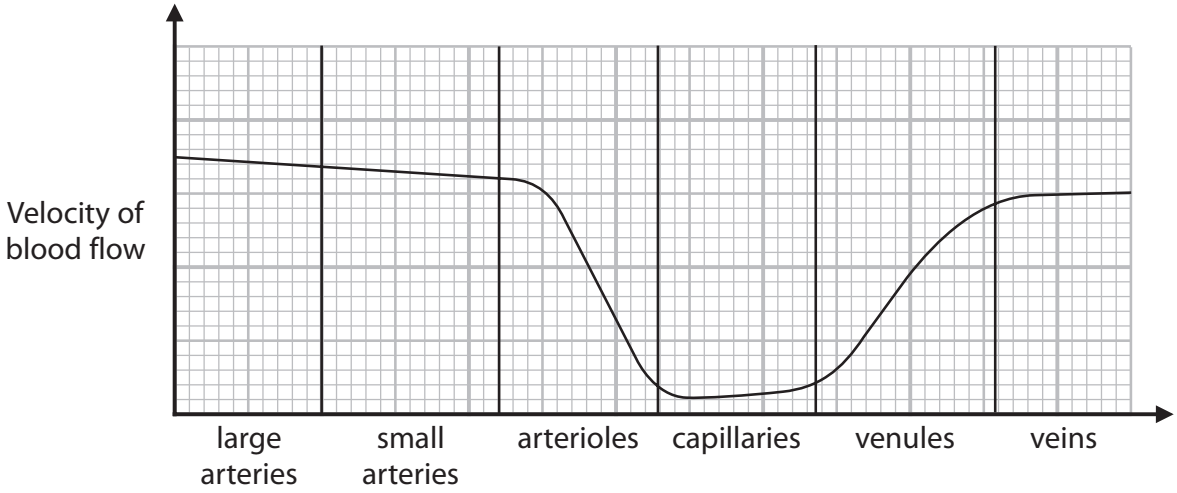
Put a cross ☒ in each row to show where these structures are found.

(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)

(Total for Question 3 = 9 marks)

4 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

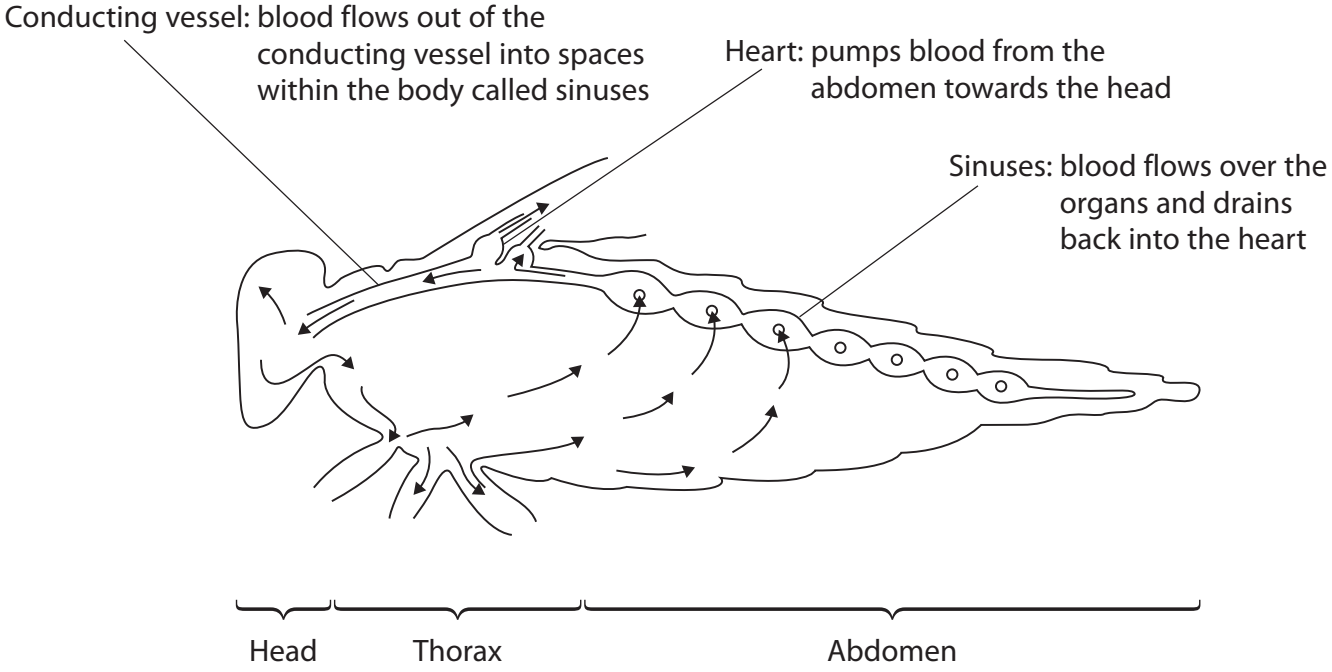
(iii) Which row of the table describes a saturated lipid?

(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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(Total for Question 4 = 9 marks)

5 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)

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

(2)

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

(3)

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

(3)

(Total for Question 5 = 10 marks)

6 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)

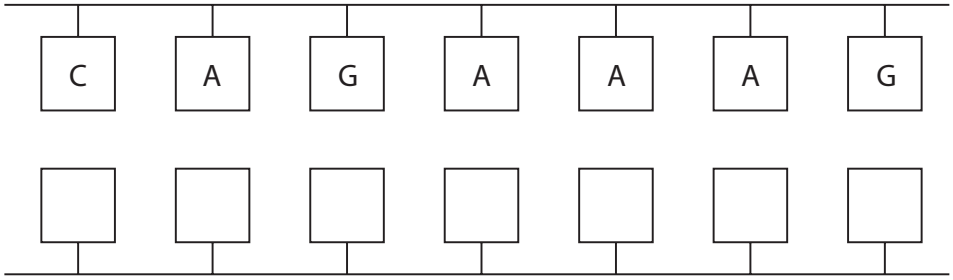
Answer .....

(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)

(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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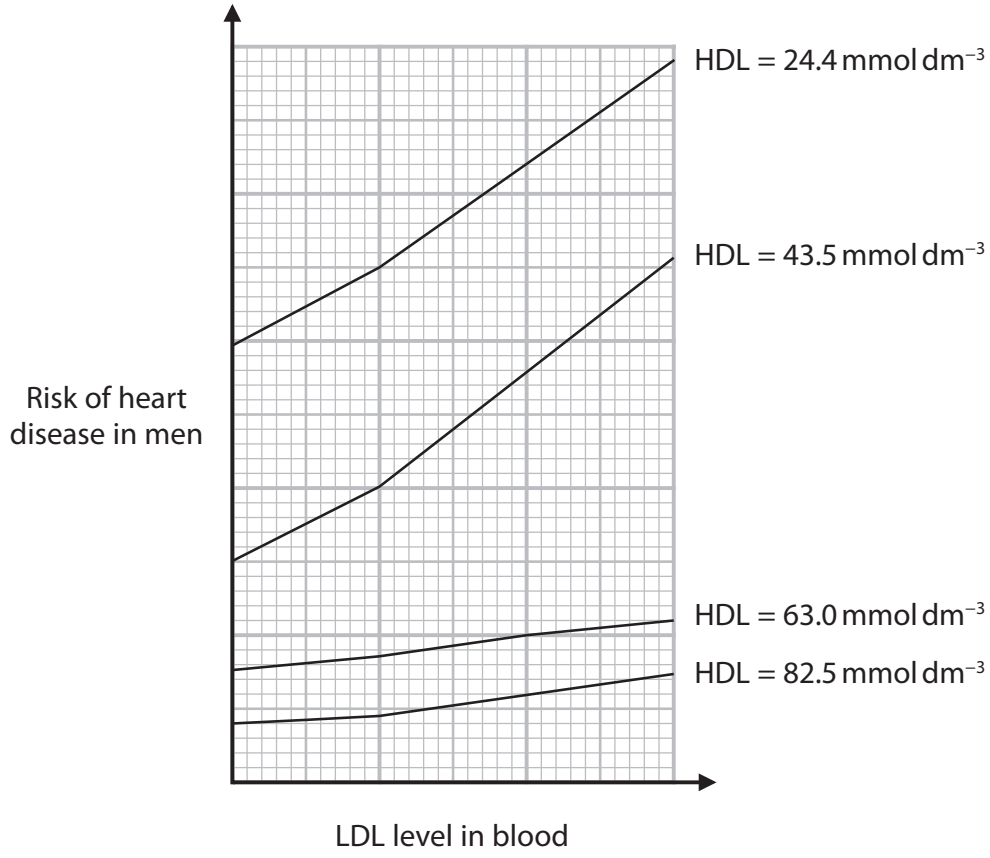
(Total for Question 6 = 14 marks)

7 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.

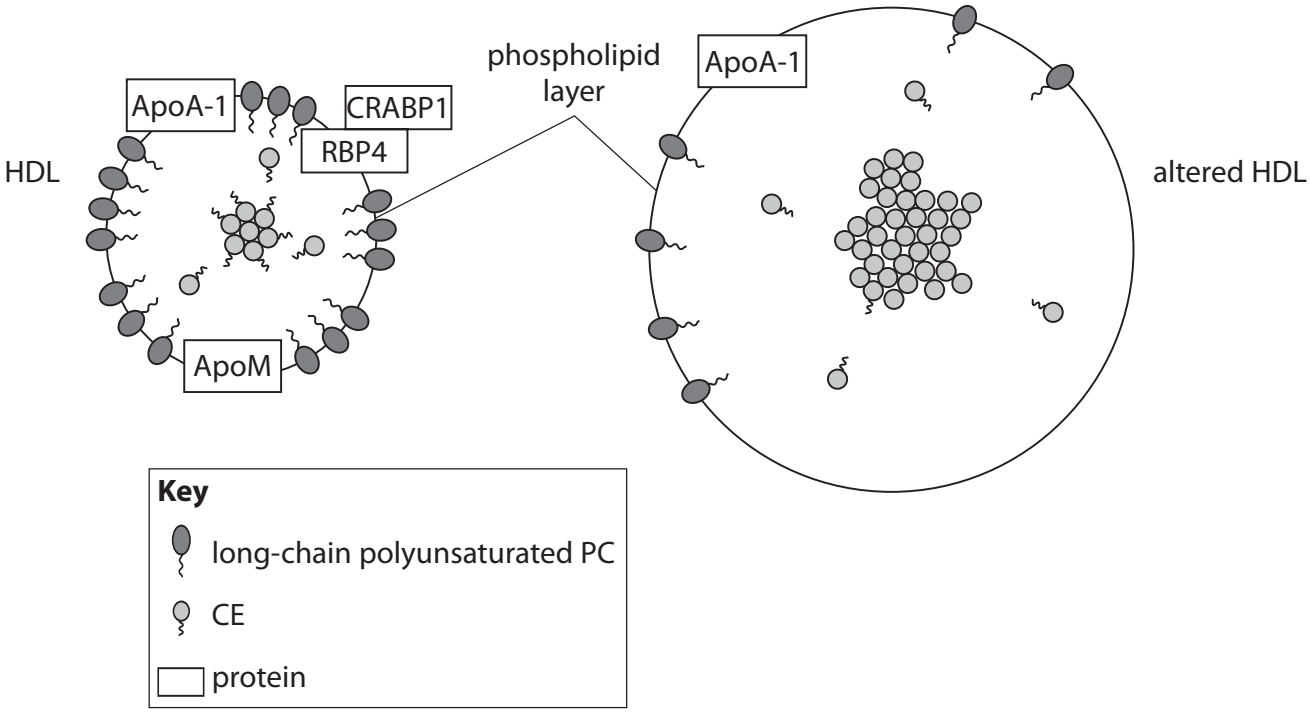
Explain why a man with a blood HDL level greater than 40 mg dm^{-3} may still have a high risk of developing heart disease.

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

(6)

(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)

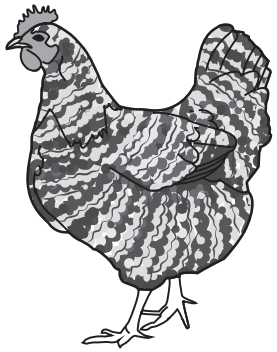
(ii) The antioxidant properties of altered HDL are reduced.

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

(3)

(Total for Question 7 = 12 marks)

8 The drawing shows a speckled chicken. These chickens have a mixture of black and white feathers.



The colour of the feathers of a chicken is an example of codominance.

One parent of this speckled chicken had white feathers and the other parent had black feathers.

(a) Describe the difference between each of the following pairs of terms, using feather colour to illustrate your answer.

(i) Gene and allele

(3)

(ii) Genotype and phenotype

(3)

(b) A black chicken was mated with a speckled chicken. They had 25 chicks.

Determine the expected number of speckled chicks.

You **must** use a genetic diagram.

(3)

Answer .....

(c) In an experiment, several pairs of speckled chickens were mated together.

They produced 480 chicks.

The table shows the expected number of speckled chicks, white chicks and black chicks. It also shows the actual number of each type of chick.

Steps in the calculation for the statistics test	Colour of feathers of chicks		
	Speckled	White	Black
Observed number (O)	243	125	112
Expected number (E)	240	120	120
(O-E)			
$\frac{(O-E)^2}{E}$			

This table can be used in a statistics test.

(i) Name the statistics test being used to analyse these data.

(1)

.....

(ii) Complete this table to show the missing values.

(2)

(iii) Calculate $\sum \frac{(O-E)^2}{E}$

(1)

Answer .....

(iv) Explain how a critical value table could be used to accept or reject a null hypothesis for this experiment.

(2)

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(Total for Question 8 = 15 marks)

TOTAL FOR PAPER = 80 MARKS

Please check the examination details below before entering your candidate information

Candidate surname	Other names

Centre Number | Candidate Number

Pearson Edexcel International Advanced Level

Time 1 hour 30 minutes

Paper reference **WBI11/01**

Biology

January 2022

Advanced Subsidiary

UNIT 1: Molecules, Diet, Transport and Health

You must have:
Scientific calculator, ruler, HB pencil

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided – *there may be more space than you need.*
- Calculators may be used.
- You must **show all your working out** with **your answer clearly identified** at the **end of your solution**.

Information

- The total mark for this paper is 80.
- The marks for **each** question are shown in brackets – *use this as a guide as to how much time to spend on each question.*
- The marks available for spelling, punctuation and grammar are clearly indicated.
- In questions marked with an **asterisk** (*), marks will be awarded for your ability to structure you're answer logically, showing how the points you make are related or follow on from each other where appropriate.

Advice

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

Turn over ▶

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P 7 1 8 6 8 A 0 1 3 2

Pearson

Answer ALL questions. Write your answers in the spaces provided.

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

1 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)

.....

(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

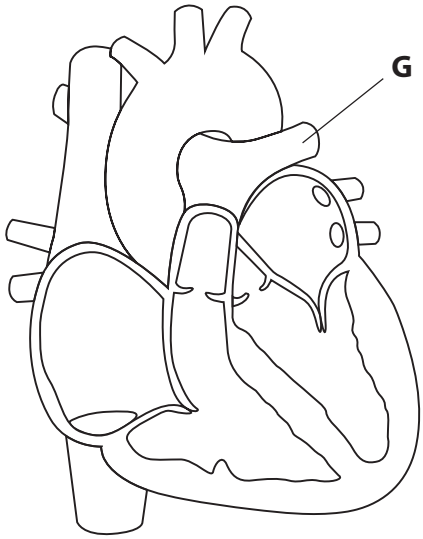
☒ **C** 342

☒ **D** 360

(Total for Question 1 = 7 marks)

2 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)

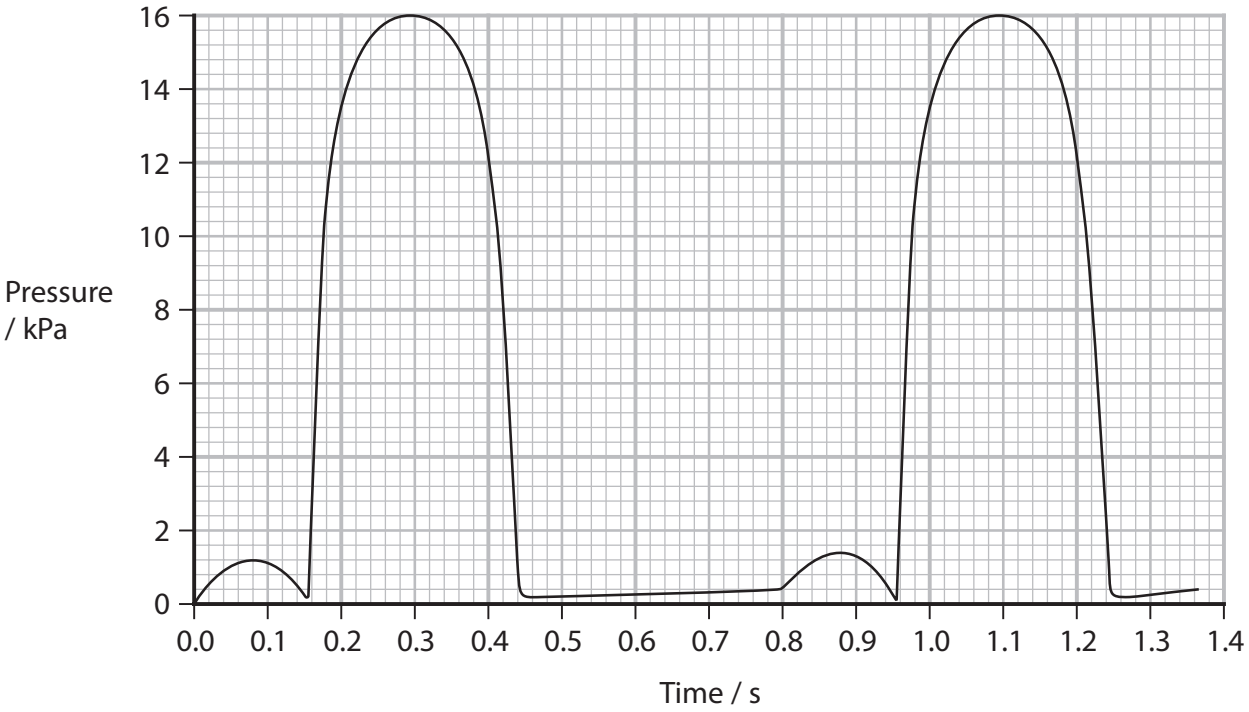
- ☒ **A** aorta
- ☒ **B** pulmonary artery
- ☒ **C** pulmonary vein
- ☒ **D** vena cava

(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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(Total for Question 2 = 7 marks)

3 An average-sized human chromosome contains a DNA molecule with about 300 million nucleotides, arranged in pairs.

(a) Describe the structure of a nucleotide pair.

(3)

(b) Before a cell can divide, the DNA molecule has to replicate. This takes place in the S phase of the cell cycle.

Human DNA replicates at a rate of 50 nucleotides per second.

Calculate how long it would take, to the nearest hour, for 150 million nucleotides to replicate.

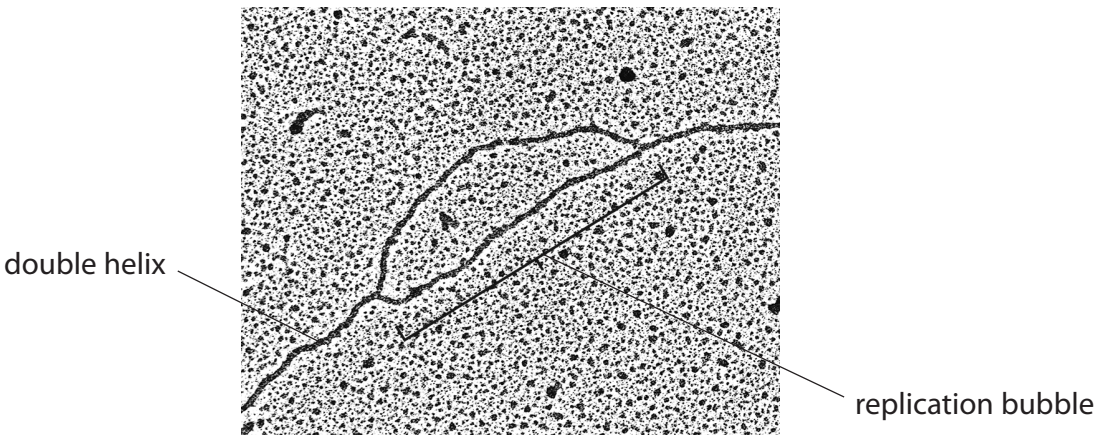
Assume that replication starts at one end of the molecule and continues to the other end.

(2)

Answer ..... hours

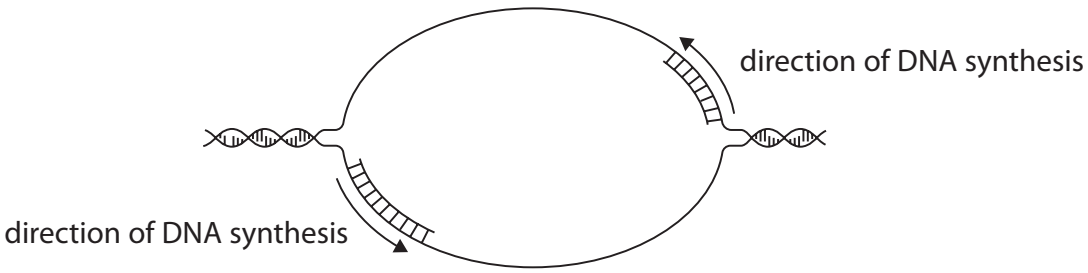
(c) In human cells, replication of DNA occurs at several sites along the molecule. These sites are called replication bubbles.

The photograph shows a replication bubble.



(Source: © Dr Gopal Murti / Science Photo Library)

The diagram shows how the DNA is replicated in one replication bubble.



(i) Explain the role of DNA polymerase in a replication bubble.

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

(2)

(ii) In human cells, S phase lasts about 10 hours.

Suggest why each DNA molecule is replicated using many replication bubbles.

(3)

(Total for Question 3 = 10 marks)

4 Cystic fibrosis is an inherited recessive disease caused by mutations in a gene on chromosome 7.

(a) Give the meaning of the term **gene**.

(1)

(b) Explain how mutations result in cystic fibrosis.

(3)

(c) Population carrier screening (PCS) is one type of genetic screening.

This involves screening people who want a child to see if they are carriers of genetic disorders.

In one country, the number of babies born with cystic fibrosis went down following the introduction of PCS.

Suggest why the number of babies born with cystic fibrosis went down.

(3)

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(Total for Question 4 = 7 marks)

5 Collagen is a component of the wall of the aorta.

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

(3)

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

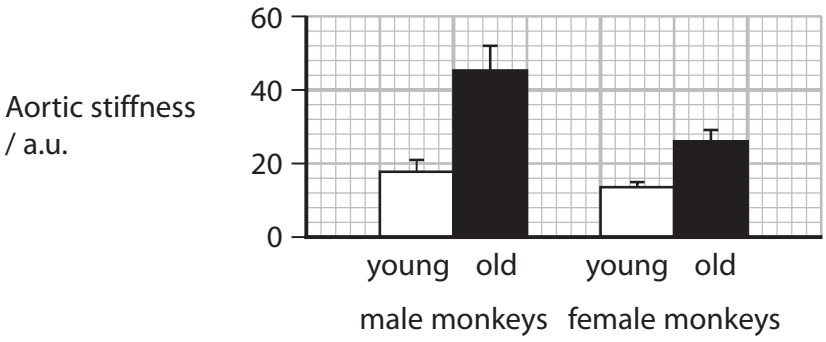
(2)

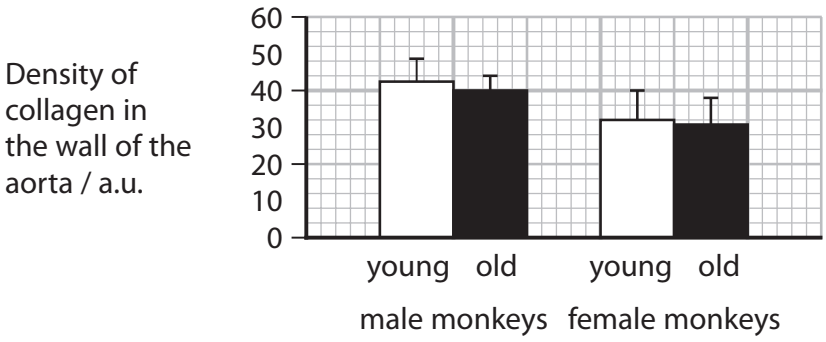
*(b) Age and sex affect the types and density of collagen found in the wall of the aorta.

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.

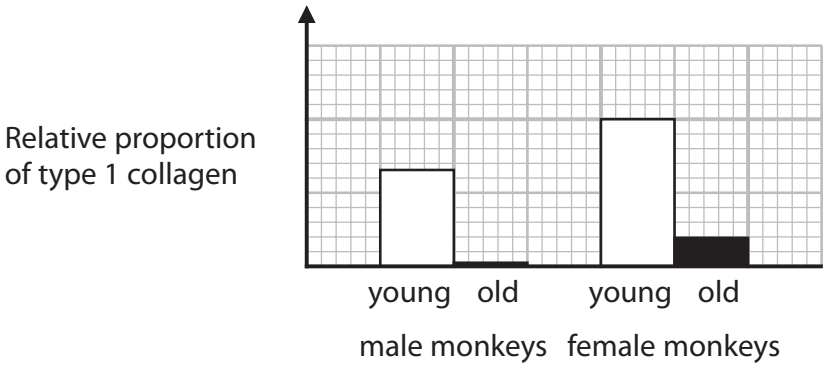
The graphs show the results of this study.

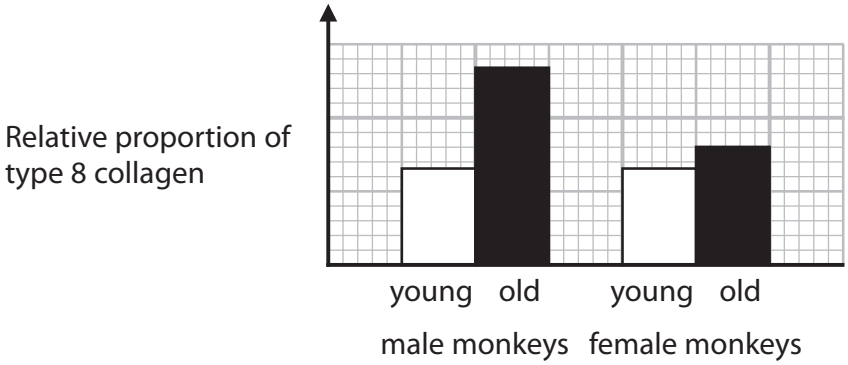




In another study, scientists investigated the effect of age and sex on two types of collagen present in the wall of the aorta.

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.

(6)

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(Total for Question 5 = 11 marks)

6 The cell membrane controls which substances can move into the cell or out of the cell.

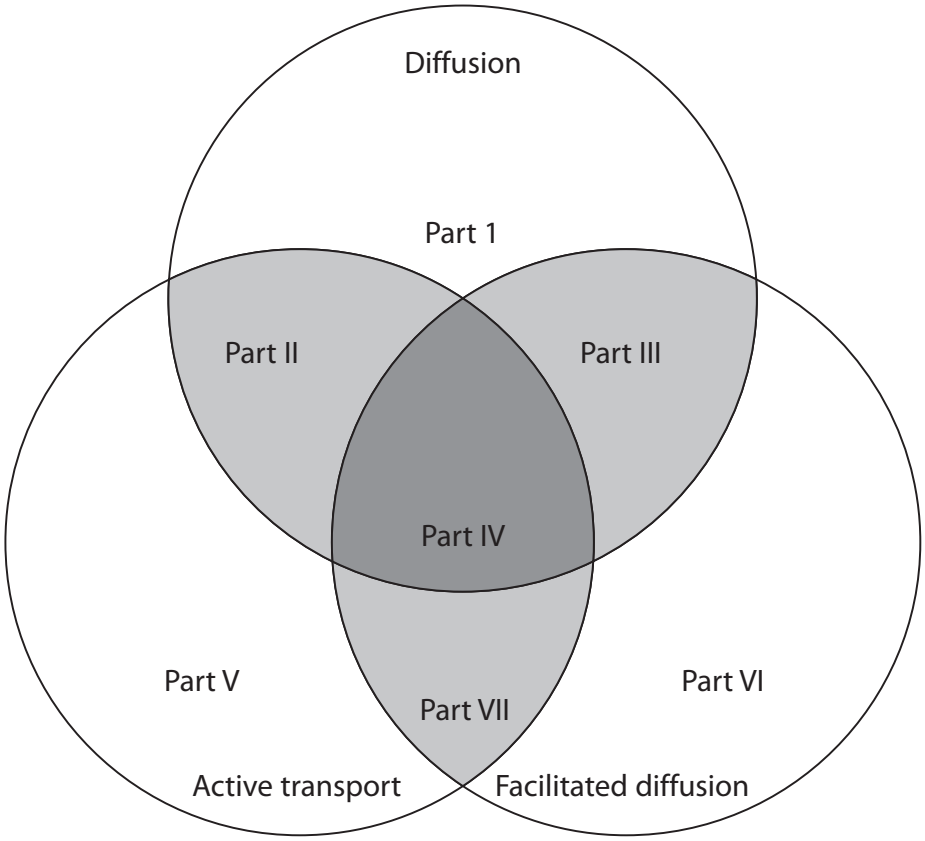
Processes by which substances can move into a cell or out of a cell include diffusion, facilitated diffusion, active transport and osmosis.

(a) A Venn diagram can be used to show the similarities and differences between diffusion, facilitated diffusion and active transport.

Statements about similarities can be written in the numbered parts of the circles that overlap.

For example, statements about similarities shared by all three processes would be written in Part IV.

Statements about differences can be written in the numbered parts of the circles that do not overlap.



(i) Which part would contain the statement: uses proteins?

(1)

- ☒ **A** II
- ☒ **B** III
- ☒ **C** IV
- ☒ **D** VII

(ii) Which part would contain the statement: needs energy in the form of ATP?

(1)

- ☒ **A** II
- ☒ **B** V
- ☒ **C** VI
- ☒ **D** VII

(iii) Which part would contain the statement: solutes can only move down a concentration gradient?

(1)

- ☒ **A** II
- ☒ **B** III
- ☒ **C** V
- ☒ **D** VII

(b) Osmosis can be defined as the movement of free water molecules through a partially permeable membrane, down a water potential gradient.

Explain this definition.

(3)

*(c) The photograph shows a Chinese mitten crab.

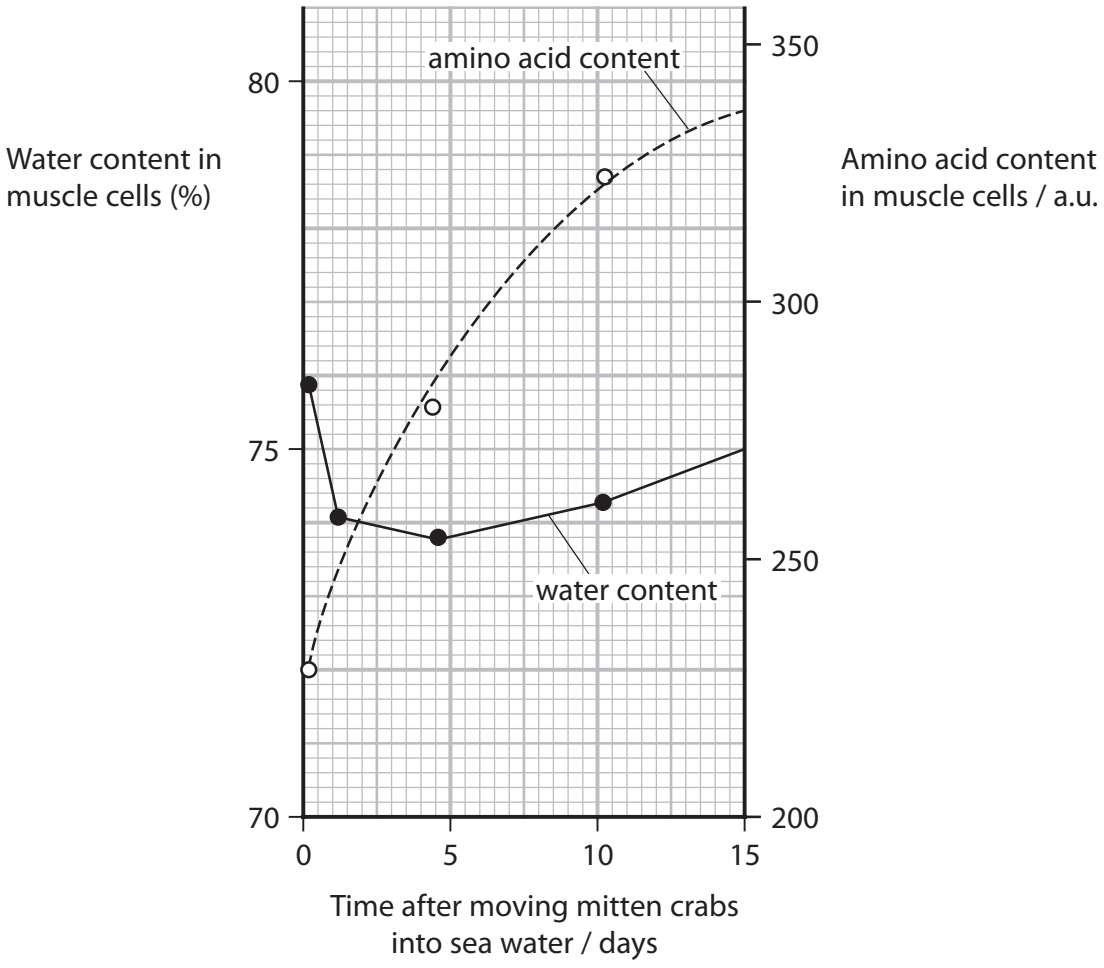
(Source: © WILDLIFE GmbH / Alamy Stock Photo)

Mitten crabs spend most of their lives in fresh water and only return to the sea to breed.

In an investigation, mitten crabs were kept in fresh water and then moved into sea water.

The water content and amino acid content in the muscle cells of these crabs were measured for 15 days after moving them from fresh water into sea water.

The graph shows the results of this investigation.



Sea water has a higher concentration of salt than fresh water.

Explain the changes in water content and amino acid content in the muscle cells of the crabs in this investigation.

(6)

(Total for Question 6 = 12 marks)

7 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)

(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)

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

(2)

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(Total for Question 7 = 11 marks)

8 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)

.....

(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)

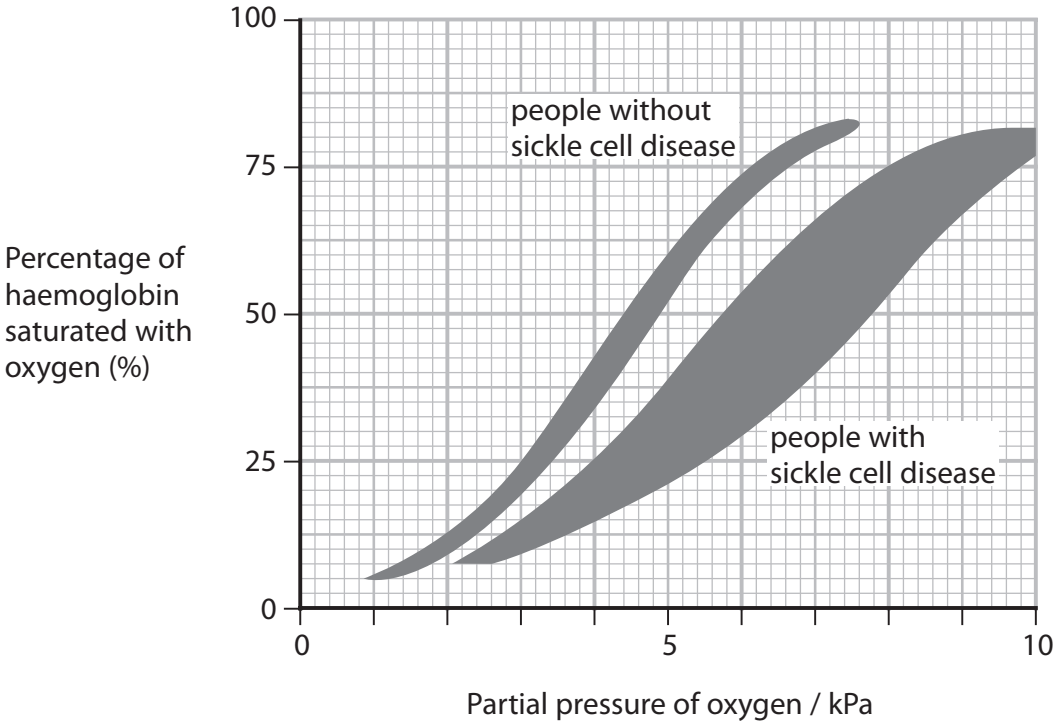
Answer .....

(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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(Total for Question 8 = 15 marks)

TOTAL FOR PAPER = 80 MARKS

Please check the examination details below before entering your candidate information

Candidate surname	Other names

Centre Number | Candidate Number

Pearson Edexcel International Advanced Level

Time 1 hour 30 minutes

Paper reference **WBI11/01**

Biology

May 2022

Advanced Subsidiary

UNIT 1: Molecules, Diet, Transport and Health

You must have:
Scientific calculator, ruler, HB pencil

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided – *there may be more space than you need.*
- Calculators may be used.
- You must **show all your working out** with **your answer clearly identified** at the **end of your solution**.

Information

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- Any diagrams may NOT be accurately drawn, unless otherwise indicated.
- In questions marked with an **asterisk** (*), marks will be awarded for your ability to structure your answer logically, showing how the points that you make are related or follow on from each other where appropriate.

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- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

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Q:1/1/1/

P 7 0 9 6 0 A 0 1 2 8

Pearson

Answer ALL questions. Write your answers in the spaces provided.

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

1 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 1 = 5 marks)

2 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)

(Total for Question 2 = 6 marks)

3 Pectinase is an enzyme that breaks down pectin. Pectin is present in the cell walls of fruits.

(a) What type of molecule is pectinase?

(1)

- ☒ **A** disaccharide
- ☒ **B** polysaccharide
- ☒ **C** protein
- ☒ **D** triglyceride

(b) Explain why enzymes are described as biological catalysts.

(2)

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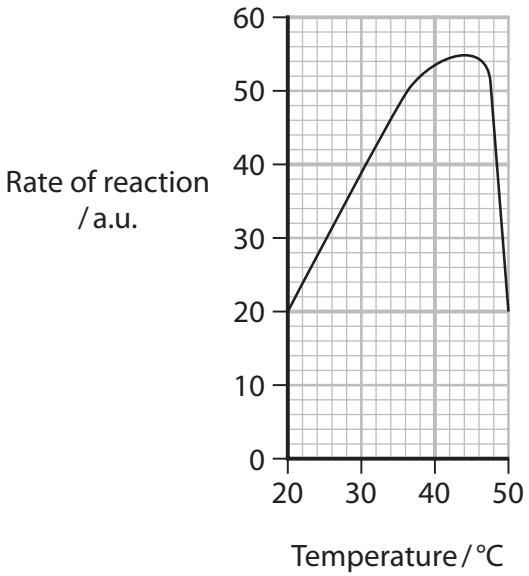
(c) The graph shows the effect of temperature on the rate of reaction of pectinase.



(i) Calculate the effect on the rate of reaction of each degree increase in temperature between 46 °C and 50 °C.

Give your answer to two significant figures.

(1)

Answer ..... a.u. per °C

(ii) State why there is a decrease in the rate of reaction above the optimum temperature.

(1)

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(Total for Question 3 = 5 marks)

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

(a) Complete the table.

Use the formula:

surface area = $2\pi rl$

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

(3)

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

(3)

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

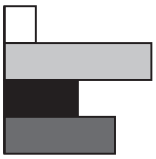
(2)

(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)

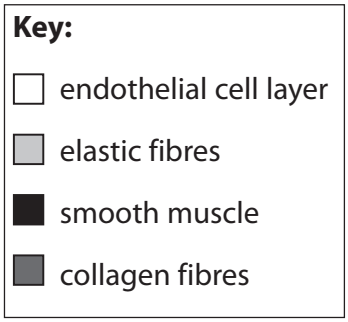
☒ **A**



☒ **B**

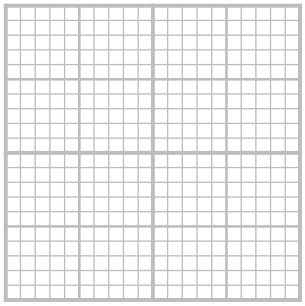
☒ **C**

☒ **D**



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

(1)



(Total for Question 4 = 10 marks)

5 Hair straightening, or rebonding, is a hair styling technique used to straighten hair using either heat or chemicals.

(a) Hair is made from an insoluble fibrous protein called keratin.

(i) Describe **two** structural features of insoluble fibrous proteins.

(2)

1 .....

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2 .....

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(ii) Keratin contains a high proportion of the amino acid, cysteine.

Disulfide bridges form between the R groups of two cysteines.

The diagram shows the R group of cysteine.

Draw the complete structure of the amino acid, cysteine.

(3)

(b) The effect of two different temperatures on the lengths of the primary structure and secondary structure of a polypeptide was investigated.

The table shows the results of this investigation.

Structure of polypeptide	Length of structure / nm	
	at 25 °C	at 55 °C
primary	505	505
secondary	48	70

(i) Describe the secondary structure of a polypeptide.

(2)

(ii) Explain the results of this investigation.

(4)

(Total for Question 5 = 11 marks)

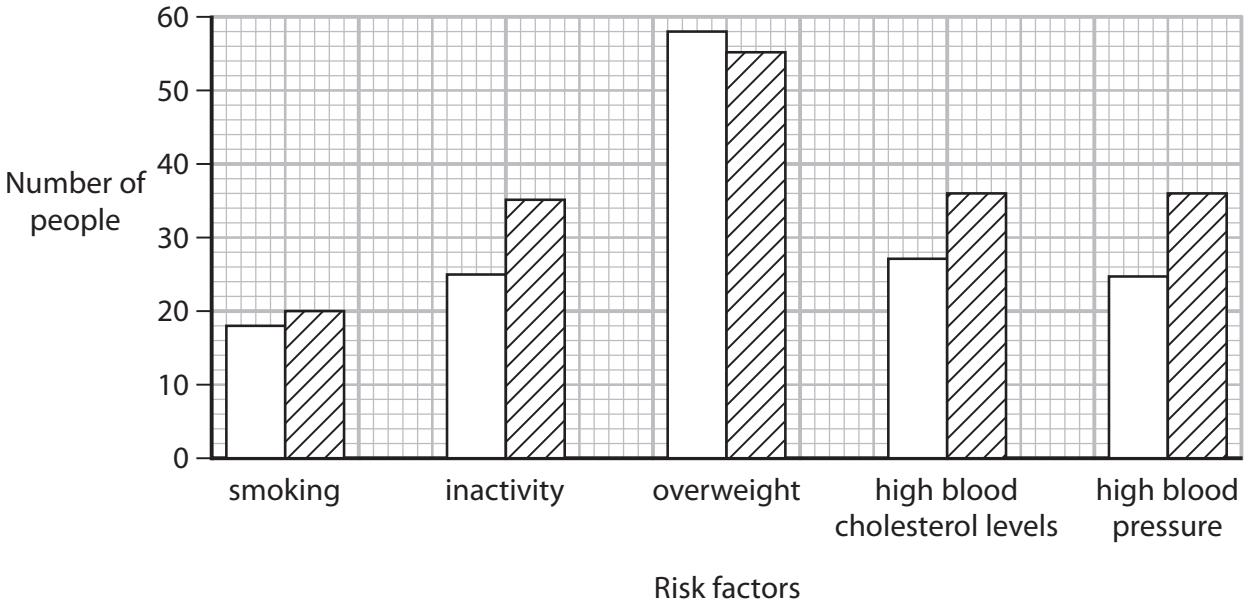
6 The risk of developing cardiovascular disease (CVD) is dependent on a number of factors.

(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)

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

(3)

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

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

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

Table 1

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

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

Table 2

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

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

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

(2)

Answer ..... %

(ii) Explain the lifestyle changes this woman could make to reduce her 10-year risk of CVD.

Use the information in the table to support your answer.

(2)

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

(1)

☒ **A** anticoagulants and statins

☒ **B** anticoagulants and antihypertensives

☒ **C** antihypertensives and platelet inhibitors

☒ **D** antihypertensives and statins

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

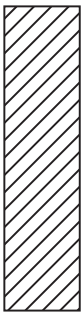
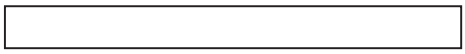
(2)

(Total for Question 6 = 15 marks)

7 The components of a cell membrane determine its properties.

The membrane is a phospholipid bilayer.

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

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

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

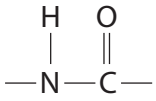
(2)

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

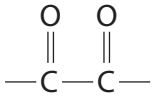
Which diagram shows an ester bond?

(1)

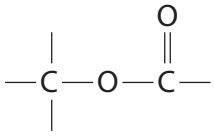
☒ **A**



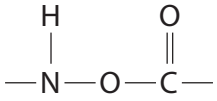
☒ **B**



☒ **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)

(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)

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

(2)

(Total for Question 7 = 13 marks)

8 Mutations can give rise to cancer or genetic disorders.

(a) Cancer is one of the main causes of death in the world.

In 2018, in the UK, there were 541 589 deaths in total and 166 800 of these were due to cancer.

Calculate the ratio of deaths caused by cancer to deaths not caused by cancer.

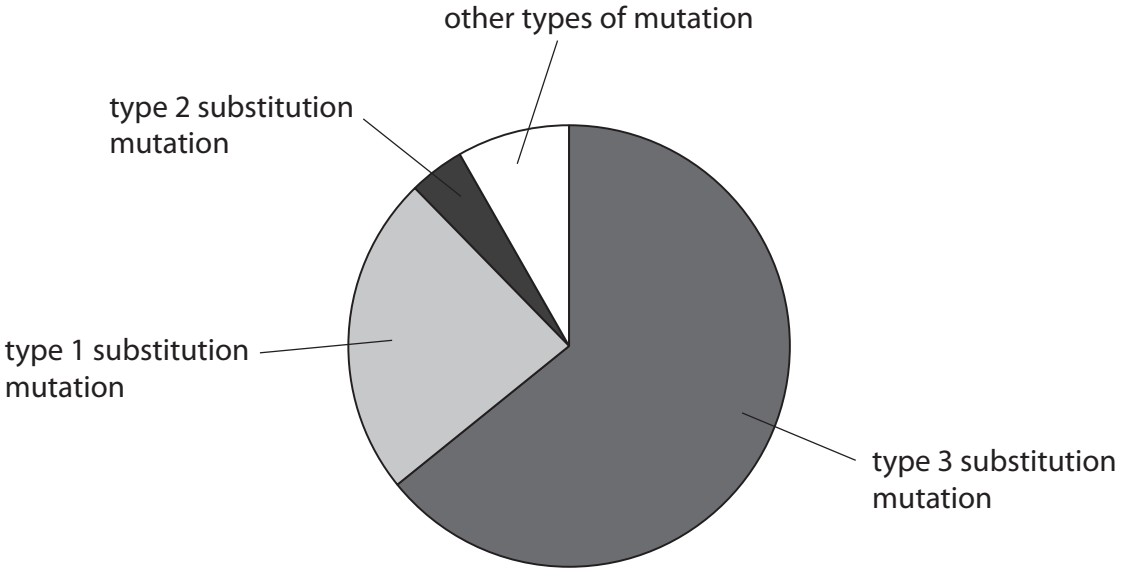
Give your answer to two decimal places.

(2)

Answer .....

(b) Scientists have identified many mutations in cancer cells and are trying to identify the mutations that are significant.

The chart shows the proportion of cancers caused by some types of mutation.



(i) Name **two** other types of mutation.

(1)

1 .....

2 .....

(ii) Estimate the percentage of cancers caused by type 3 substitution mutations.

(1)

Answer ..... %

(iii) A type 1 substitution mutation in a gene alters the DNA and mRNA but does **not** affect the protein synthesised from the mutated gene.

Explain how a substitution mutation can alter the DNA and mRNA but **not** the protein.

(4)

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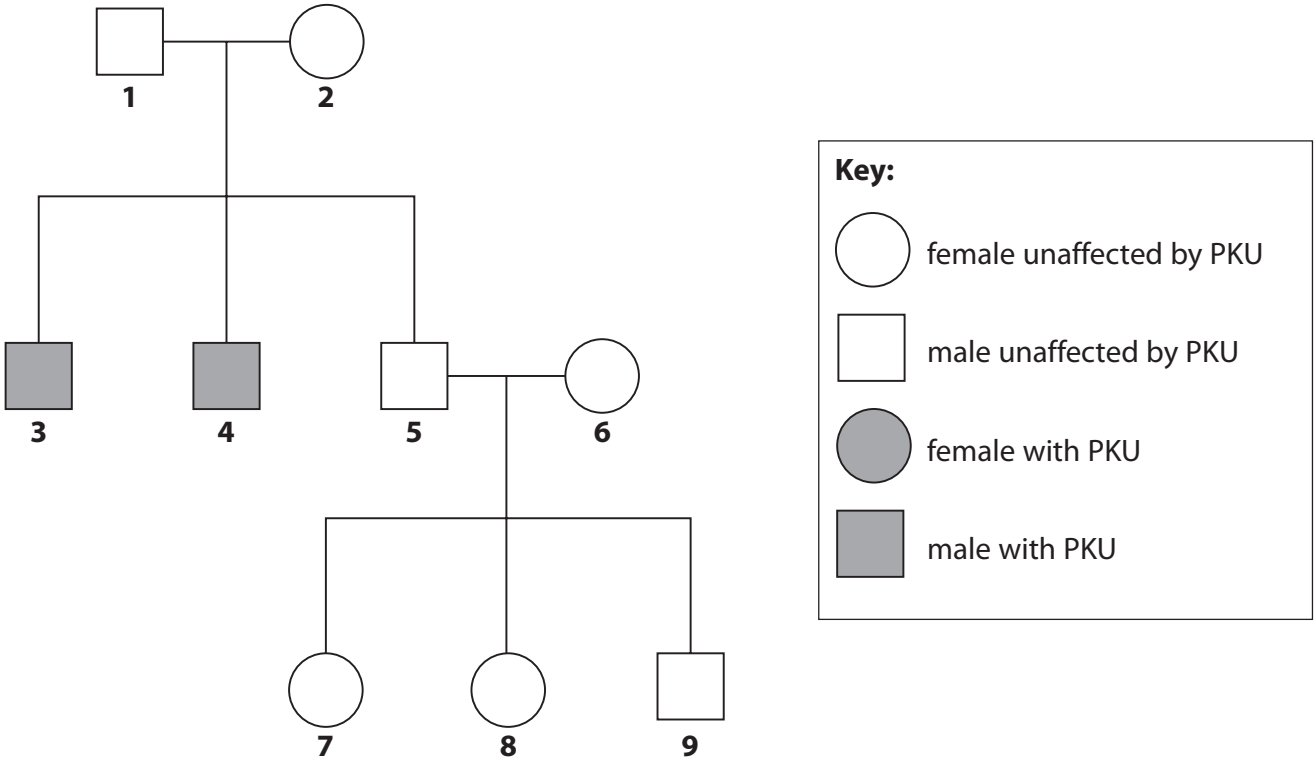
(c) Phenylketonuria (PKU) is a genetic disorder.

This disorder is inherited in a similar way to cystic fibrosis.

The pedigree diagram shows the phenotypes of individuals in one family affected by PKU.



(i) What is the probability of couple **1** and **2** having a fourth child that is a male affected by PKU?

(1)

- ☒ **A** 0.000
- ☒ **B** 0.125
- ☒ **C** 0.250
- ☒ **D** 0.500

*(ii) Discuss the extent to which this pedigree diagram can be used to identify the genotypes of all the members of this family.

(6)

(Total for Question 8 = 15 marks)

TOTAL FOR PAPER = 80 MARKS

Please check the examination details below before entering your candidate information

Candidate surname	Other names

Centre Number | Candidate Number

Pearson Edexcel International Advanced Level

Time 1 hour 30 minutes

Paper reference **WBI11/01**

Biology

October 2022

Advanced Subsidiary

UNIT 1: Molecules, Diet, Transport and Health

You must have:
Scientific calculator, ruler, HB pencil

Total Marks

Instructions

- Use **black** ink or ball-point pen.
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Turn over ▶

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B:1/1/1/1/

P 7 1 8 4 5 A 0 1 2 8

Pearson

Answer ALL questions. Write your answers in the spaces provided.

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

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

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

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

phosphate group	glycerol	fatty acid	covalent bond
			

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

(2)

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

(1)

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

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

(1)

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

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

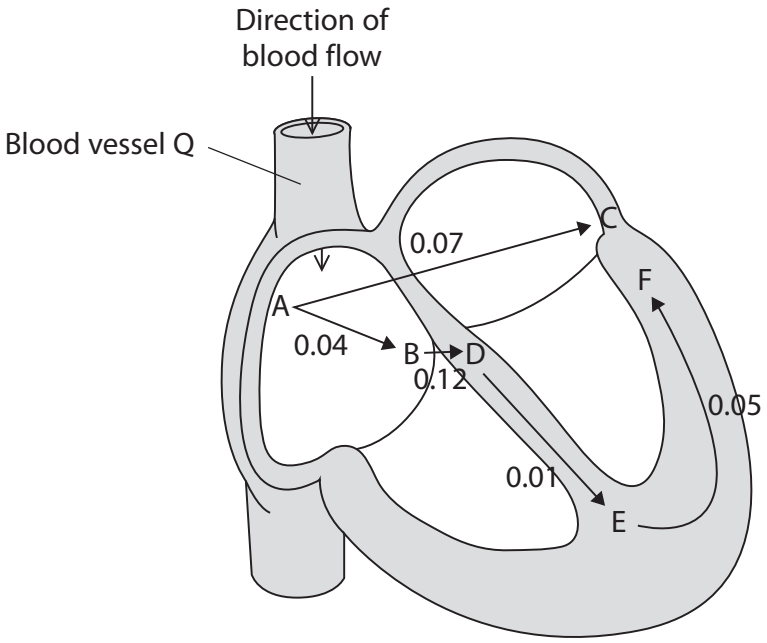
- transports substances out of the cell
- the cell membrane surrounds the substance
- can only transport substances down a concentration gradient

(1)

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

(Total for Question 1 = 5 marks)

2 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)

.....

(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 2 = 7 marks)

3 The structure of blood vessels relates to their function.

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

(2)

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

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

(3)

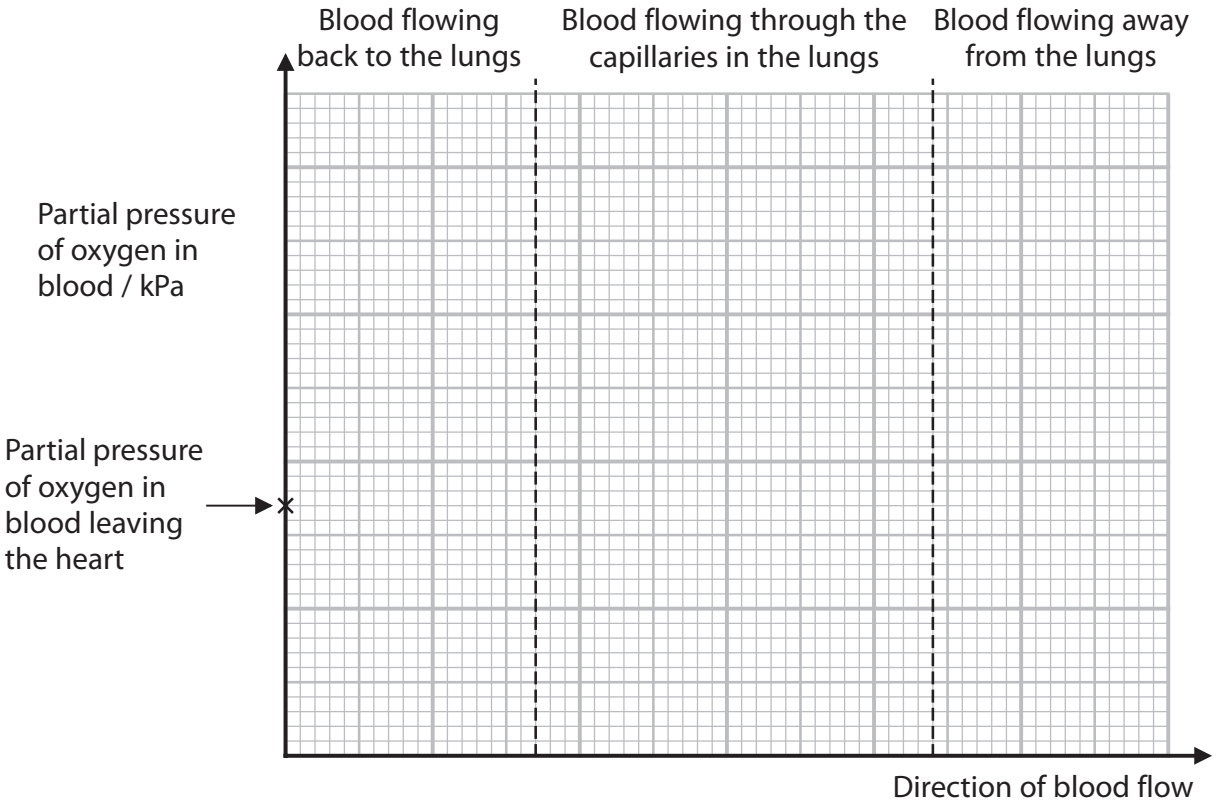
(c) Explain why veins need valves along their length.

(2)

(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 3 = 10 marks)

4 Enzymes are biological catalysts that have an effect on the energy required for a reaction.

(a) State the meaning of the term **biological catalyst**.

(2)

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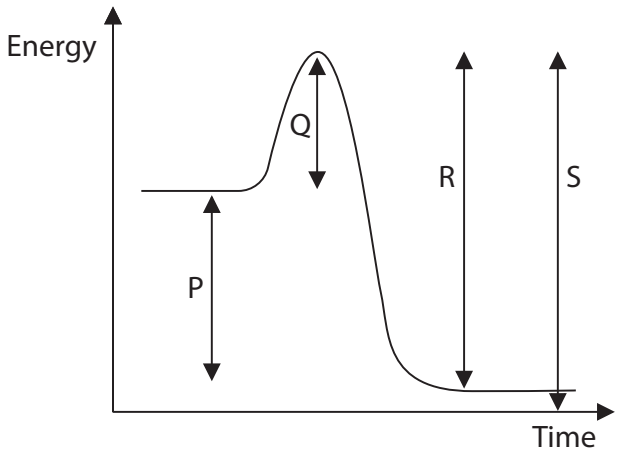
.....

(b) The graph shows the energy changes during an enzyme catalysed reaction.



Which arrow shows the energy required to start the reaction?

(1)

☒ **A** P

☒ **B** Q

☒ **C** R

☒ **D** S

(c) The diagram shows a series of chemical reactions.

$$A + B \xrightarrow{E_1} AB \xrightarrow{E_2} AC \xrightarrow{E_3} D$$

Three different enzymes, E_1, E_2 and E_3, are involved in these reactions.

Explain why E_1 cannot convert AB into AC or AC into D.

Use the information in the diagram to support your answer.

(3)

(d) Pectinase is an enzyme that breaks down pectin.

The effect of different combinations of pH and temperature on pectinase activity was investigated.

The volume and concentration of pectinase and pectin were kept the same in all reactions.

The table shows the rate of reaction for each pH and temperature combination tested.

pH	Temperature / °C	Rate of reaction / a.u.
2	5	0
2	30	0
2	60	0
4	5	5
4	30	35
4	60	0
8	5	5
8	30	10
8	60	0

Describe **two** conclusions that can be drawn from these results.

(2)

1 .....

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2 .....

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(Total for Question 4 = 8 marks)

5 Gas exchange requires diffusion.

The rate of diffusion is dependent on the surface area, the diffusion distance and the concentration gradient.

The rate of diffusion can be calculated using the formula:

$$\text{rate of diffusion} \propto \frac{\text{surface area} \times \text{concentration gradient}}{\text{diffusion distance}}$$

(a) Name the law on which this formula is based.

(1)

.....

(b) What will happen to the rate of diffusion if all three of the following are changed at the same time?

- the surface area is halved
- the concentration gradient is halved
- the diffusion distance is halved

(1)

☒ **A** it will stay the same

☒ **B** it will be a quarter of its value

☒ **C** it will halve

☒ **D** it will double

(c) The properties of gas exchange surfaces include:

- a large surface area
- a short diffusion distance
- a high concentration gradient.

Describe how mammalian lungs are adapted to have each of these three properties.

(3)

*(d) The photograph shows a hellbender salamander.

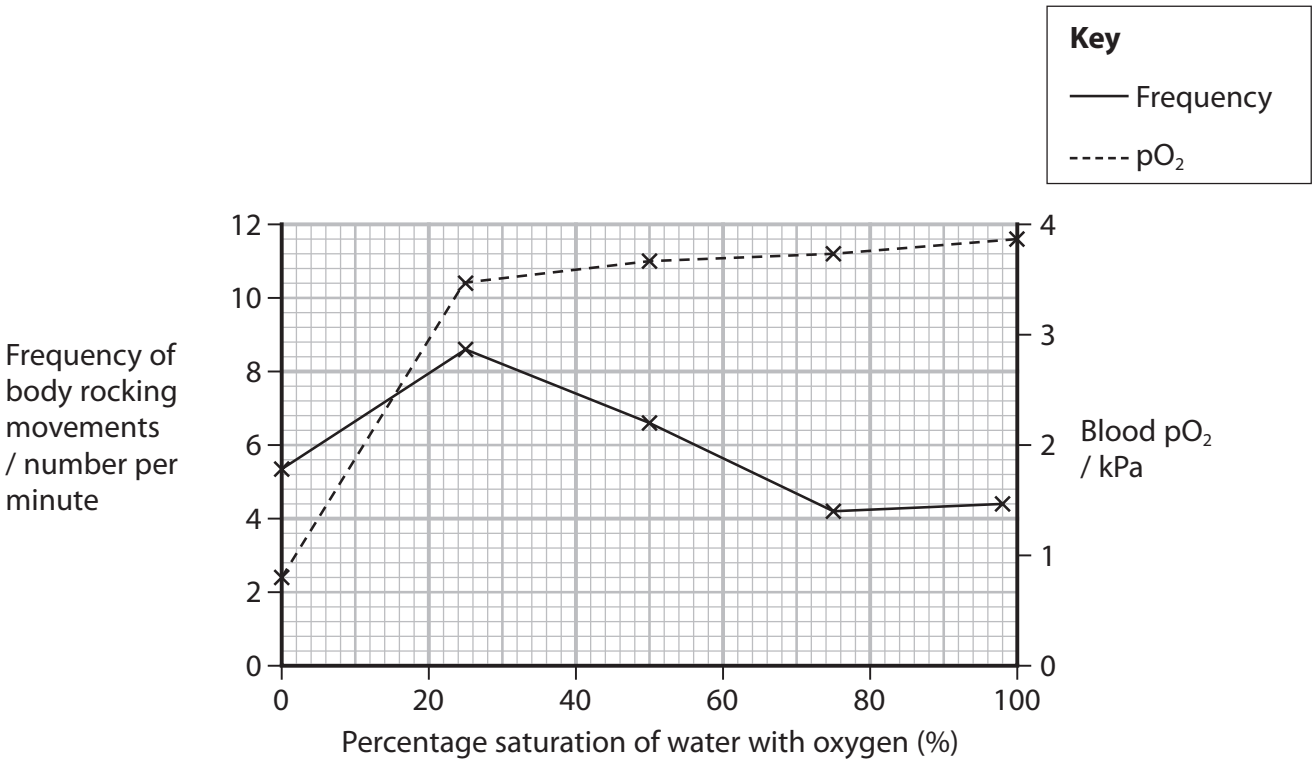
(Source: © Robert Hamilton/Alamy Stock Photo)

These salamanders live in freshwater streams that are shallow and fast-flowing.

They use their lungs and the surface of their skin for gas exchange.

They also use body rocking and swaying movements in the water.

The graph shows the relationship between the frequency of body rocking movements, blood pO_2 and the percentage saturation with oxygen of the water they live in.



Discuss how the structure and behaviour of these salamanders are adapted for gas exchange.

(6)

(Total for Question 5 = 11 marks)

6 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)

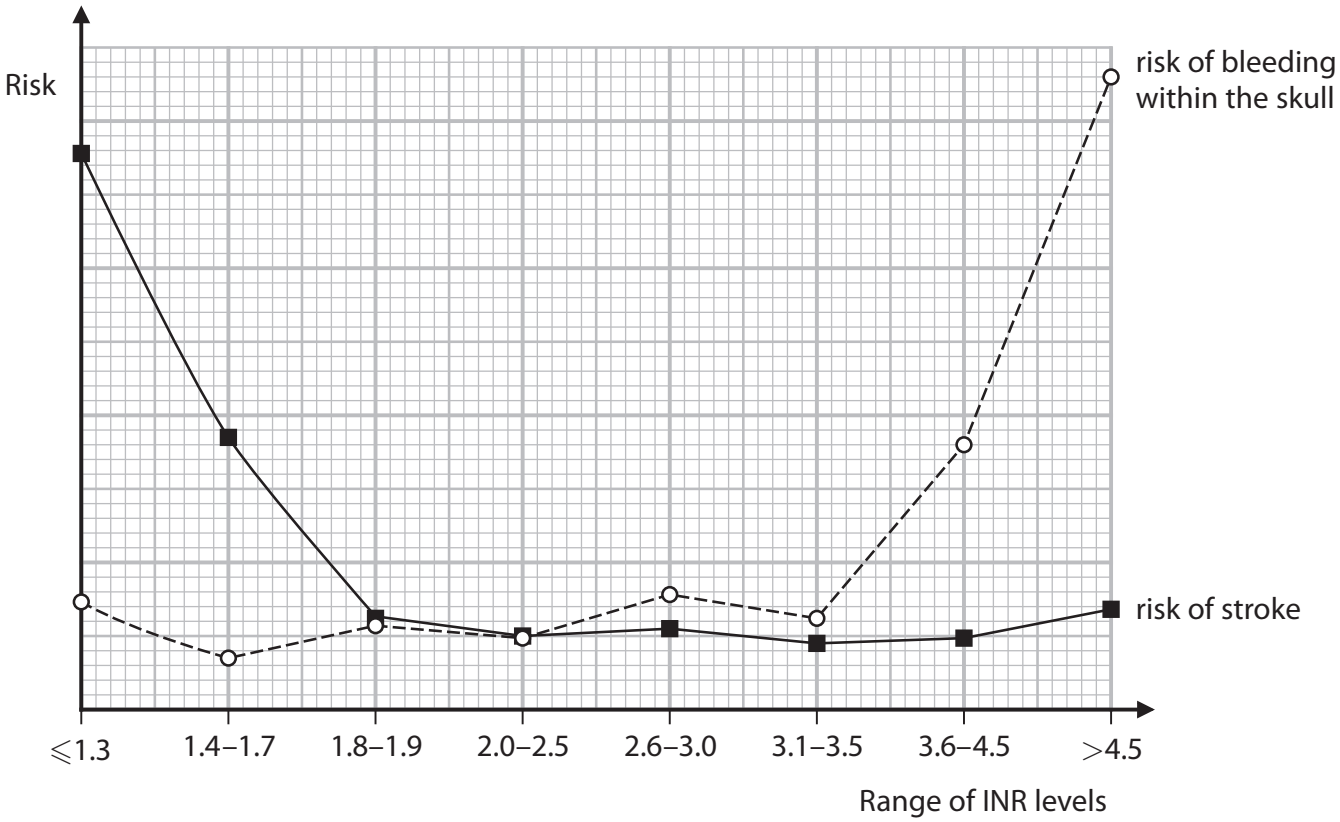
☒ **A** none

☒ **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)

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

(3)

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

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

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

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

(1)

Answer .....

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

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

(4)

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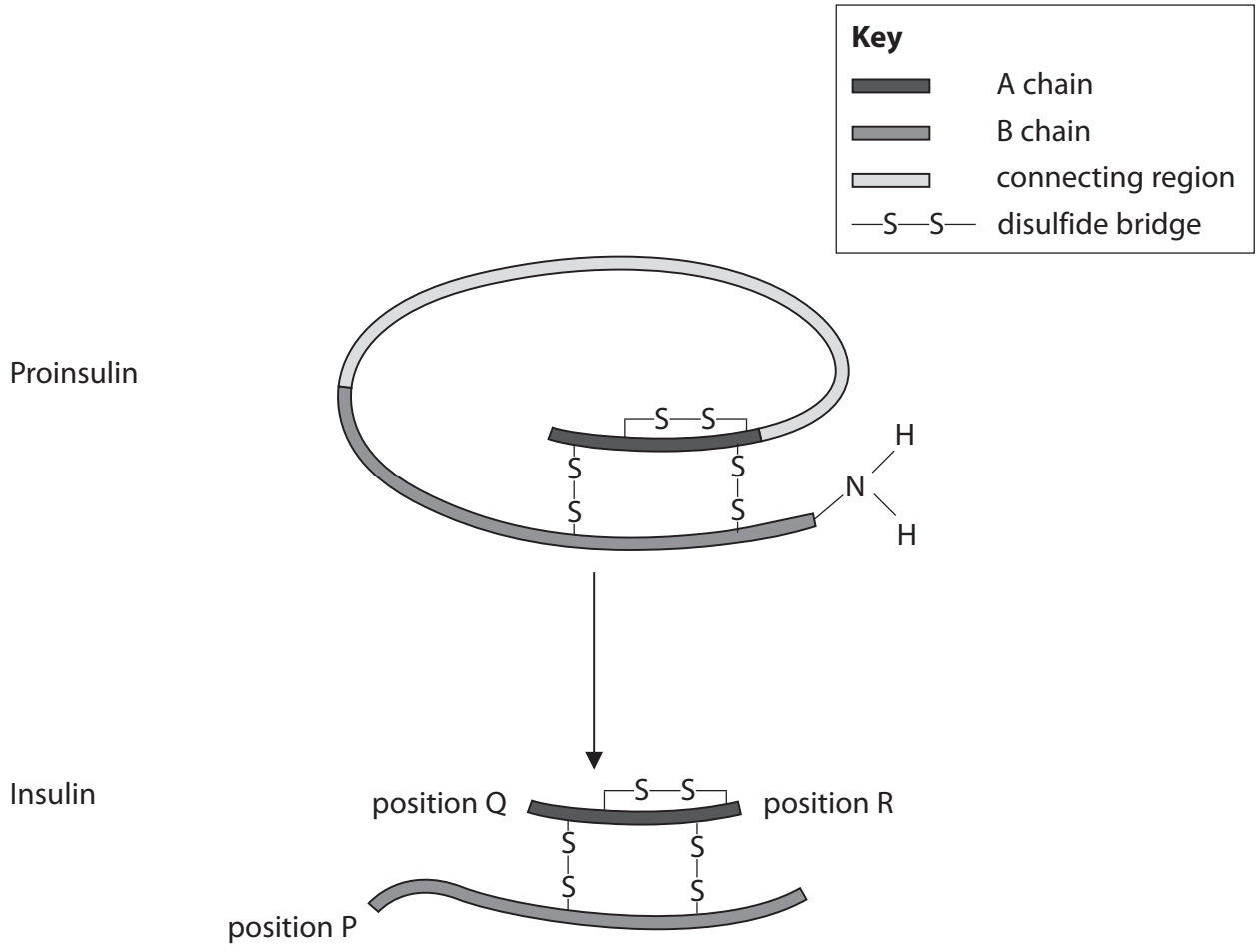
(Total for Question 6 = 12 marks)

7 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)

*(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.

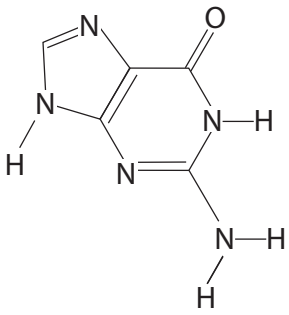
(6)

(Total for Question 7 = 14 marks)

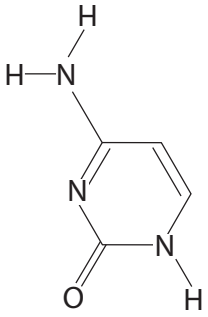
8 Mononucleotides are joined together to form DNA. Each mononucleotide is composed of a deoxyribose linked to a phosphate and one of four bases.

(a) The diagrams show the structure of the four bases.

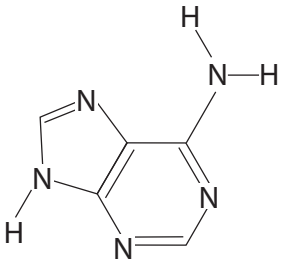
Guanine and adenine have two ring structures, cytosine and thymine have one ring structure.



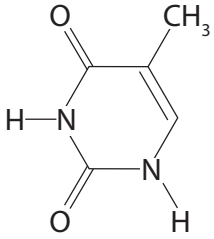
guanine



cytosine



adenine



thymine

Explain the role of these bases in the structure of DNA.

Use the information in the diagram to support your answer.

(3)

(b) The DNA of the bacterium *E. coli* has a mass of 3.1×10^9 daltons (Da) and consists of 4.7×10^6 base pairs.

(i) Calculate the mean mass of a base pair.

Express your answer in standard form.

(1)

Answer ..... Da

(ii) Calculate the total mass of DNA produced after three cell divisions.

Give your answer in grams, where 1 dalton = 1.67×10^{-24} grams.

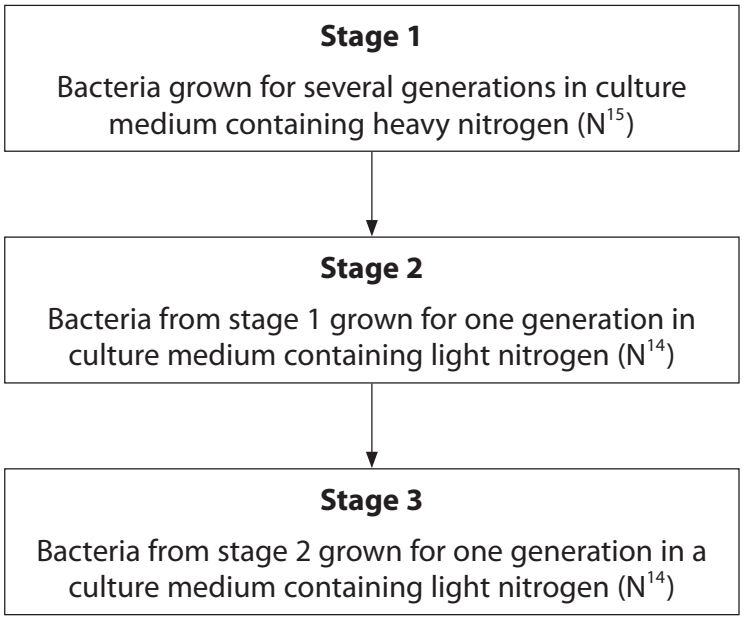
(2)

Answer ..... g

(c) Meselson and Stahl provided data that supported the theory that DNA replicates by semi-conservative replication and disproved competing theories.

Heavy nitrogen (N^{15}) and light nitrogen (N^{14}) were used in their experiments.

The flow chart summarises part of one experiment performed by Meselson and Stahl.



After each stage, a sample of DNA was taken from the bacteria and the DNA molecules separated on a density gradient in a tube.

The heavier DNA molecules form bands lower down the gradient than the lighter DNA molecules.

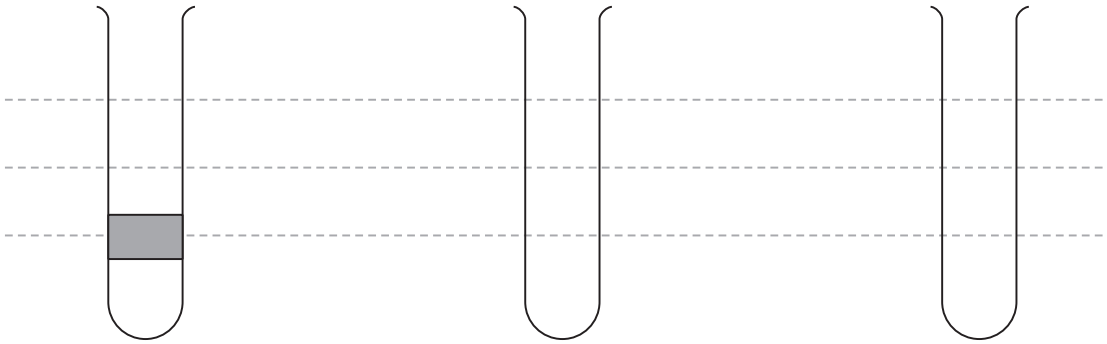
The width of each band is proportional to the percentage of molecules in the sample.

(i) Complete the diagram to show the results of this investigation.

Use the dotted lines to help you position the bands on the diagram.

The first one has been done for you.

(3)



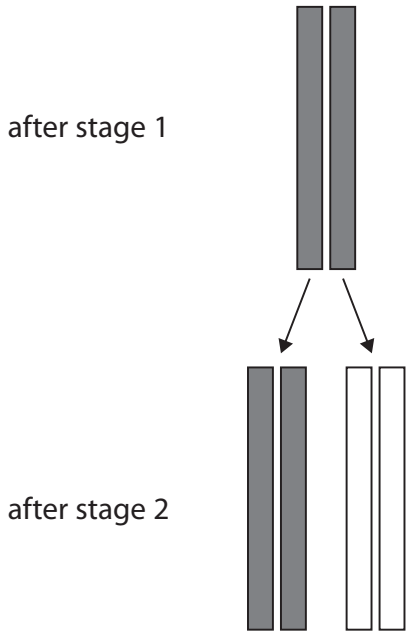
DNA taken after stage 1

DNA taken after stage 2

DNA taken after stage 3

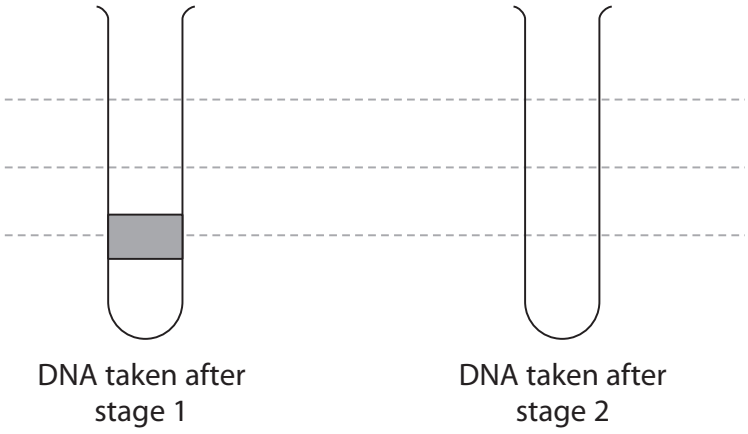
(ii) One competing theory was the conservative theory.

The diagram shows the conservative theory for the replication of DNA.



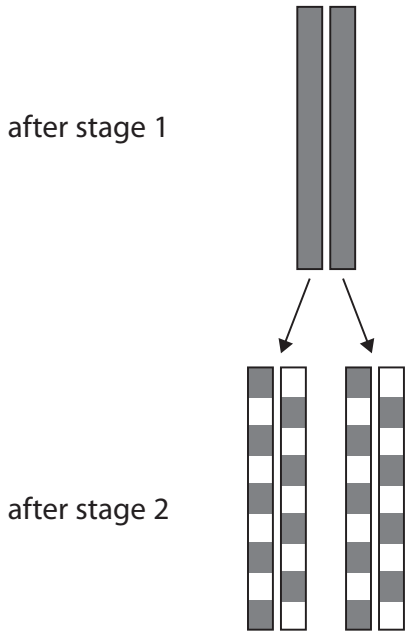
Complete the diagram to show the position of the bands on the density gradient in a tube if this was the correct theory.

(2)



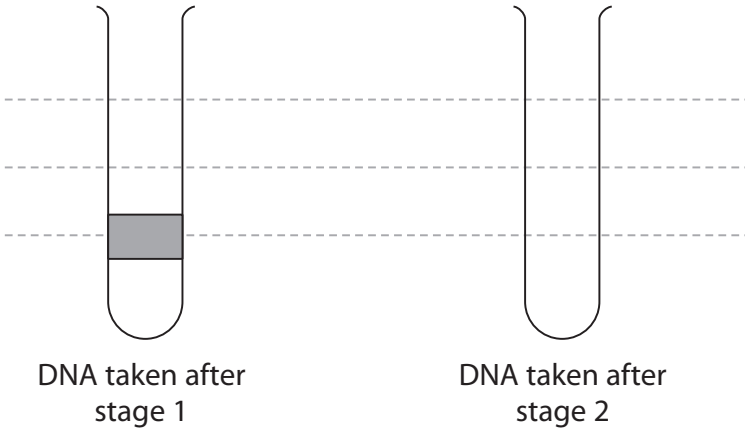
(iii) Another competing theory was the dispersive theory.

The diagram shows the dispersive theory.



Complete the diagram to show the position of the bands on the density gradient in a tube if this was the correct theory.

(2)



(Total for Question 8 = 13 marks)

TOTAL FOR PAPER = 80 MARKS

Please check the examination details below before entering your candidate information

Candidate surname	Other names

Centre Number | Candidate Number

Pearson Edexcel International Advanced Level

Time 1 hour 30 minutes

Paper reference **WBI11/01**

Biology

January 2023

Advanced Subsidiary

UNIT 1: Molecules, Diet, Transport and Health

You must have:
Scientific calculator, ruler, HB pencil

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided – *there may be more space than you need.*
- Calculators may be used.
- You must **show all your working out** with **your answer clearly identified** at the **end of your solution**.

Information

- The total mark for this paper is 80.
- The marks for **each** question are shown in brackets – *use this as a guide as to how much time to spend on each question.*
- The marks available for spelling, punctuation and grammar are clearly indicated.
- In questions marked with an **asterisk** (*), marks will be awarded for your ability to structure you're answer logically, showing how the points you make are related or follow on from each other where appropriate.

Advice

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

Turn over ▶

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J:1/1/1/1/1/

P 7 1 8 6 8 A 0 1 3 2

Pearson

Answer ALL questions. Write your answers in the spaces provided.

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

1 Water and carbohydrates are molecules found in all living organisms.

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

(2)

(b) The table gives some statements about carbohydrates.

For each statement, put **one** cross in the appropriate box in each row to match the statement to the correct carbohydrates.

(3)

Statement	Carbohydrates			
	both monosaccharides and polysaccharides	**monosaccharides only**	**polysaccharides only**	**neither monosaccharides nor polysaccharides**
Have the general formula $C_nH_{2n}O_n$	☒	☒	☒	☒
Have glycosidic bonds	☒	☒	☒	☒
Have little effect on water potential	☒	☒	☒	☒

(Total for Question 1 = 5 marks)

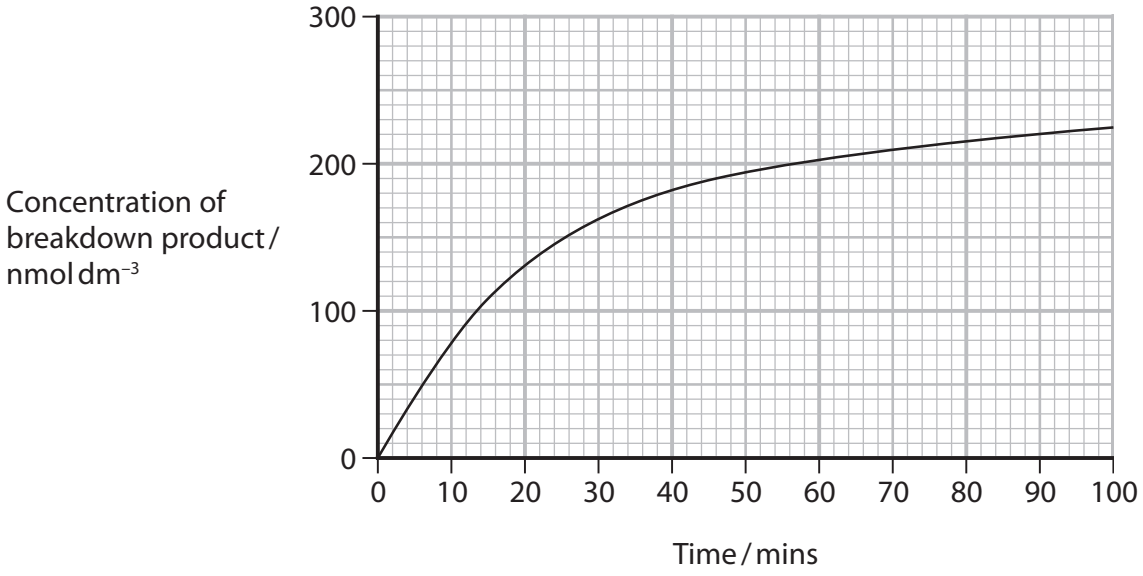
2 Elastin and collagen are proteins found in connective tissue.

(a) Describe the structure of collagen.

(3)

(b) Proteases are enzymes that break down proteins.

The graph shows the effect of a protease solution on a sample of elastin.



(i) Calculate the rate of reaction at 30 minutes.

Draw a tangent to help with your calculation.

(2)

Answer ..... nmol dm^{-3} min^{-1}

(ii) Explain how a protease breaks down elastin.

(3)

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(Total for Question 2 = 8 marks)

3 Cystic fibrosis results from mutations in the CFTR gene.

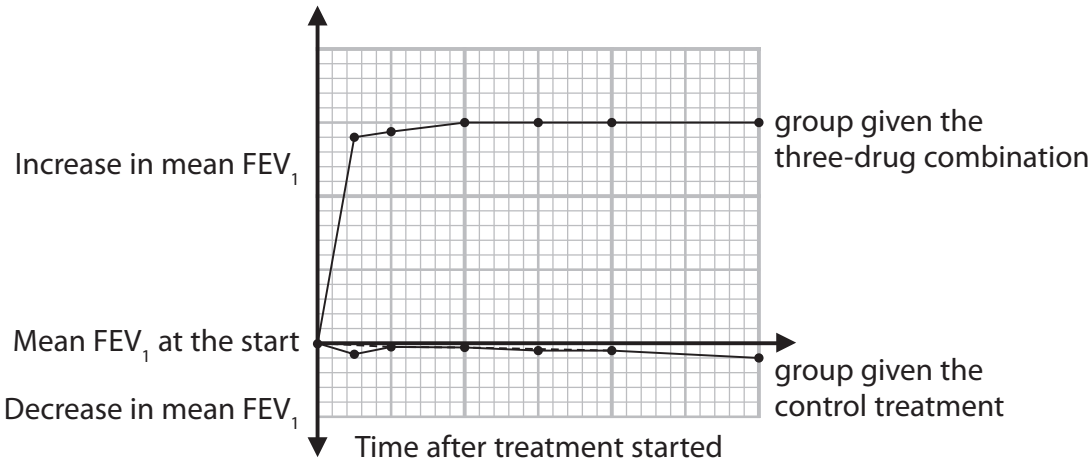
Mutations may occur at a number of positions within the gene, resulting in a range of clinical symptoms and severity of cystic fibrosis.

The effect of combining three different drugs to treat people with cystic fibrosis was investigated.

People with cystic fibrosis were divided into two groups. One group was given the three-drug combination and the other group was given a control treatment.

The volume of air each person could forcefully blow out in one second (FEV_1) was measured.

The graph shows the results of this investigation.



(a) Explain why the change in mean FEV_1 was used in this investigation.

(3)

(b) Explain why the results of this investigation **do not** show that this treatment is more effective than using each drug on its own.

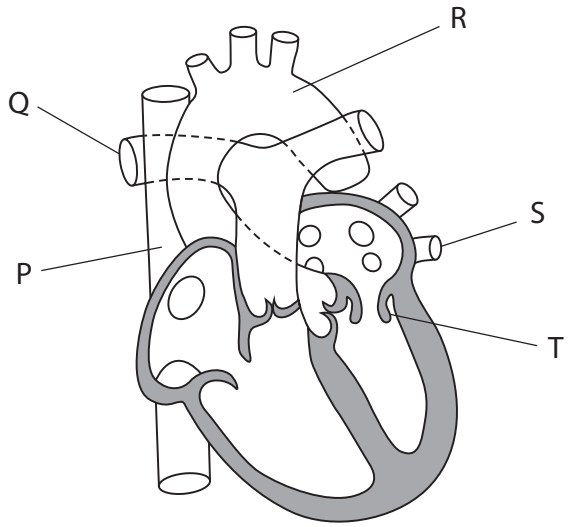
(2)

(c) Suggest why a combination of drugs could be more effective in treating people with cystic fibrosis than each drug used on its own.

(2)

(Total for Question 3 = 7 marks)

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



(i) How many of the following are correct for blood vessel P?

(1)

- carries blood to the heart
- has valves along its length
- has an endothelial lining

☒ **A** 0

☒ **B** 1

☒ **C** 2

☒ **D** 3

(ii) Why is blood vessel Q classified as an artery?

(1)

☒ **A** because it carries deoxygenated blood

☒ **B** because it carries oxygenated blood

☒ **C** because it carries blood away from the heart

☒ **D** because it carries blood back to the heart

(iii) Which blood vessel does the coronary artery branch from?

(1)

- ☒ **A** P
- ☒ **B** Q
- ☒ **C** R
- ☒ **D** S

(iv) When in the cardiac cycle is valve T open?

(1)

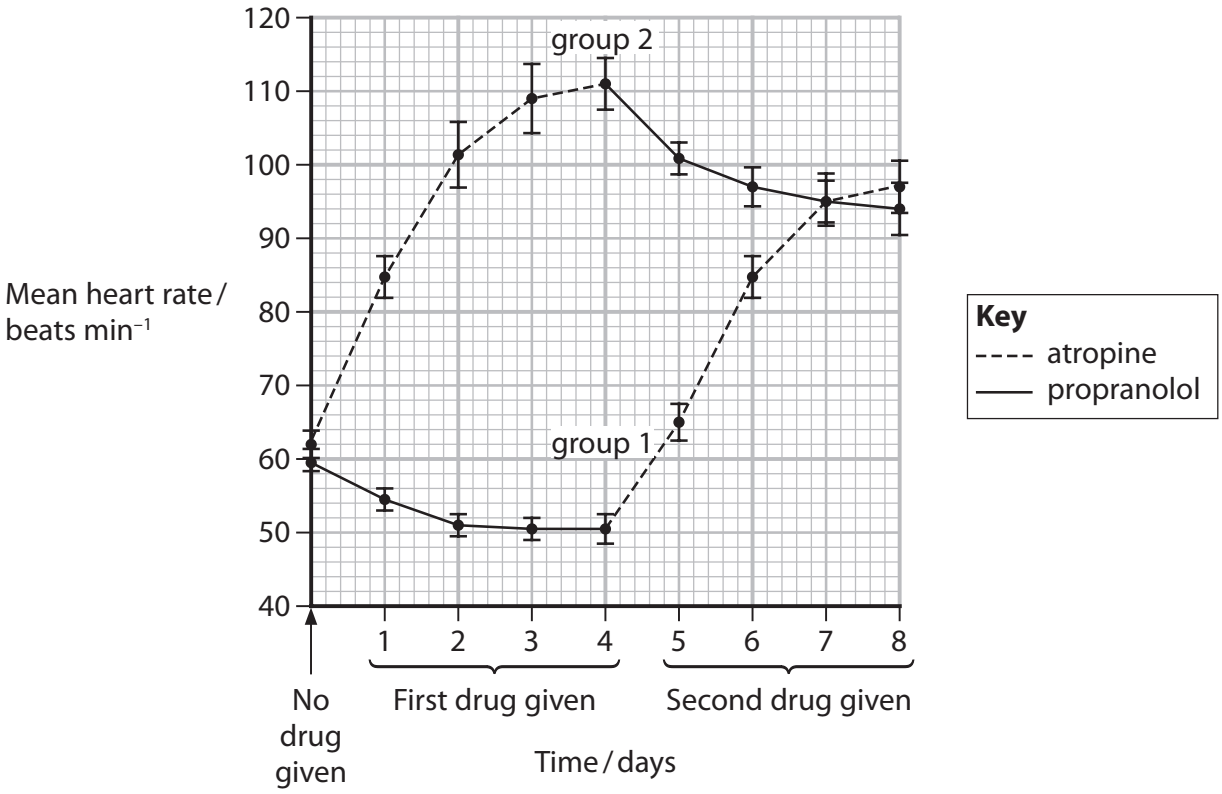
- ☒ **A** atrial systole and cardiac diastole
- ☒ **B** atrial systole only
- ☒ **C** cardiac diastole and ventricular systole
- ☒ **D** ventricular systole only

(b) The effect of atropine and propranolol on heart rate was investigated.

One group of people, group 1, were given propranolol each day for four days followed by atropine for four days.

A second group of people, group 2, were given atropine each day for four days followed by propranolol for four days.

The graph shows the results of this investigation.



(i) Calculate the change in mean heart rate for group 2 after 8 days.

(1)

Answer ..... beats min^{-1}

(ii) Calculate the mean length of the cardiac cycle for group 2 on day 4.

(1)

Answer ..... seconds

(iii) Comment on the conclusions that can be drawn from this investigation.

(3)

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(Total for Question 4 = 9 marks)

5 The Portfolio diet is a diet that has been shown to lower low-density lipoproteins (LDLs) and other risk factors of cardiovascular disease (CVD).

(a) (i) Which row in the table describes the cholesterol content and antioxidant content of this diet?

(1)

		Cholesterol content	Antioxidant content
☒	**A**	high	high
☒	**B**	high	low
☒	**C**	low	high
☒	**D**	low	low

(ii) Name **two** other dietary risk factors that could be changed in this diet.

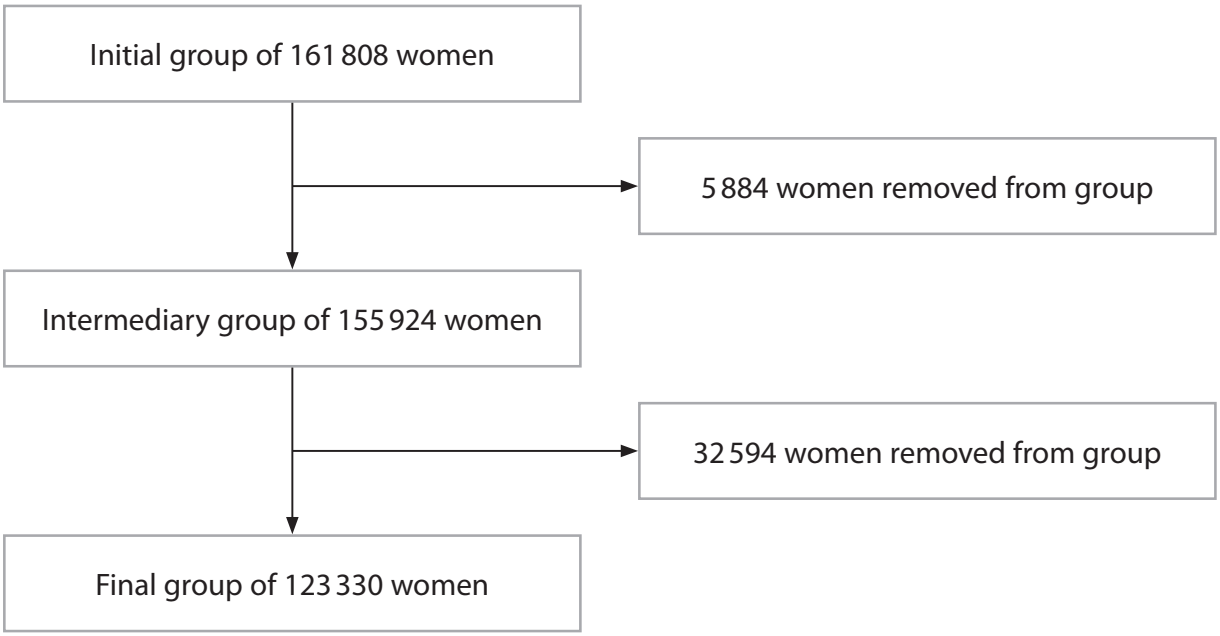
(1)

1 .....

2 .....

(b) The effect of this diet on the development of CVD in women was investigated.

The diagram shows how 123 330 women were selected from an initial group of 161 808 women.



(i) Some of the women were removed from the initial group because there was information missing about their lifestyles.

Suggest why women with missing lifestyle information were removed from the initial group.

(1)

.....

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(ii) Some of the women were removed from the initial group because they gave unrealistic estimates of their daily energy intake.

Give **two** reasons why some women may have given unrealistic estimates of their daily energy intake.

(2)

1 .....

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2 .....

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.....

(iii) The women removed from the intermediary group had signs of CVD.

Explain why these women were removed from this investigation.

(2)

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.....

(iv) Calculate the percentage of all the women removed from this investigation.

(1)

Answer ..... %

(c) Explain why a diet that is low in saturated fat is likely to reduce the risk of CVD.

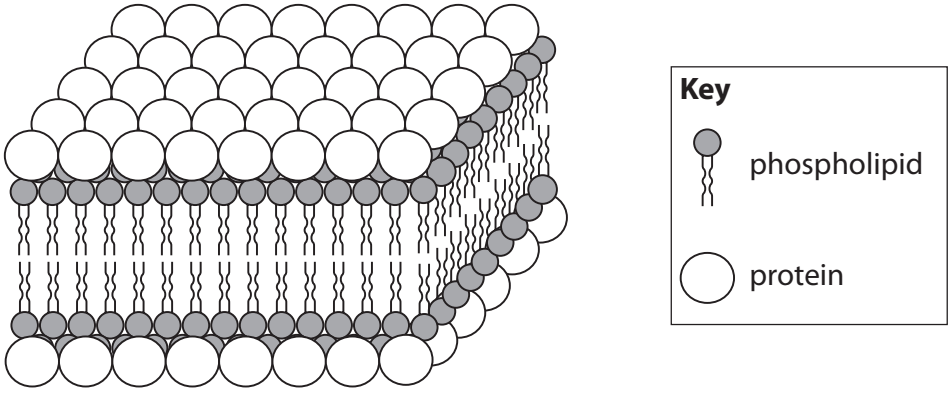
(3)

(Total for Question 5 = 11 marks)

6 The fluid mosaic model of membrane structure was developed to explain the structure and properties of cell membranes.

(a) One model of membrane structure was developed by Davson and Danielli.

The diagram shows the Davson–Danielli model.



(i) Which describes a phospholipid?

(1)

☒ **A** hydrophilic fatty acid head and hydrophobic phosphate tails

☒ **B** hydrophilic phosphate head and hydrophobic fatty acid tails

☒ **C** hydrophobic fatty acid head and hydrophilic phosphate tails

☒ **D** hydrophobic phosphate head and hydrophilic fatty acid tails

(ii) Compare and contrast the structure of the model shown in the diagram with that of the fluid mosaic model of membrane structure.

(4)

(b) The cell membrane is important to the cell and if it gets damaged the cell could die.

(i) Suggest how damage to the cell membrane could result in cell death.

(2)

(ii) Cells can repair damage to the cell membrane.

This involves fusion of parts of the membrane around the edge of the damage.

Explain why parts of the membrane are able to fuse together to repair the damage.

(2)

(iii) Once the membrane has fused together, other processes are needed to complete the repair of the membrane.

Suggest what else the cell needs to do to complete this repair.

(2)

(Total for Question 6 = 11 marks)

7 The photograph shows a yak.

(Source: Zoonar GmbH / Alamy Stock Photo)

Yaks are cattle that live at high altitudes, such as in the Himalayas.

They are well-adapted for the low temperatures and low levels of oxygen in the air.

These adaptations include:

- a thick layer of fat below the skin
- large lungs and a large heart
- many small red blood cells
- presence of fetal haemoglobin throughout their adult life.

(a) Triglycerides are fats.

Describe the structure of a triglyceride.

(2)

(b) Explain why large lungs and a large heart would help a yak to survive at high altitudes.

(3)

(c) The table shows some characteristics of the blood of yaks and the blood of humans.

Characteristic of blood	Blood of yaks	Blood of humans
Concentration of red blood cells / cells dm^{-3}	1.0×10^{13}	4.0×10^{6} to 6.0×10^{6}
Volume of one red blood cell / fl	43	90
Concentration of haemoglobin / g dm^{-3}	136	12 to 18

(i) The unit given for the volume of a red blood cell is a femtolitre (fl).

1 fl = 1.0×10^{-15} dm^3

Give the volume of a red blood cell of a yak in cm^3.

Express your answer in standard form.

(1)

Answer ..... cm^3

(ii) The diagram gives some information about two spheres, sphere A and sphere B.

- sphere A has a surface area : volume ratio of 1 : 1.3
- sphere B has a surface area of 768 mm^2

Calculate the surface area : volume ratio of sphere B.

Use the formula:

$$\text{Volume} = \frac{4}{3}\pi r^3$$

where $\pi = 3.0$

(2)

Answer .....

*(iii) Discuss why the blood of yaks enables these animals to live at high altitudes.

Use all the information in this question to support your answer.

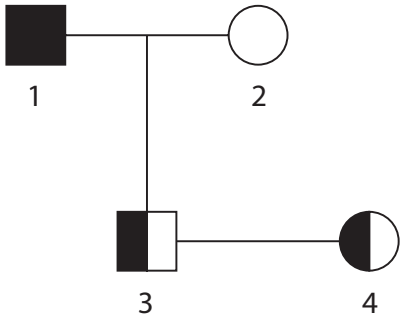
(6)

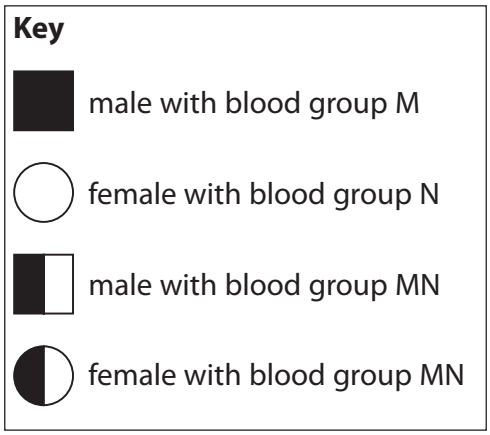
(Total for Question 7 = 14 marks)

8 Red blood cells have a number of different groups of proteins on the cell surface membrane.

The inheritance of some of these groups of proteins is an example of codominance.

The pedigree diagram shows the blood type of individuals in part of one family. Individuals 1 and 2 are both homozygous for blood type.





(a) Explain why the inheritance of blood type, shown in this diagram, is an example of codominance.

(2)

(b) Determine the ratio of the possible blood type phenotypes of the children of individuals 3 and 4.

You must draw a genetic diagram.

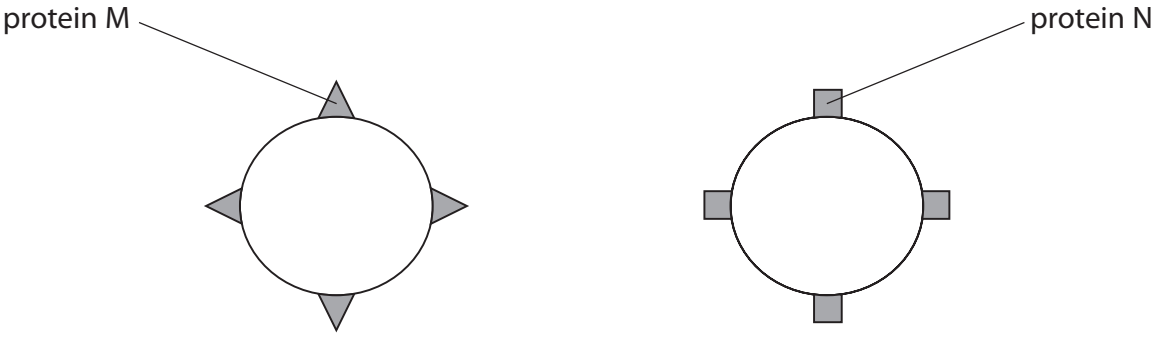
(4)

Genetic diagram:

Ratio.....

(c) The gene that determines this blood type codes for proteins present on the cell membranes of red blood cells.

The diagram shows red blood cells from two members of the family shown in the pedigree diagram.



Individual **1** Individual **2**

(i) Explain how the alleles present in individual **3** result in the proteins found on the surfaces of his red blood cells.

(3)

*(ii) Discuss the possible effects that a mutation in one of the genes coding for this blood type could have on the phenotype of individual **3**.

(6)

(Total for Question 8 = 15 marks)

TOTAL FOR PAPER = 80 MARKS

Please check the examination details below before entering your candidate information

Candidate surname	Other names

Centre Number | Candidate Number

Pearson Edexcel International Advanced Level

Monday 8 May 2023

Morning (Time: 1 hour 30 minutes)

Paper reference **WBI11/01**

Biology

Advanced Subsidiary/Advanced Level

UNIT 1: Molecules, Diet, Transport and Health

You must have:
Scientific calculator, ruler, HB pencil

Total Marks

Instructions

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

Information

- The total mark for this paper is 80.
- The marks for **each** question are shown in brackets – *use this as a guide as to how much time to spend on each question.*
- Questions labelled with an **asterisk** (*) are ones where the quality of your written communication will be assessed – you should take particular care on these questions with your spelling, punctuation and grammar, as well as the clarity of expression.

Advice

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

Turn over ▶

P71934A

P 7 1 9 3 4 A 0 1 2 8

Pearson

Answer ALL questions.

Write your answers in the spaces provided.

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

1 Messenger RNA (mRNA) and transfer RNA (tRNA) are involved in protein synthesis.

(a) The diagram shows the sequence of bases in part of a DNA template (antisense) strand and the mRNA molecule formed during protein synthesis.

DNA template strand	A	T	G	C	C	G	T	T
mRNA								

(i) Complete the diagram to show the sequence of bases in this mRNA.

(1)

(ii) Name this stage of protein synthesis.

(1)

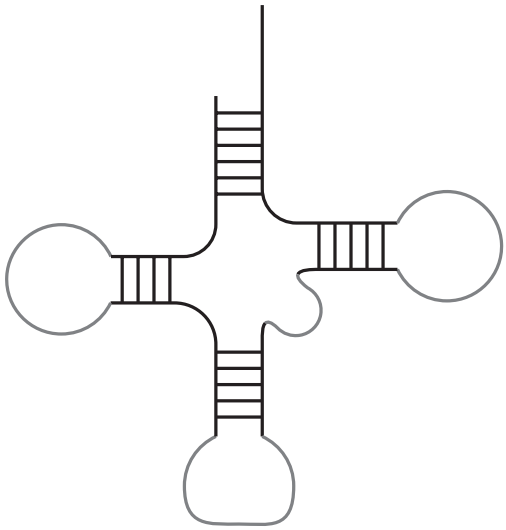
.....

(iii) Name the enzyme used in this stage of protein synthesis.

(1)

.....

(b) The diagram shows part of a tRNA molecule.

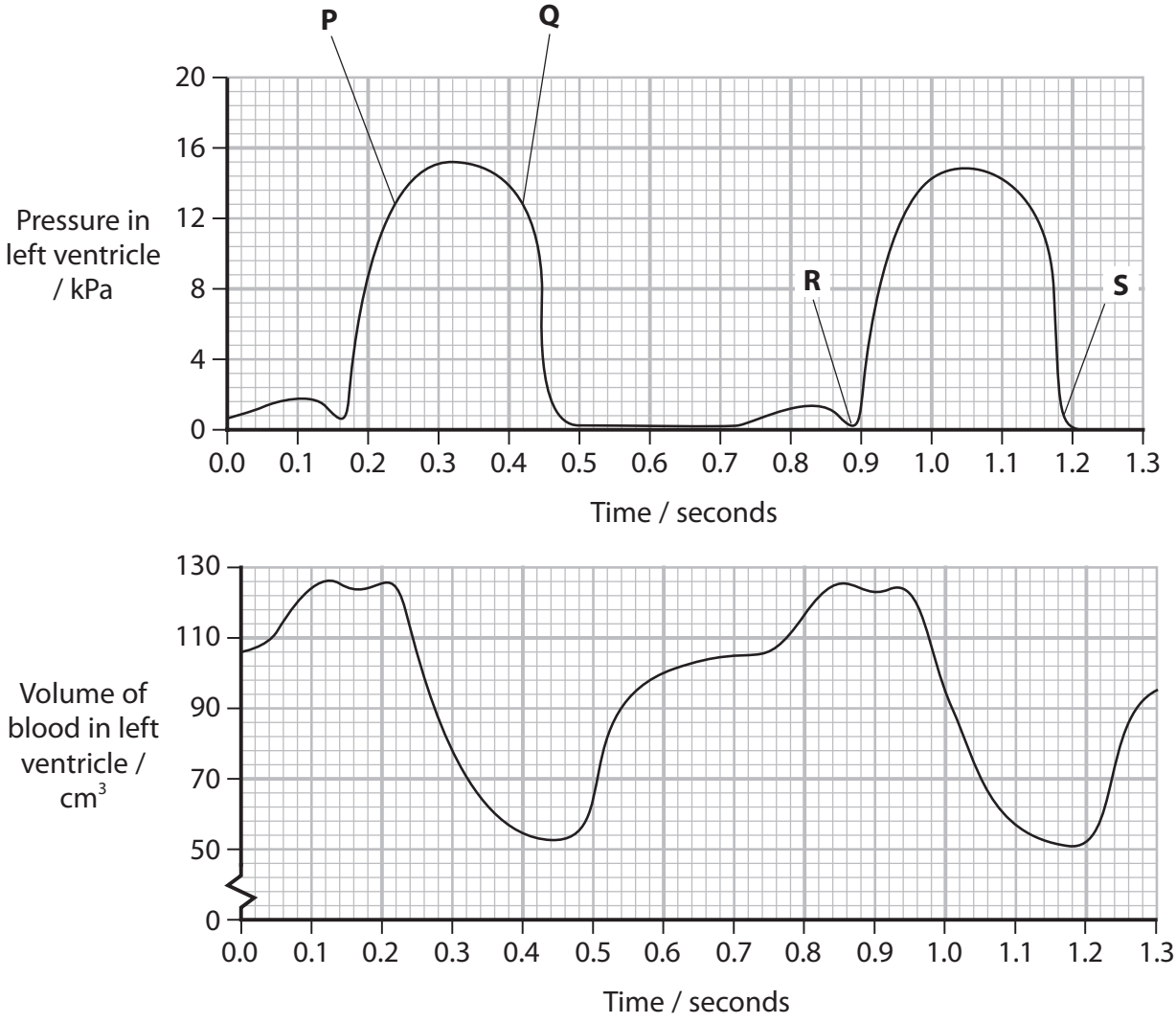


Compare and contrast the structure of an mRNA molecule with that of a tRNA molecule.

(3)

(Total for Question 1 = 6 marks)

2 The graphs show how the pressure and volume of blood in the left ventricle change during the cardiac cycle.



(a) Which letter indicates when the atrioventricular (mitral) valves close?

(1)

- ☒ **A** P
- ☒ **B** Q
- ☒ **C** R
- ☒ **D** S

(b) Calculate the time for one cardiac cycle.

(1)

Answer ..... seconds

(c) The volume of blood in the left ventricle changes during the cardiac cycle.

Explain these changes.

(3)

(Total for Question 2 = 5 marks)

3 Sucrose is a disaccharide made from glucose and fructose.

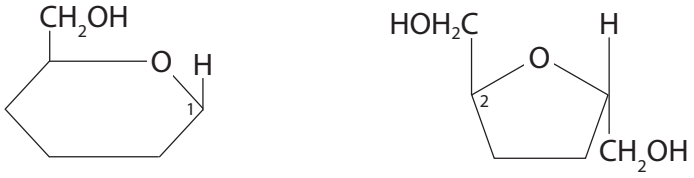
Glucose is joined to fructose by a 1–2 glycosidic bond.

(a) (i) The diagram shows a molecule of glucose and a molecule of fructose.

Carbon 1 on the glucose and carbon 2 on the fructose are numbered.

Complete the diagram to show a glycosidic bond between the glucose molecule and the fructose molecule.

(1)



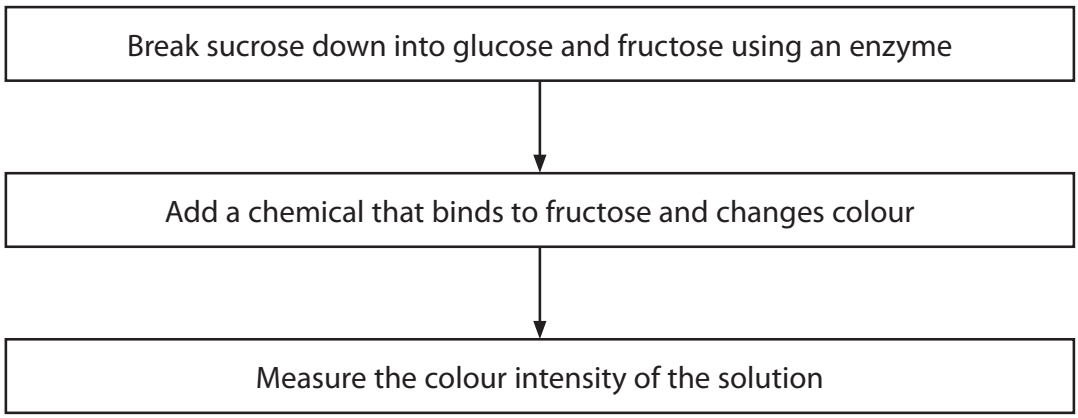
(ii) Complete the formula equation for the reaction that makes sucrose from glucose and fructose.

(2)

$C_6H_{12}O_6 + C_6H_{12}O_6 \longrightarrow$

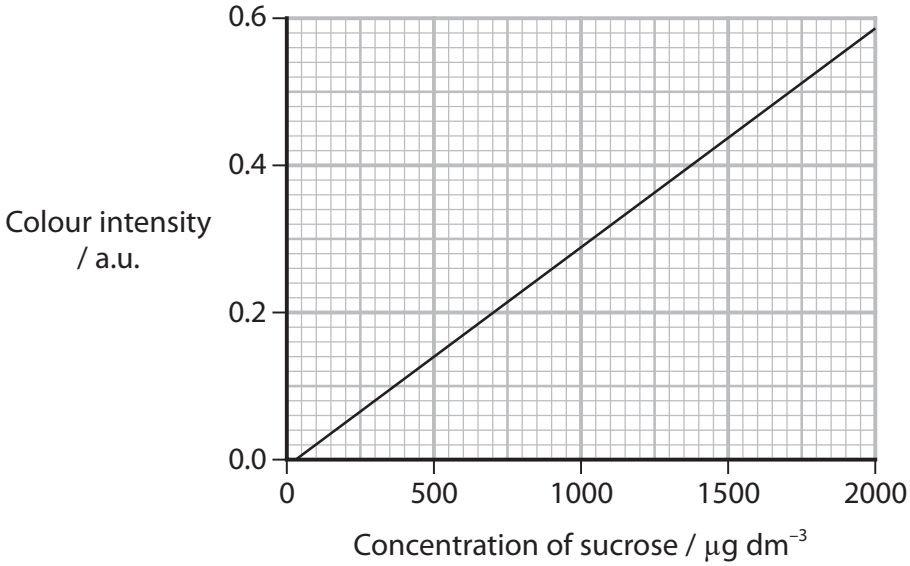
(b) The concentration of sucrose in a solution can be determined by a test.

The chart shows the steps involved in this test.



The colour intensity is directly proportional to the concentration of sucrose.

The graph shows this relationship.



(i) Give a reason why the colour intensity is directly proportional to the concentration of sucrose.

(1)

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(ii) Suggest why the line does not start at the origin of the graph.

(1)

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(iii) State why the concentration of maltose and lactose cannot be measured using this test.

(1)

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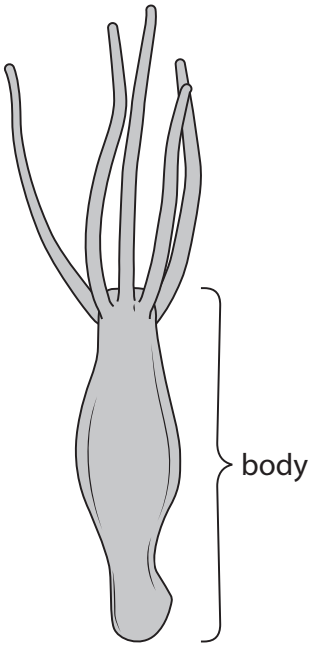
(Total for Question 3 = 6 marks)

4 Hydra are small animals that live in water.

They have a cylindrical body.

The drawing shows a hydra.



(a) This hydra has a body length of 1.8 mm and a diameter of 1 mm.

(i) Which is the magnification of this drawing?

(1)

☒ **A** 3.75×10^{-2}

☒ **B** 3.75×10^{-1}

☒ **C** 2.67×10^{0}

☒ **D** 2.67×10^{1}

(ii) Which is the surface area, in mm^2, of this hydra?

Use the formula:

surface area = $2\pi rl$

(1)

☒ **A** 0.9π

☒ **B** 1.8π

☒ **C** 3.6π

☒ **D** 5.4π

(iii) Another hydra has a surface area of $2.3\pi\,mm^2$, a body length of 1.8 mm and a diameter of 1.2 mm.

Calculate the surface area to volume ratio of this hydra.

Use the formula:

volume = $\pi r^2 l$

(2)

Answer .....

(b) A hydra has a hollow body that is made up of two layers of cells.

Explain how a hydra is adapted for gas exchange.

(3)

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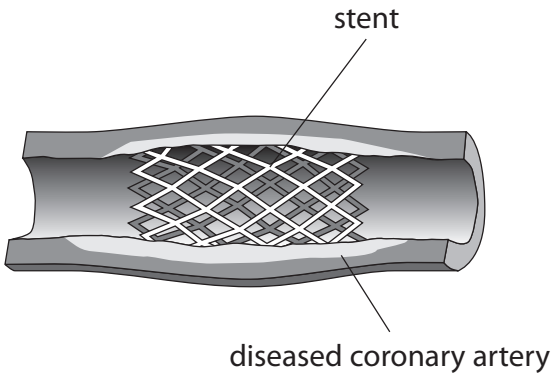
(Total for Question 4 = 7 marks)

5 Stents are used in the treatment of atherosclerosis.

Stents widen the diseased coronary artery so that blood can flow through to the heart muscle.

The diagram shows a stent.



Stents can damage the endothelial cells lining the artery and trigger the formation of a blood clot.

Patients who have a stent fitted are given anticoagulants.

(a) Explain how damage to the endothelial cells results in the formation of thrombin.

(2)

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(b) Give **one** risk of treating patients with anticoagulants.

(1)

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(c) The photograph shows a tropical bont tick.

(Source: © Phanie/Alamy Stock Photo)

This bont tick produces a peptide called variegin.

Variegin binds to the active site of thrombin and prevents blood clotting.

(i) Variegin is a peptide consisting of 32 amino acids.

Which is the minimum number of bases in the gene that codes for this peptide?

(1)

- ☒ **A** 32
- ☒ **B** 33
- ☒ **C** 96
- ☒ **D** 99

(ii) Explain how variegin prevents blood clotting.

(2)

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(iii) Thrombin slowly splits variegin into two molecules.

Explain how thrombin splits variegin.

(2)

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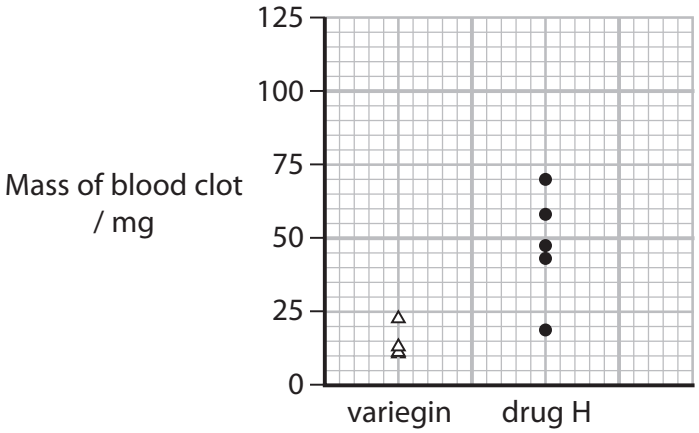
(iv) The effect of variegin on the mass of blood clots forming inside a stent was investigated.

The masses were compared with another anticoagulant, drug H.

The graph shows the results of this investigation.

Each plotted point represents the mass of blood clot in one stent.



Comment on the results of this investigation.

(2)

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(Total for Question 5 = 10 marks)

6 Insects and other invertebrates are a good source of protein, unsaturated fatty acids, iron and other nutrients.

Recent research has shown that some insects and other invertebrates have a high antioxidant content.

(a) How many of the following statements are true for proteins?

- Proteins contain only the elements carbon, hydrogen and nitrogen.
- Proteins can be made of more than one polypeptide chain.
- Proteins contain hydrogen bonds.

(1)

☒ **A** 0

☒ **B** 1

☒ **C** 2

☒ **D** 3

(b) Which row of the table is correct for an unsaturated fatty acid?

(1)

	Contains carbon–carbon double bonds	Carbon : hydrogen ratio compared with a saturated fatty acid is
☒ **A**	no	lower
☒ **B**	no	higher
☒ **C**	yes	lower
☒ **D**	yes	higher

(c) Name **one** organic molecule that contains iron.

(1)

.....

(d) Explain why dietary antioxidants are important.

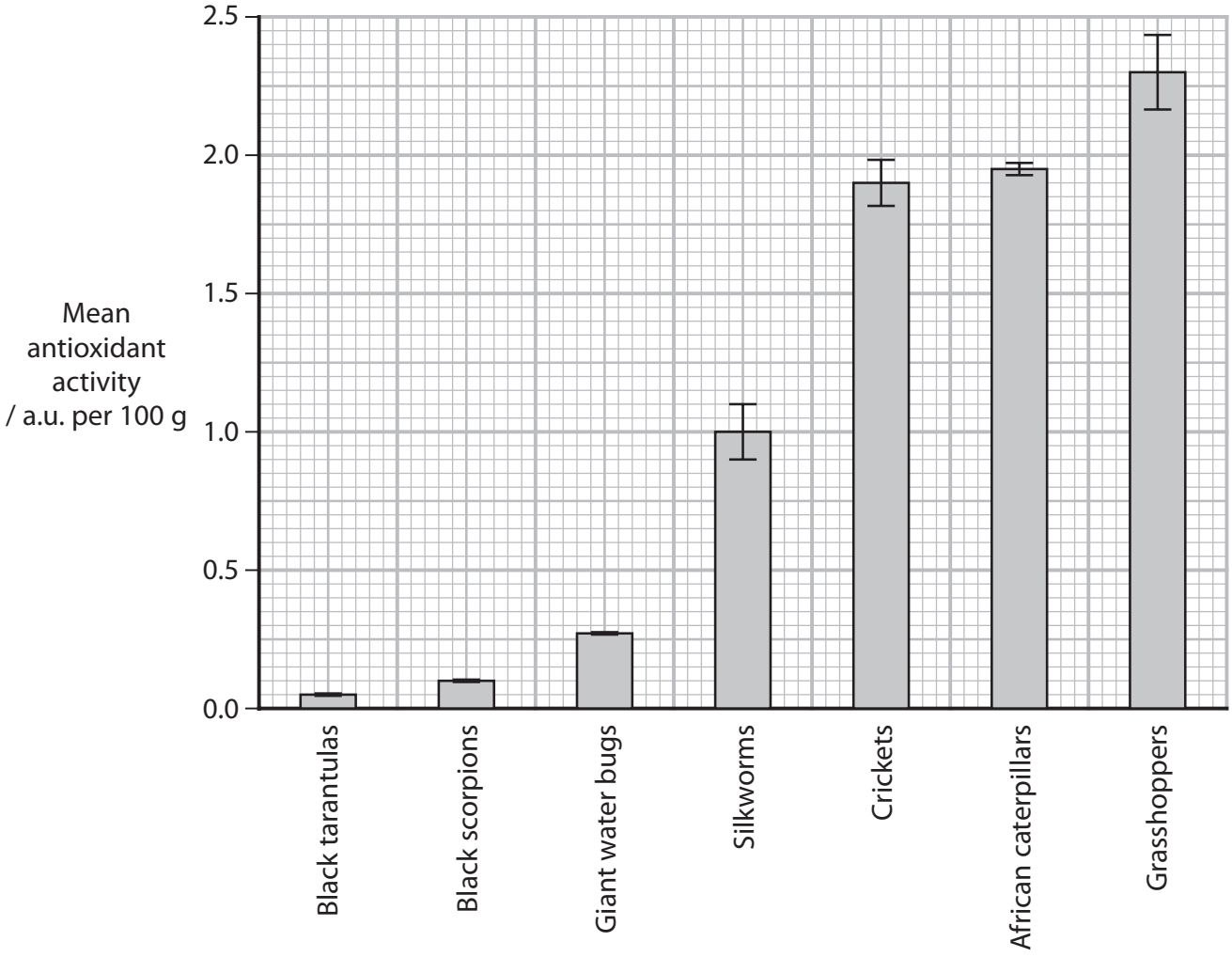
(4)

(e) The antioxidant activity of some insects and arachnids was investigated.

The table shows the dietary habits of the organisms used in this investigation.

Name of organism	Type of organism	Dietary habits
Black tarantulas	arachnid	eat animals
Black scorpions	arachnid	eat animals
Giant water bugs	insect	eat animals
Silkworms	insect	eat plants
Crickets	insect	eat plants
African caterpillars	insect	eat plants
Grasshoppers	insect	eat plants

The graph shows the mean antioxidant activity of extracts made from these organisms.



(i) The antioxidant activity of orange juice is 0.80 a.u. per 100 g.

Calculate how many times more antioxidant activity there is in 100 g of grasshopper extract.

Give your answer to two significant figures.

(1)

Answer .....

(ii) Calculate the percentage difference between the antioxidant activity in black scorpions and crickets.

(1)

Answer ..... %

(iii) Comment on the results of this investigation.

Use the information in the table and the graph to support your answer.

(3)

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(Total for Question 6 = 12 marks)

7 Prenatal testing is used to screen for genetic disorders in developing embryos.

(a) Phenylketonuria (PKU) is one genetic disorder that is screened for by prenatal testing.

This disorder is inherited in a similar way to cystic fibrosis.

Explain why a healthy couple might choose to have a prenatal test for PKU.

Draw a genetic diagram in your answer.

(4)

*(b) A group of women, who had recently given birth to healthy babies, were asked about their opinions on screening for four different genetic disorders, A, B, C and D.

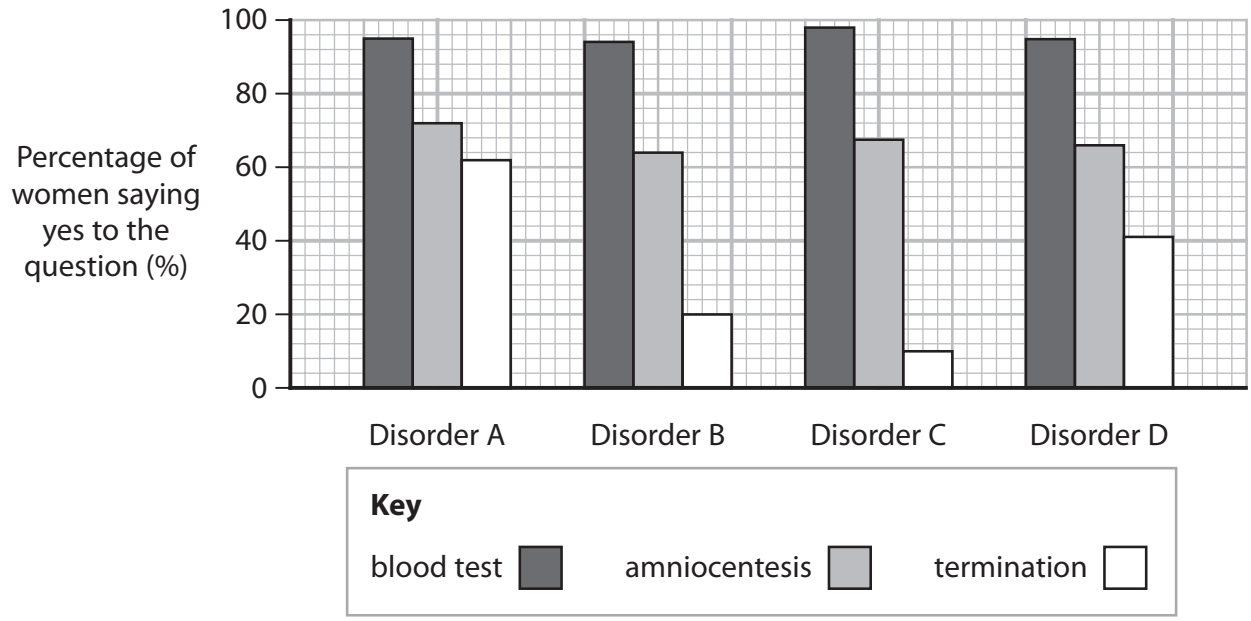
They were asked three questions about each disorder:

1 Would they be screened themselves with a blood test?

2 Would they have amniocentesis to screen for the genetic disorders?

3 Would they have a pregnancy termination (abortion) if an unborn child was found to have the genetic disorder?

The graph shows the percentage of women who said yes to each question for each disorder.



The table gives some information about each of these genetic disorders.

Genetic disorder	Information
A	muscles are weak and movement is difficult symptoms can be managed some types are lethal in childhood
B	treatable does not shorten life expectancy
C	treatable most individuals live into adulthood
D	intellectual disability medical care results in individuals leading healthy lives

Discuss the responses to the three questions.

(6)

(Total for Question 7 = 10 marks)

8 The risk of developing cardiovascular disease (CVD) is influenced by a number of factors.

Risk assessment calculators allow a person to calculate their own risk of developing CVD.

The person completes a questionnaire about their health and lifestyle. This information is then used to calculate the risk of the person developing CVD within the next ten years.

The table shows the information required by two different risk assessment calculators, RAC-1 and RAC-2.

Information	Information required by the calculators	
	RAC-1	RAC-2
Age	✓	✓
Blood pressure	✓	✓
Smoking	✓	x
Total cholesterol	✓	✓
HDL cholesterol	x	✓

(a) How many of the risk factors listed in the table are **not** influenced by lifestyle?

(1)

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

*(b) Explain the effectiveness of these two calculators in the assessment of risk and whether other factors should be considered.

(6)

(c) The calculators work out the risk of a person developing CVD in the next 10 years.

(i) Explain why the information entered by a person may lead to an underestimate of their 10-year risk of developing CVD.

(2)

(ii) Suggest why these two risk calculators may not be suitable for everybody to use.

(2)

(iii) Suggest why these risk calculators estimate the **10-year** risk of developing CVD.

(1)

(Total for Question 8 = 12 marks)

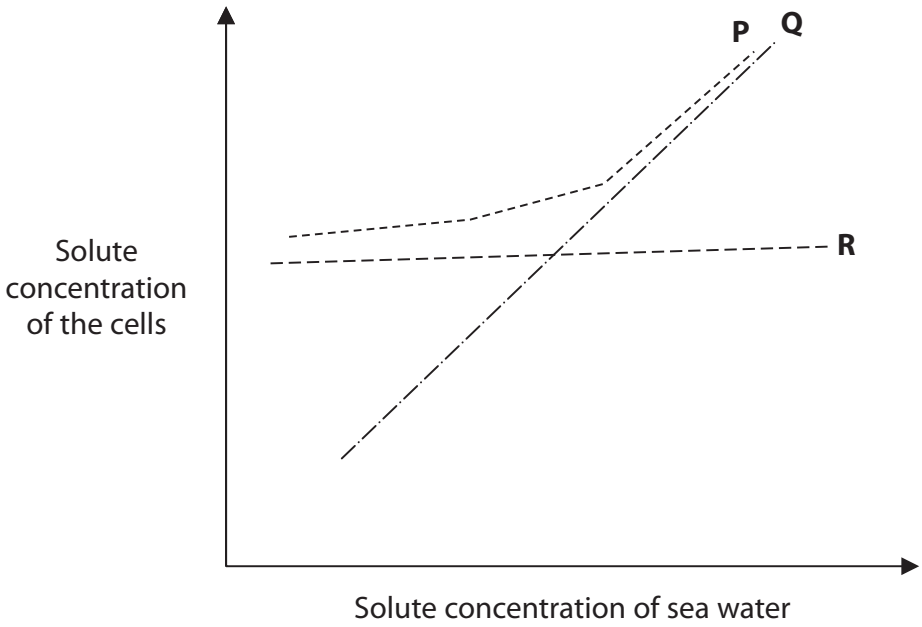
9 Some marine animals are osmoconformers and some are osmoregulators.

Strict osmoconformers have a cell solute concentration that matches the solute concentration of the sea water.

Partial osmoconformers have a cell solute concentration that varies with the solute concentration of the sea water.

Osmoregulators control the solute concentration of their cells when the solute concentration of sea water changes.

(a) The graph shows the solute concentration of the cells of three marine animals, P, Q and R.



(i) Which row in the table identifies the marine animals P, Q and R?

(1)

		P	Q	R
☒	**A**	partial osmoconformer	osmoregulator	strict osmoconformer
☒	**B**	partial osmoconformer	strict osmoconformer	osmoregulator
☒	**C**	osmoregulator	strict osmoconformer	partial osmoconformer
☒	**D**	strict osmoconformer	partial osmoconformer	osmoregulator

(ii) Explain the advantages for osmoconformers of having cells with solute concentrations similar to that of the sea water they live in.

(3)

(b) The table shows the concentration of ions in sea water and in some osmoconformers.

Location		Ion concentration / a.u.				
		sodium	**magnesium**	**calcium**	**potassium**	**chloride**
Sea water		478	55	11	10	558
Cells of osmoconformers	jellyfish	474	53	10	11	
	sea urchin	474	54	11	10	557
	lobster	541	9	12	8	552

(i) Estimate the chloride concentration of the cells of a jellyfish.

(1)

Answer ..... a.u.

(ii) Calculate the percentage difference in the concentration of magnesium ions in the lobster compared with the sea urchin.

Give your answer to two decimal places.

(2)

Answer ..... %

(iii) These three animals are osmoconformers even though they have different concentrations of each ion in their cells.

Explain why these three animals can be described as osmoconformers.

(2)

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(iv) Suggest why osmoconformers do not have the same concentration of each ion in their cells.

(1)

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(v) Energy is needed to maintain the concentration of ions inside the osmoconformers.

Explain what this energy is being used for.

(2)

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(Total for Question 9 = 12 marks)

TOTAL FOR PAPER = 80 MARKS

Please check the examination details below before entering your candidate information

Candidate surname	Other names

Centre Number | Candidate Number

Pearson Edexcel International Advanced Level

Monday 9 October 2023

Morning (Time: 1 hour 30 minutes)

Paper reference **WBI11/01**

Biology

Advanced Subsidiary/Advanced Level

UNIT 1: Molecules, Diet, Transport and Health

You must have:
Scientific calculator, ruler, HB pencil

Total Marks

Instructions

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

Information

- The total mark for this paper is 80.
- The marks for **each** question are shown in brackets – *use this as a guide as to how much time to spend on each question.*
- In questions marked with an **asterisk** (*), marks will be awarded for your ability to structure your answer logically, showing how the points that you make are related or follow on from each other where appropriate.

Advice

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

Turn over ▶

P75615A

P 7 5 6 1 5 A 0 1 2 8

Pearson

Answer ALL questions.

Write your answers in the spaces provided.

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

1 Nucleic acids include DNA and RNA.

(a) Read through the following passage about DNA.

Complete the passage by writing the most appropriate word or words on the dotted lines.

(5)

A strand of DNA is composed of mononucleotides linked

by ..... bonds formed during ..... reactions.

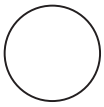
During this type of reaction a molecule of ..... is also formed.

One DNA molecule has two strands of DNA joined together

by ..... bonds between complementary base pairs.

The DNA molecule then twists to form a ..... .

(b) The table shows some components of DNA mononucleotides and RNA mononucleotides and shapes that can be used to represent them.

Component	Shapes
bond	
thymine	
uracil	
deoxyribose	
ribose	
phosphate	

Draw **one** DNA mononucleotide, using shapes selected from those shown in the table.

(3)

(Total for Question 1 = 8 marks)

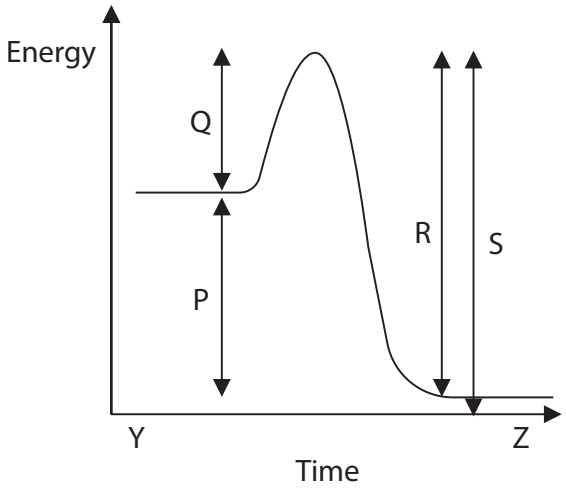
2 Polyphenol oxidase is an enzyme found in avocados.

This enzyme causes green avocados to go brown when they are cut open.

The equation shows the reaction catalysed by this enzyme.

monophenol ⟶ *o*-diphenol

(a) The graph shows the energy changes during this reaction, when the enzyme is not present.



(i) Which arrow shows the activation energy for this reaction?

(1)

☒ **A** P

☒ **B** Q

☒ **C** R

☒ **D** S

(ii) Which row of the table shows the molecule present at time Y and time Z on this graph?

(1)

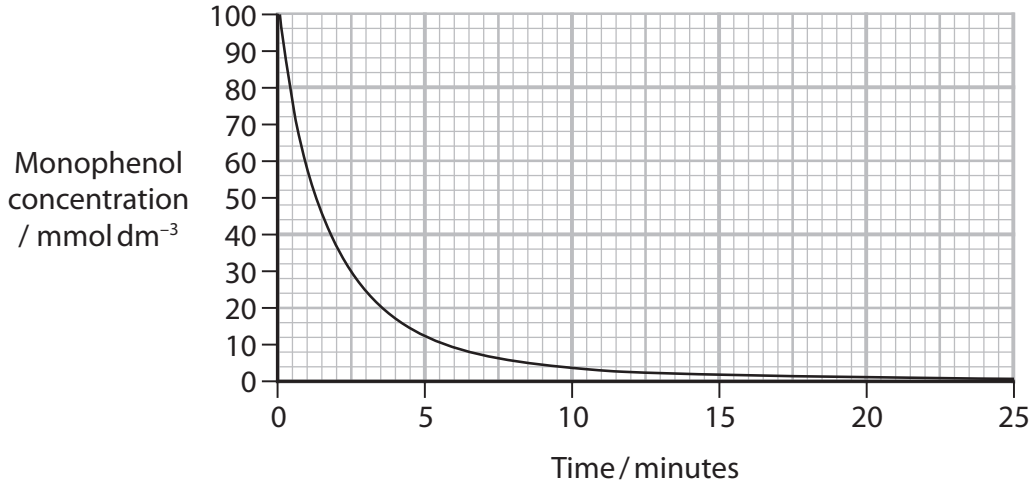
		Time Y		Time Z	
☒	**A**	product	monophenol	reactant	*o*-diphenol
☒	**B**	product	*o*-diphenol	reactant	monophenol
☒	**C**	reactant	monophenol	product	*o*-diphenol
☒	**D**	reactant	*o*-diphenol	product	monophenol

(iii) Which row of the table shows how the length of the arrows P and Q on this graph would change when polyphenol oxidase is present?

(1)

		Change in length of arrow	
		P	**Q**
☒	**A**	increase	decrease
☒	**B**	increase	no change
☒	**C**	no change	decrease
☒	**D**	no change	no change

(b) The graph shows the change in monophenol concentration in the presence of polyphenol oxidase, at a temperature of 25 °C.



(i) Calculate the rate of reaction at 3 minutes.

Draw a tangent to help with your calculation.

(2)

Answer ..... mmol dm^{-3} min^{-1}

(ii) This reaction was carried out below the optimum temperature for the enzyme.

Explain what would happen to the shape of this curve if the temperature was increased to the optimum temperature for this enzyme.

(2)

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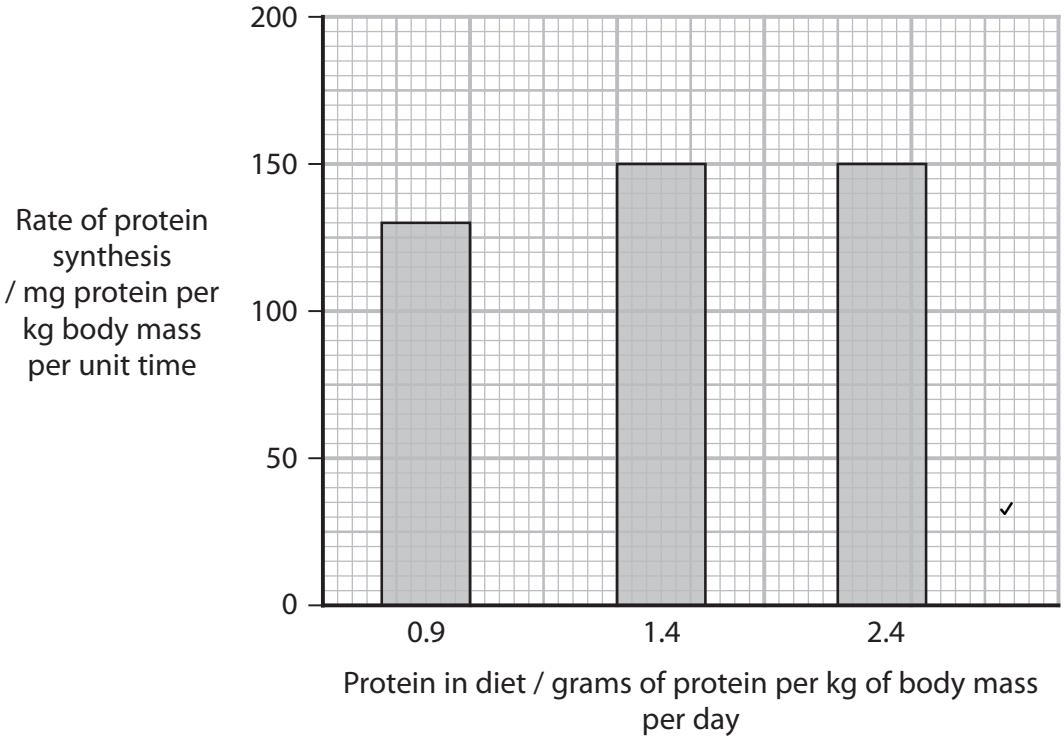
(Total for Question 2 = 7 marks)

3 Amino acids in the diet of animals are used to synthesise proteins.

(a) The rate of protein synthesis is dependent on a number of factors.

The graph shows the effect of the mass of protein in the diet on the rate of protein synthesis.



Calculate the minimum mass of protein a person with a mass of 70 kg should eat in one week if they want a rate of protein synthesis of 150 mg protein per kg body mass per unit time.

(2)

Answer ..... g

(b) (i) Name the **two** stages in protein synthesis, in the order that they occur.

(1)

Stage 1

.....

Stage 2

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(ii) Describe the roles of messenger RNA (mRNA) and transfer RNA (tRNA) in protein synthesis.

(4)

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(Total for Question 3 = 7 marks)

4 Red-green colour blindness is an inherited condition.

The table shows some statistics on red-green colour blindness in some countries.

Country	Population size in millions	Number of people who are red-green colour blind in millions	Percentage of population who are red-green colour blind (%)
India	1380		5.2
Japan	126	3.024	2.4
Malaysia	32	1.024	
Philippines	108	3.024	2.8

(a) Complete the table to show the number of people who are red-green colour blind in India and the percentage of people who are red-green colour blind in Malaysia.

(2)

(b) The percentage of males in Malaysia who are red-green colour blind is 6.7% and the percentage of females who are red-green colour blind is 0.4%.

(i) Calculate the ratio of red-green colour blind males to red-green colour blind females in Malaysia.

(1)

Answer .....

(ii) Explain why the percentage of red-green colour blind males is greater than the percentage of red-green colour blind females.

(4)

(Total for Question 4 = 7 marks)

5 Many animals have a heart and circulation.

(a) Molecules such as glucose move by mass transport to overcome the limitations of diffusion in meeting the requirements of an animal.

(i) State what is meant by the term **mass transport**.

(1)

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(ii) All the cells in an animal require glucose.

Explain the limitations of diffusion in providing cells with glucose.

(2)

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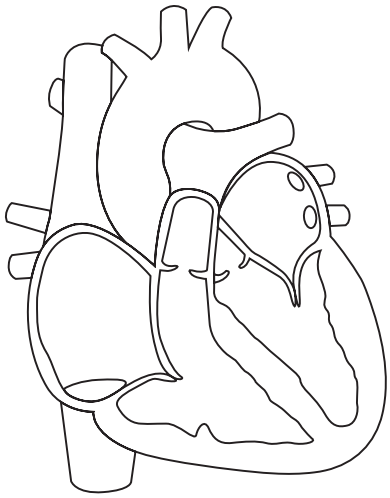
(b) The diagram shows a mammalian heart.



Draw arrows on the diagram to show the flow of deoxygenated blood (oxygen-depleted blood) into, through and out of the heart.

(2)

(c) The tunica media is the middle layer in the wall of an artery.

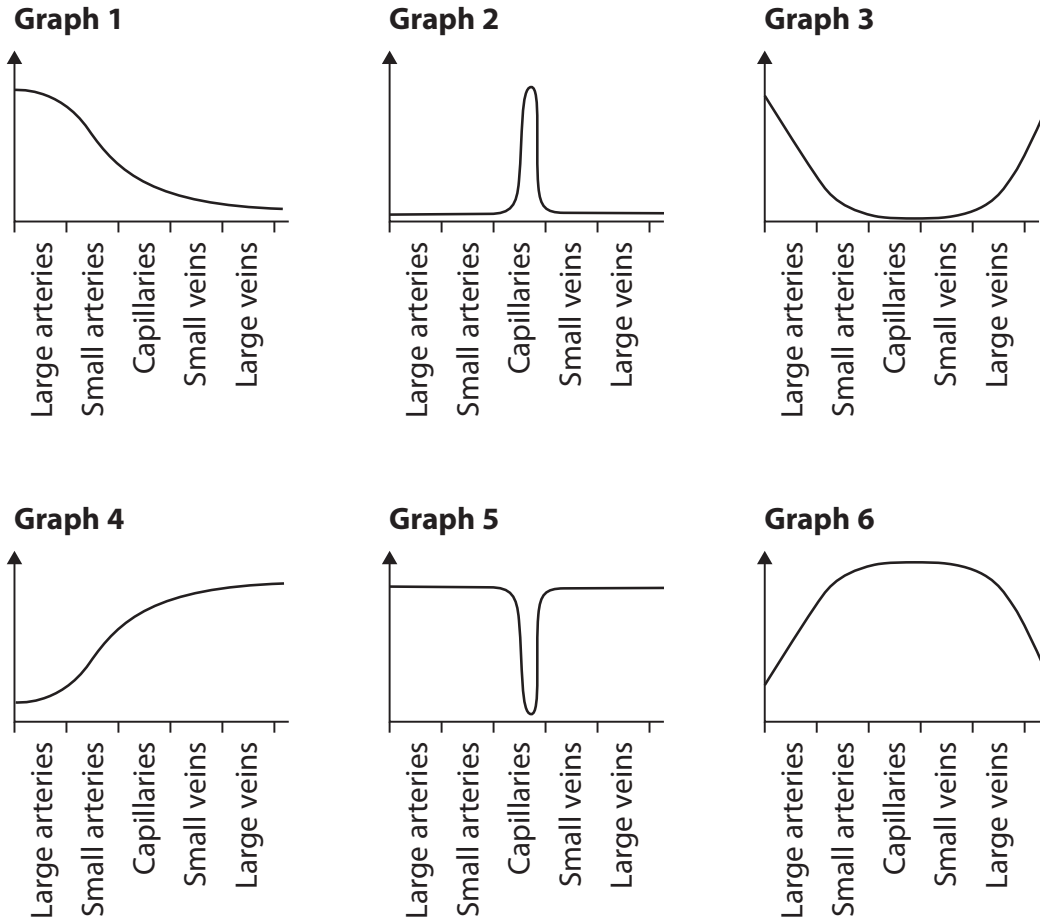
The table shows the percentages of some components in the tunica media of arteries of different sizes.

Component	Percentages of some components in tunica media (%)		
	Large artery	Medium-sized artery	Small artery
Smooth muscle cells	33.5%		60.5%
Collagen	37.0%		12.0%
Elastin	24.5%		1.5%

Explain why the percentages of the components in these arteries are different.

(4)

(d) The graphs show differences in some features of blood vessels.



(i) Which graph shows the diameter of the blood vessels?

(1)

- ☒ **A** graph 1
- ☒ **B** graph 3
- ☒ **C** graph 4
- ☒ **D** graph 6

(ii) Which graph shows the permeability of the blood vessels?

(1)

- ☒ **A** graph 1
- ☒ **B** graph 2
- ☒ **C** graph 3
- ☒ **D** graph 6

(Total for Question 5 = 11 marks)

6 Starch from plants is used in the production of food, paper and building materials.

The structural and chemical properties of starch depend on its amylose and amylopectin content.

(a) The table shows some of the bonds found in amylose and amylopectin.

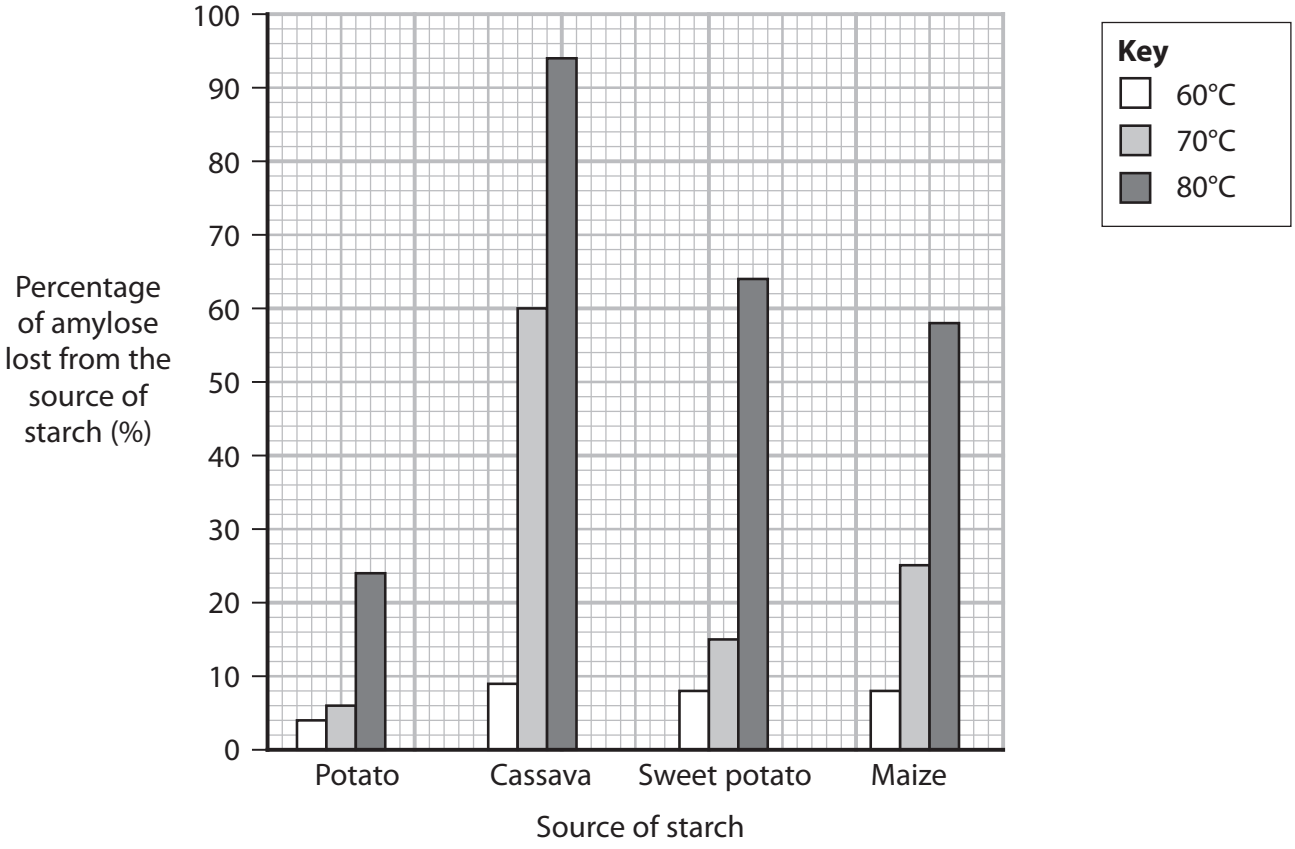
Put **one** cross ☒ in the appropriate box in each row to show whether the bond is present in these molecules.

(3)

Types of bond	Bonds found in			
	amylose only	amylopectin only	both amylose and amylopectin	neither amylose nor amylopectin
glycosidic bonds	☒	☒	☒	☒
1-6 α bonds	☒	☒	☒	☒
hydrogen bonds	☒	☒	☒	☒

(b) When sources of starch are heated in water, amylose moves into the water.

The graph shows the percentage of amylose that is lost from four sources of starch at three temperatures.



Describe **two** conclusions that can be made about the effects of temperature and source of starch on the loss of amylose.

(2)

1 Effect of temperature

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2 Effect of source of starch

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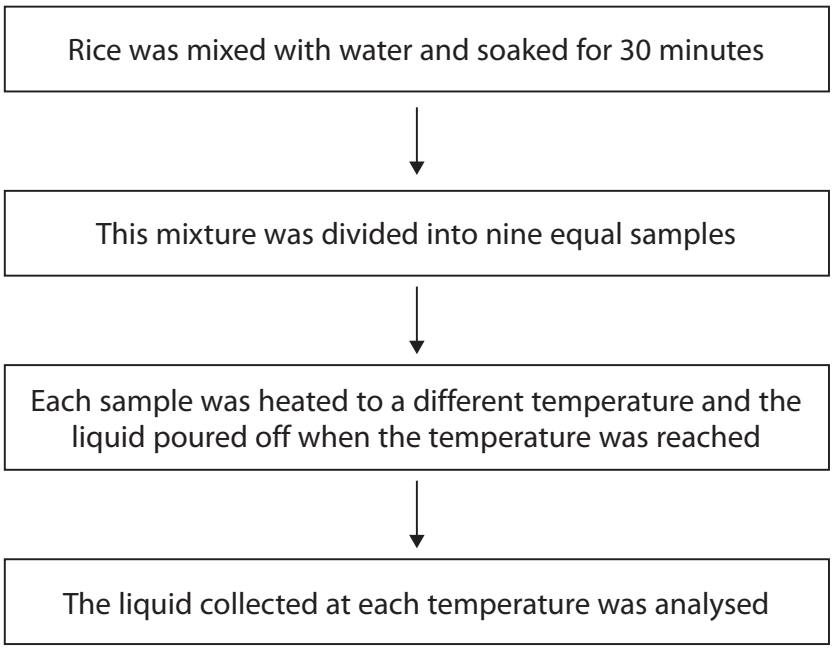
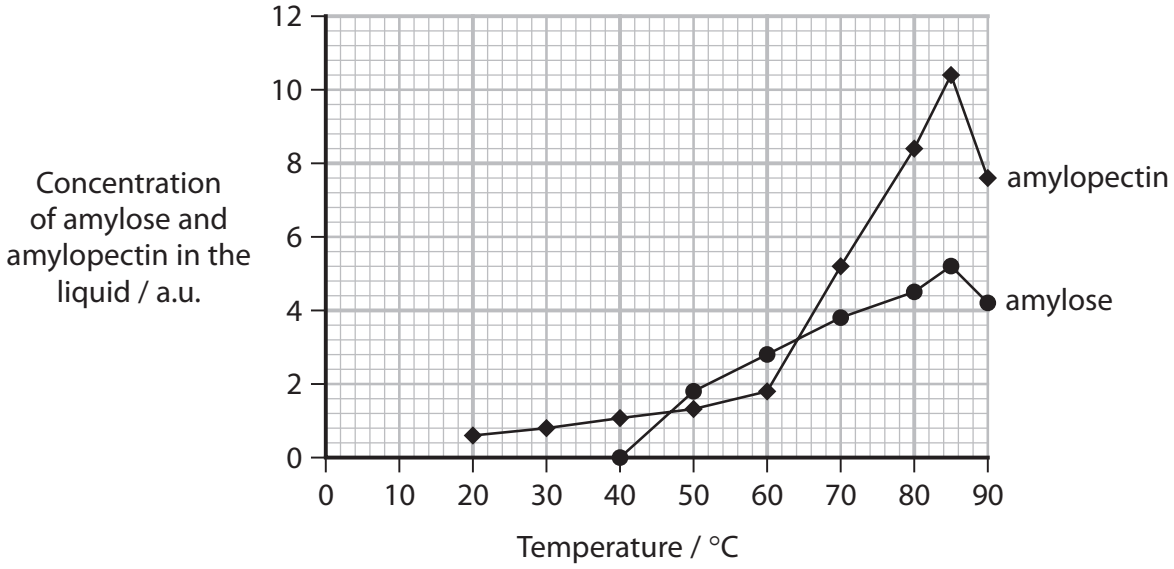
(c) The loss of amylose and amylopectin during the cooking of rice affects the hardness and stickiness of the cooked rice.

The effect of temperature on the loss of amylose and amylopectin was investigated.

The diagram shows part of the method used.



The graph shows the results of this investigation.



(i) Compare and contrast the effects of temperature on the loss of amylose and amylopectin from rice.

(3)

(ii) The investigation continued by adding a replacement liquid to finish cooking the rice.

The hardness and stickiness of the cooked rice was determined for each replacement liquid.

The table shows the results of this investigation.

Replacement liquid	Hardness of cooked rice / a.u.	Stickiness of cooked rice / a.u.
Water	19.42	1.19
Water containing amylose	27.63	1.21
Water containing amylopectin	20.43	1.71
Water containing both amylose and amylopectin	27.65	1.70

Comment on the effect of the replacement liquids on the hardness and stickiness of cooked rice.

Use the information in the table to support your answer.

(3)

(iii) Suggest why rice should be cooked in a measured volume of water, with the lid on, until all the cooking liquid has been absorbed.

Use the information in the table to support your answer.

(2)

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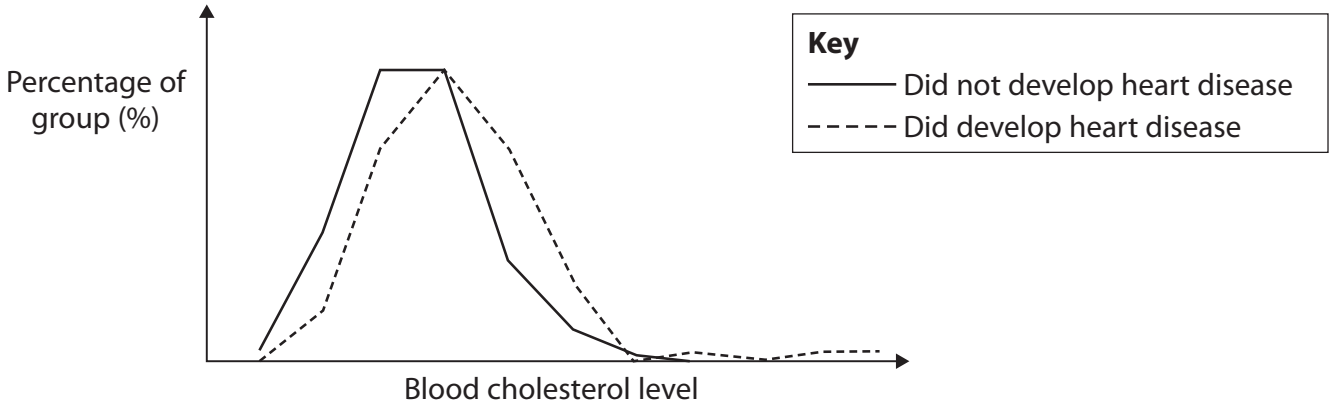
(Total for Question 6 = 13 marks)

7 A number of factors increase the risk of cardiovascular disease (CVD), including blood cholesterol levels.

(a) In one investigation, scientists measured the blood cholesterol level in a group of people and monitored the development of heart disease in the following 10 years.

The graph shows the results of this investigation.



Some people interpreted the data as showing evidence for a relationship between blood cholesterol levels and heart disease.

Other people interpreted the data as not showing evidence for a relationship between blood cholesterol levels and heart disease.

Describe the evidence for and against a relationship between blood cholesterol levels and heart disease.

(2)

Evidence for

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.....

Evidence against

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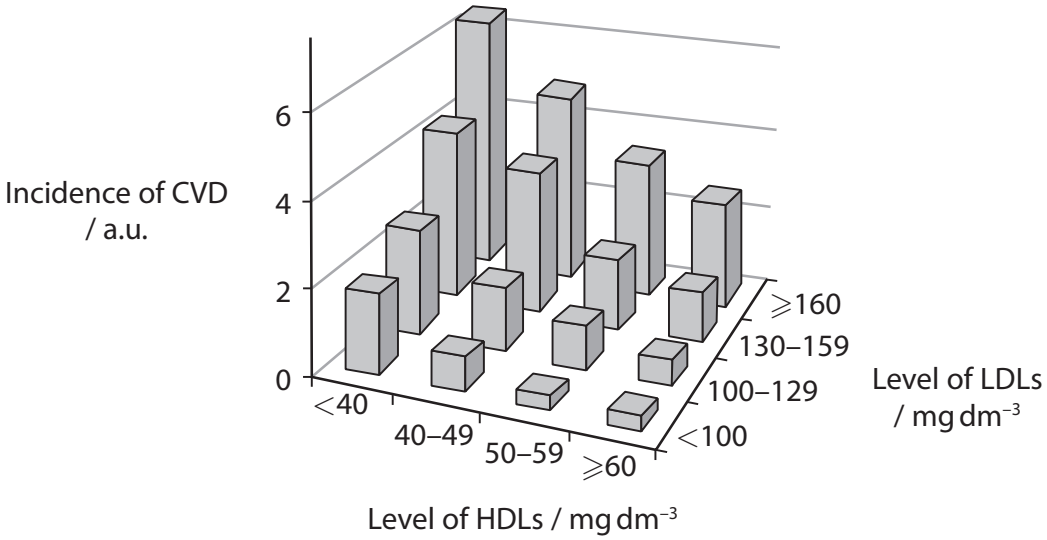
(b) Other investigations have shown that the levels of high-density lipoproteins (HDLs) and low-density lipoproteins (LDLs) are significant in determining the risk of CVD.

The graph shows the relationship between levels of HDLs and LDLs on the incidence of CVD.



The following conclusions can be made from this graph:

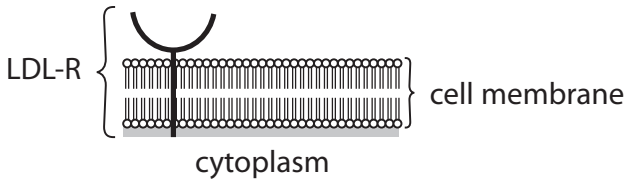
- as the levels of LDLs increases so does the incidence of CVD
- as the levels of HDLs increases the incidence of CVD decreases
- the higher the ratio of HDLs to LDLs the lower the incidence of CVD.

Describe the evidence shown in this graph that support these conclusions.

(3)

(c) The low-density lipoprotein receptor (LDL-R) is a protein on the surface of liver cells that is involved in the endocytosis of LDLs.

The diagram shows an LDL-R in a cell membrane.



(i) Explain how the LDL-R is involved in endocytosis of LDLs.

(3)

(ii) The lower pH inside the cell causes the LDL to separate from its receptor.

Suggest how a change in pH could cause this separation.

(2)

(iii) Mutations in the gene coding for the LDL-R can result in an increased risk of CVD.

Explain why mutations in this gene can increase the risk of CVD.

(3)

(Total for Question 7 = 13 marks)

8 In 2021, it was reported that cardiovascular diseases (CVDs) kill 17.9 million people per year. This is 31% of all global deaths.

(a) (i) Calculate how many global deaths there are in one year.

Express your answer in standard form.

(2)

Answer .....

(ii) It is predicted that by 2030 more than 22.2 million people will die each year from CVDs.

Suggest how this prediction was made.

(2)

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(b) The rhizomes of a ginger plant are used in cooking.

The photograph shows the rhizomes of a ginger plant.

(Source: © Helen Sessions / Alamy Stock Photo)

These rhizomes have high levels of antioxidants.

Some people believe that eating these rhizomes reduces the risk of CVD.

(i) Explain why eating these rhizomes may help to prevent CVD.

(3)

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(ii) There is very little data available to show that these rhizomes reduce the risk of CVD.

Suggest why these rhizomes can be eaten to prevent CVD even though their effectiveness has not been thoroughly tested by scientists.

(1)

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*(iii) Explain how a study should be designed to collect valid and repeatable data to show the effectiveness of using ginger in preventing CVD.

(6)

(Total for Question 8 = 14 marks)

TOTAL FOR PAPER = 80 MARKS

Please check the examination details below before entering your candidate information

Candidate surname	Other names

Centre Number | Candidate Number

Pearson Edexcel International Advanced Level

Monday 8 January 2024

Afternoon (Time: 1 hour 30 minutes)

Paper reference **WBI11/01**

Biology

Advanced Subsidiary

UNIT 1: Molecules, Diet, Transport and Health

You must have:
Scientific calculator, ruler, HB pencil

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided – *there may be more space than you need.*
- Calculators may be used.
- You must **show all your working out** with **your answer clearly identified** at the **end of your solution**.

Information

- The total mark for this paper is 80.
- The marks for **each** question are shown in brackets – *use this as a guide as to how much time to spend on each question.*
- The marks available for spelling, punctuation and grammar are clearly indicated.
- In questions marked with an **asterisk** (*), marks will be awarded for your ability to structure your answer logically, showing how the points you make are related or follow on from each other where appropriate.

Advice

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

Turn over ▶

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Pearson

Answer ALL questions.

Write your answers in the spaces provided.

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

1 Red blood cells transport oxygen to the cells of the body.

Read through the following description of how oxygen is transported from the lungs to respiring cells.

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

Oxygen binds to ..... inside red blood cells.

Oxygen binds to this molecule in the lungs where the partial pressure of

oxygen is ..... compared with elsewhere in the body.

The oxygenated blood returns to the heart in the blood vessel called the

..... and is pumped to the body by the part

of the heart called the ..... .

In the tissues, the ability of this molecule to bind oxygen is affected by the

higher concentration of carbon dioxide.

This is called the ..... effect.

(Total for Question 1 = 5 marks)

2 The nature of the genetic code of a gene is important in determining the sequence of amino acids in a polypeptide chain.

The diagrams show the genetic code for some amino acids and the sequence of bases in part of a gene.

Genetic code	Amino acid	Genetic code	Amino acid	Genetic code	Amino acid	Genetic code	Amino acid
AAA AAG	Lysine	CAA CAG	Glutamine	GAA GAG	Glutamic acid	TAC TAT	Tyrosine
AAC AAT	Asparagine	CAT CAC	Histidine	GAC GAT	Aspartate	TCA TCC TCG TCT	Serine
ACA ACC ACG ACT	Threonine	CCA CCC CCG CCT	Proline	GCA GCC GCG GCT	Alanine	TGG	Tryptophan

Part of a gene:

The genetic code is described as a triplet code that is non-overlapping and is degenerate.

Explain what each of these phrases means.

Use the information provided to illustrate your answer.

(a) Triplet code

(2)

(b) Non-overlapping code

(2)

(c) Degenerate code

(2)

(Total for Question 2 = 6 marks)

3 The cell membrane determines which molecules can enter or leave a cell.

(a) Which pair of membrane transport mechanisms only involves a **solute** moving down a concentration gradient?

(1)

☒ **A** active transport and diffusion

☒ **B** active transport and osmosis

☒ **C** diffusion and facilitated diffusion

☒ **D** facilitated diffusion and osmosis

(b) Which of the following transport mechanisms involve carrier proteins in the membrane?

- active transport
- diffusion
- exocytosis

(1)

☒ **A** active transport only

☒ **B** active transport and exocytosis

☒ **C** diffusion only

☒ **D** diffusion and exocytosis

(c) Which cell transport mechanism is used to take large particles or bacteria into a cell?

(1)

☒ **A** active transport

☒ **B** endocytosis

☒ **C** exocytosis

☒ **D** facilitated diffusion

(d) Which cell transport mechanism moves small lipid-soluble molecules through the membrane?

(1)

- ☒ **A** active transport
- ☒ **B** diffusion
- ☒ **C** facilitated diffusion
- ☒ **D** osmosis

(e) Channel proteins are involved in facilitated diffusion.

Which row of the table describes the charge on the R groups on the amino acids of a channel protein?

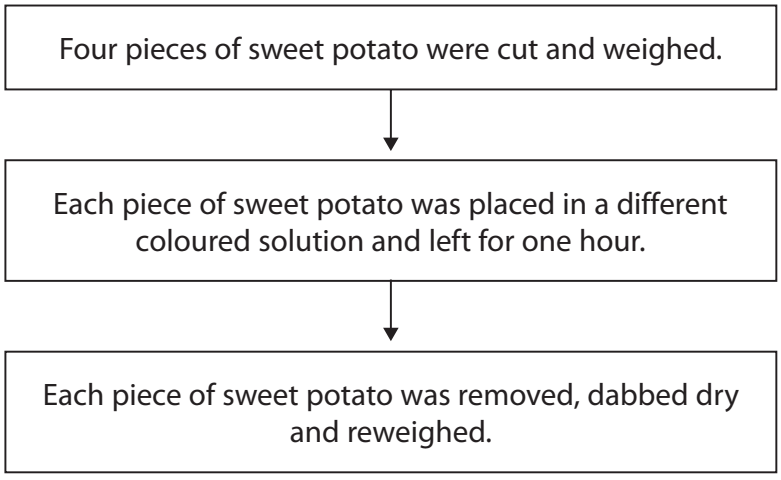
(1)

		Charge on R groups facing inside the channel are mostly	Charge on R groups facing the rest of the membrane are mostly
☒	**A**	polar	polar
☒	**B**	polar	non-polar
☒	**C**	non-polar	polar
☒	**D**	non-polar	non-polar

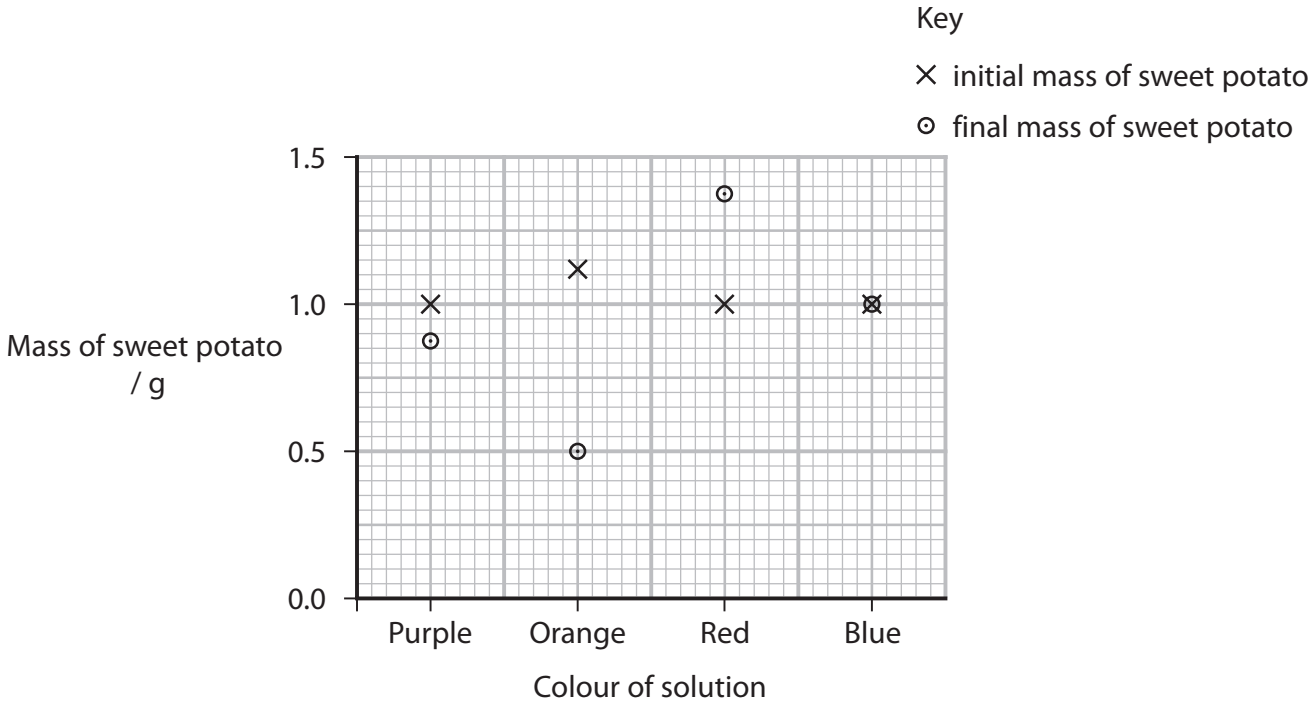
(f) A student investigated the effect of four different coloured solutions on the mass of pieces of sweet potato.

Dyes were dissolved in water to produce the coloured solutions.

The diagram shows the method used by the student.



The graph shows the results of this investigation.



Explain the results of this investigation.

(4)

(Total for Question 3 = 9 marks)

4 Water is an important molecule in living organisms.

(a) Water is a dipolar molecule that forms hydrogen bonds with other water molecules.

(i) Explain the dipole nature of water.

(2)

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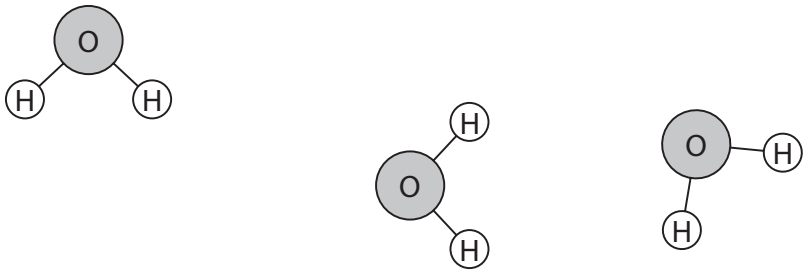
(ii) The diagram shows three water molecules.

Complete the diagram to show a hydrogen bond between two water molecules.

(1)



(b) Water plays a role as a solvent.

Sodium chloride dissolves in water.

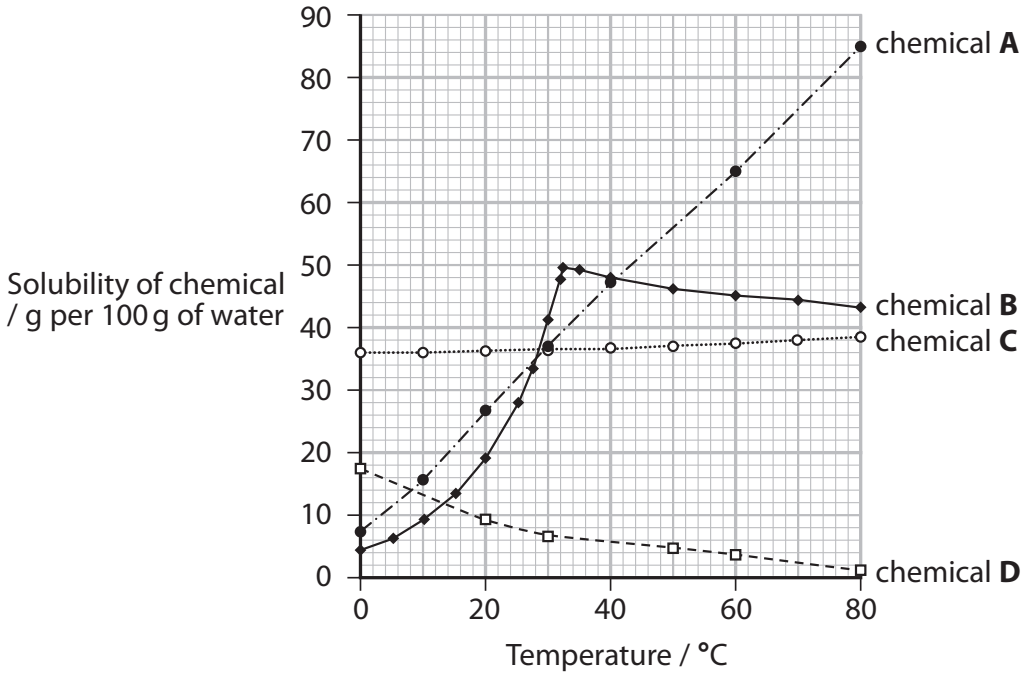
The diagram shows a sodium ion (Na^+).

Complete the diagram to show the arrangement of two water molecules around a sodium ion when it is dissolved.

(1)

(c) Temperature affects the solubility of chemicals in water.

The graph shows the effect of temperature on the solubility of four chemicals, **A**, **B**, **C** and **D**.



Describe the effects of temperature on the solubility of these chemicals.

(4)

(Total for Question 4 = 8 marks)

5 Several factors are associated with the risk of developing cardiovascular disease (CVD).

Obesity is one risk factor associated with CVD.

The ability of a group of people to lose weight was investigated.

This investigation considered:

- the body mass index (BMI) of the person
- the levels of amylase in their saliva
- the bacteria present in their digestive system.

(a) The BMI of a person can be calculated using the formula:

BMI = mass in kg ÷ (height in m)^2

(i) Name **one** other obesity indicator.

(1)

.....

(ii) Which of the following is the BMI of a person who has a mass of 65 kg and a height of 165 cm?

(1)

☒ **A** 23

☒ **B** 24

☒ **C** 39

☒ **D** 40

(iii) A person's BMI is used to put them into a weight category.

A person with a BMI of 25 and above, but below 30, is considered to be overweight but not obese.

Which describes the body mass of a person who is obese?

(1)

☒ **A** BMI $>$ 30

☒ **B** BMI $\geqslant$ 30

☒ **C** BMI $<$ 30

☒ **D** BMI $\leqslant$ 30

(b) People who are overweight or obese are encouraged to lose weight.

State **two** ways in which a person could lose weight.

(1)

1 .....

2 .....

(c) Amylase in saliva breaks down amylose into maltose.

(i) Which row of the table describes the action of amylase?

(1)

		Type of reaction	Glycosidic bond broken
☒	**A**	condensation	1 – 4
☒	**B**	condensation	1 – 6
☒	**C**	hydrolysis	1 – 4
☒	**D**	hydrolysis	1 – 6

(ii) People with low levels of amylase in their saliva were found to lose weight more easily.

Suggest why these people lost weight more easily.

(2)

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(d) The bacteria in people's digestive systems replicate.

The investigation found that people with greater weight loss had bacteria with increased rates of replication.

(i) Explain why this finding can be described as a positive correlation.

(2)

(ii) Suggest why the rate of replication of the bacteria could affect weight loss.

(2)

(Total for Question 5 = 11 marks)

6 The cell membrane consists of phospholipids and proteins.

(a) Name the current model for the structure of the cell membrane.

(1)

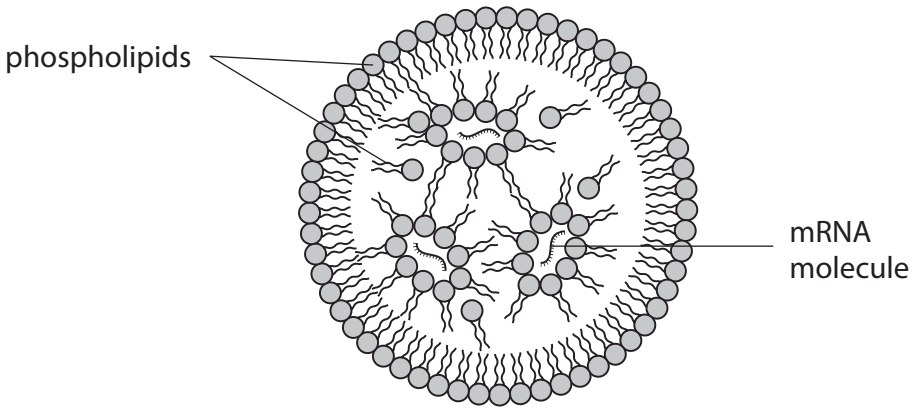
(b) Describe the arrangement of phospholipids in the cell membrane in this model.

(3)

(c) Phospholipids can be used to form lipid nanoparticles.

Lipid nanoparticles can be used to carry nucleic acids to tissues in the body.

The diagram shows a lipid nanoparticle containing messenger RNA (mRNA) molecules.



(i) Lipid nanoparticles are very small.

Calculate the diameter of a lipid nanoparticle with a volume of 0.108 μm^3.

Use the formula

$$V = \frac{4}{3}\pi r^3$$

Use π = 3.0

(3)

Answer ..... μm

(ii) Describe the structure of a mRNA molecule.

(3)

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(iii) Explain the arrangements of phospholipids in this lipid nanoparticle that carries mRNA to tissues in the body.

(3)

(Total for Question 6 = 13 marks)

7 Cystic fibrosis is an inherited disorder caused by a mutation in the gene coding for the CFTR protein.

(a) Explain how this mutation results in reduced gas exchange in the lungs.

(3)

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(b) The number of new cases of cystic fibrosis in the USA in 2015 was 964.

It is predicted that this value will have fallen to 839 by 2025.

(i) Calculate the predicted percentage decrease in the number of new cases from 2015 to 2025.

(1)

Answer ..... %

(ii) Explain why the number of cases could fall.

(3)

*(c) One complication of cystic fibrosis is lung disease caused by the build-up of bacteria in the airways.

This may be due to the inability of the person to clear mucus from the airways.

People with cystic fibrosis can inhale a salt solution to treat their symptoms. This gives improvements in the clearance of mucus, lung function and quality of life, for a short time.

It has been suggested that pre-treatment with drug A could extend the effects of inhalation of a salt solution.

Devise an investigation to determine if pre-treatment with drug A is more effective than inhalation of a salt solution on its own.

Give reasons for your choice of method.

(6)

(Total for Question 7 = 13 marks)

8 The types of lipid consumed in the diet can affect the health of individuals.

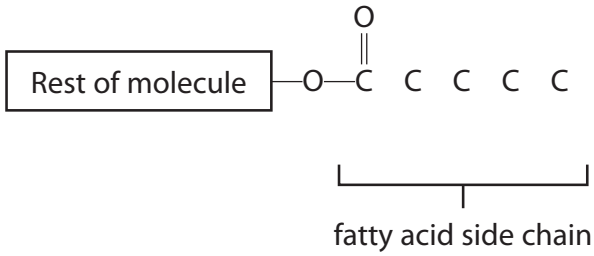
(a) Tropical sprue is a disorder that limits the absorption of nutrients into the blood.

Consumption of unsaturated lipids has been proposed as a cause of tropical sprue.

The diagram shows part of an unsaturated lipid.

Complete the diagram to show one possible structure of a fatty acid side chain of an unsaturated lipid.

(2)



(b) Consumption of high levels of cholesterol is associated with atherosclerosis.

In the development of atherosclerosis, lesions form in the coronary arteries and these develop into atheromas (plaques).

In an investigation, one group of primates was fed a diet supplemented with cholesterol and saturated fatty acids.

A second group was fed a diet supplemented with cholesterol and unsaturated fatty acids.

The primates were fed these diets from a young age and then monitored over a period of 60 months.

Primates are a higher order of mammals that include monkeys.

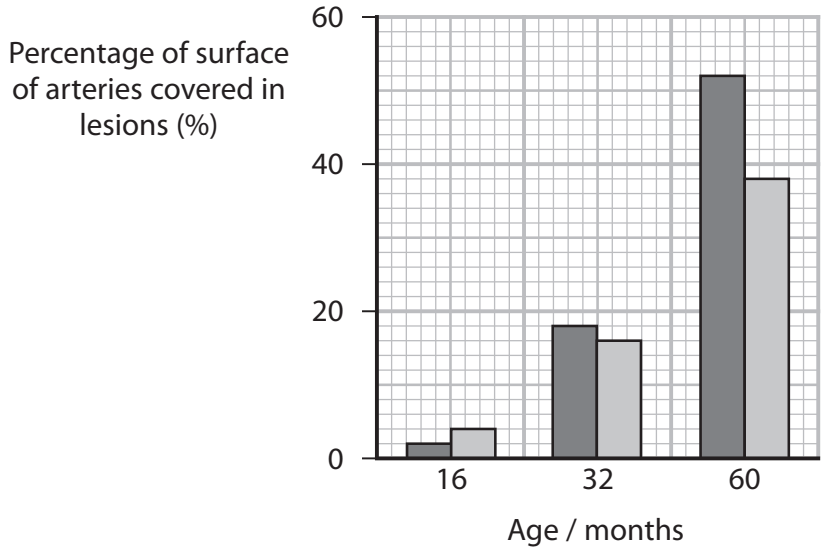
The results of the investigation are shown in the graphs.

Key

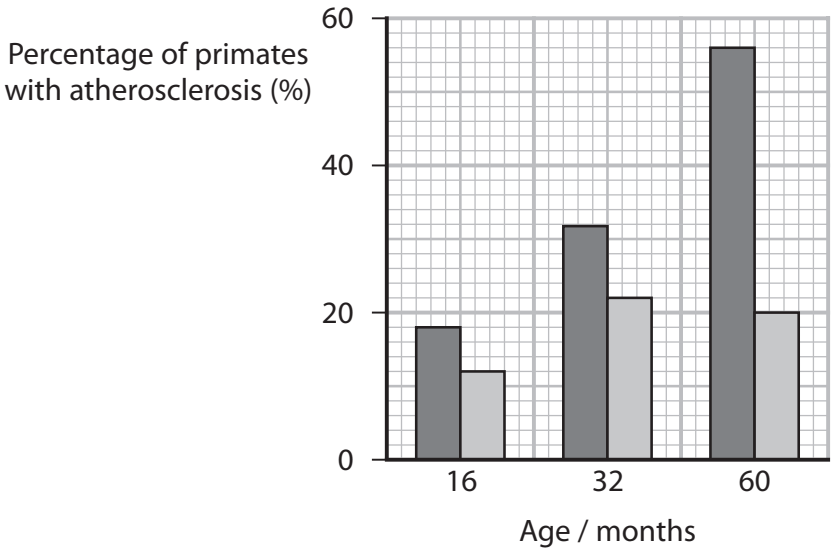
saturated lipids

unsaturated lipids

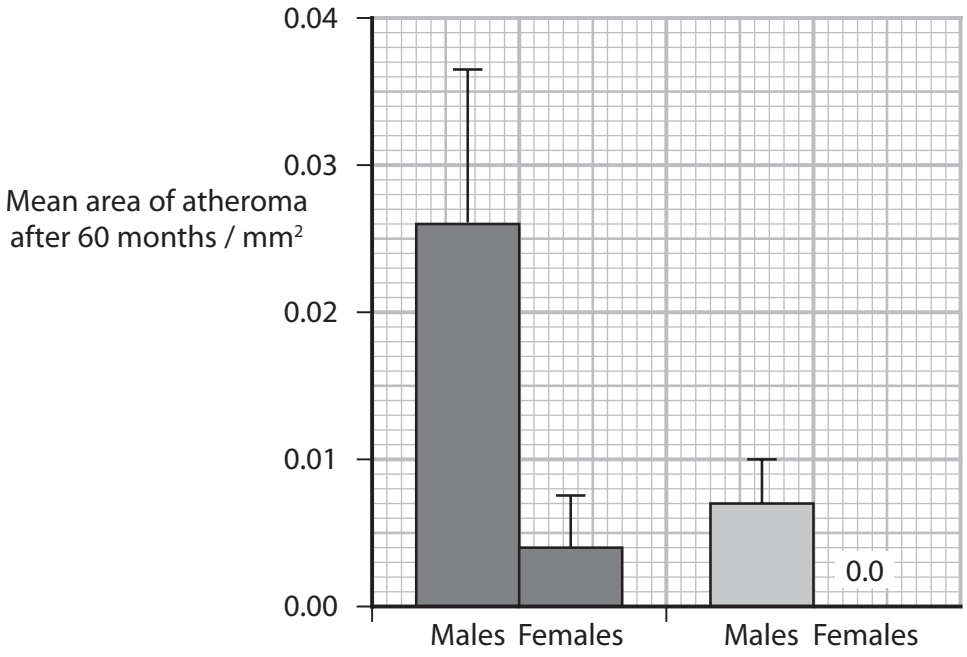
Graph 1



Graph 2



Graph 3



(i) Calculate the mean rate of increase in the surface of arteries covered in lesions from 16 to 60 months in the primates given saturated lipids (graph 1).

(1)

Answer ..... percentage per month

(ii) Calculate the ratio of primates with atherosclerosis given saturated lipids to those given unsaturated lipids, at 32 months (graph 2).

(1)

Answer .....

(iii) Calculate the difference in the area of the atheromas in males compared with females, in primates given saturated fats (graph 3).

Give your answer in μm^2.

(2)

Answer ..... μm^2

*(iv) These primates were fed a diet supplemented with cholesterol and either saturated lipids or unsaturated lipids.

Deduce the effects of these two diets on the development of lesions in the coronary arteries, atherosclerosis and atheromas.

(6)

(v) Discuss the ethical issues relating to the use of primates and other animals in investigations such as this one.

(3)

(Total for Question 8 = 15 marks)

TOTAL FOR PAPER = 80 MARKS

Please check the examination details below before entering your candidate information

Candidate surname	Other names

Centre Number | Candidate Number

Pearson Edexcel International Advanced Level

Tuesday 7 May 2024

Morning (Time: 1 hour 30 minutes)

Paper reference **WBI11/01**

Biology

Advanced Subsidiary

UNIT 1: Molecules, Diet, Transport and Health

You must have:
Scientific calculator, ruler, HB pencil

Total Marks

Instructions

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- Check your answers if you have time at the end.

Turn over ▶

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P 7 5 7 7 1 A 0 1 2 8

Pearson

Answer ALL questions.

Write your answers in the spaces provided.

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

1 Enzymes are biological catalysts.

(a) Enzyme molecules are formed from chains of amino acids joined together.

Which pair of elements is found in all amino acids?

(1)

☒ **A** carbon and oxygen

☒ **B** carbon and sulfur

☒ **C** nitrogen and magnesium

☒ **D** oxygen and magnesium

(b) Which row of the table describes how two amino acids are joined together in an enzyme molecule?

(1)

		Name of bond	Reaction that forms the bond
☒	**A**	ester	condensation
☒	**B**	ester	hydrolysis
☒	**C**	peptide	condensation
☒	**D**	peptide	hydrolysis

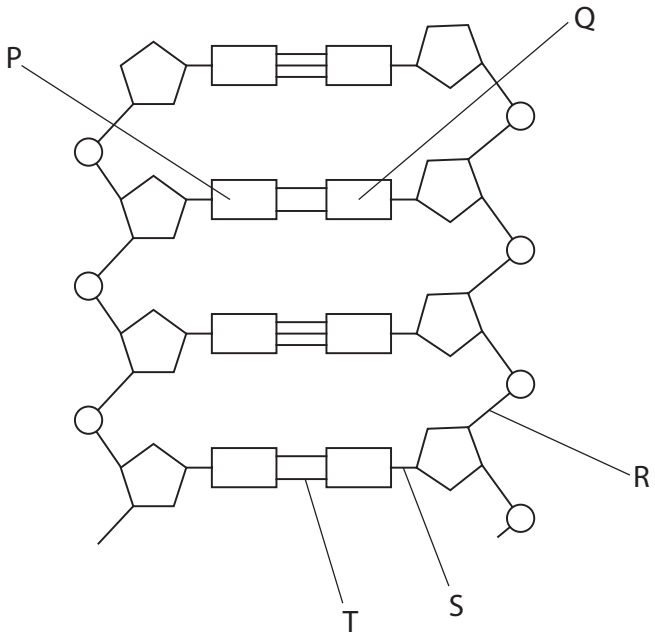
(c) Describe how a chain of amino acids can form an enzyme molecule.

(3)

(Total for Question 1 = 5 marks)

2 Errors in DNA replication can give rise to mutations.

(a) The diagram shows part of a DNA molecule.



(i) The base labelled **Q** is thymine.

Which is the base labelled **P**?

(1)

- ☒ **A** adenine
- ☒ **B** cytosine
- ☒ **C** guanine
- ☒ **D** uracil

(ii) Which row of the table identifies the bonds labelled **R**, **S** and **T**?

(1)

	R	S	T
☒ **A**	covalent	phosphodiester	hydrogen
☒ **B**	hydrogen	covalent	phosphodiester
☒ **C**	hydrogen	phosphodiester	covalent
☒ **D**	phosphodiester	covalent	hydrogen

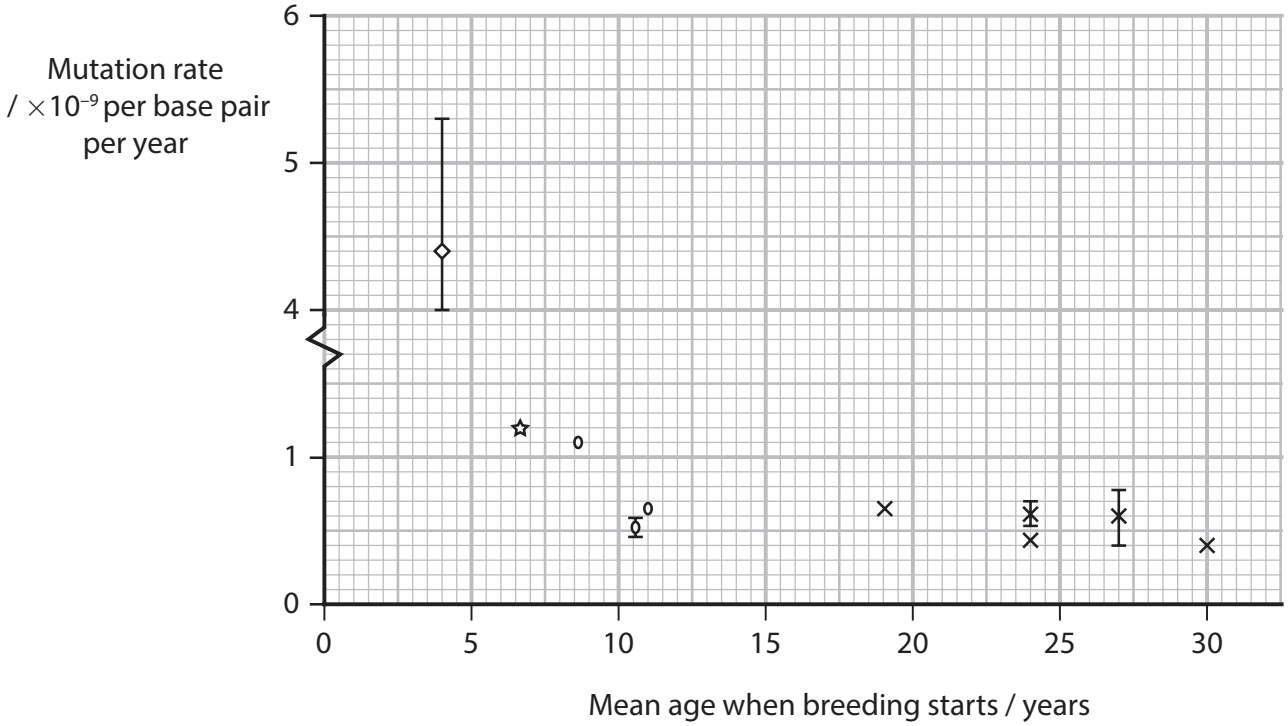
(b) Name **two** types of gene mutation.

(1)

1 .....

2 .....

(c) The graph shows the estimated mutation rate in four groups of primates.



Key

◇ prosimians ☆ new world monkeys o old world monkeys × apes

Describe **two** conclusions that can be made about the mutation rate in these four groups of primates.

(2)

1 .....

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2 .....

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(Total for Question 2 = 5 marks)

3 The process of protein synthesis involves RNA polymerase, start and stop codons and ribosomes.

(a) Describe the role of RNA polymerase in protein synthesis.

(2)

(b) Compare and contrast the structure of the start and stop codons and how they work.

(3)

(c) Describe the roles of the ribosomes in protein synthesis.

(2)

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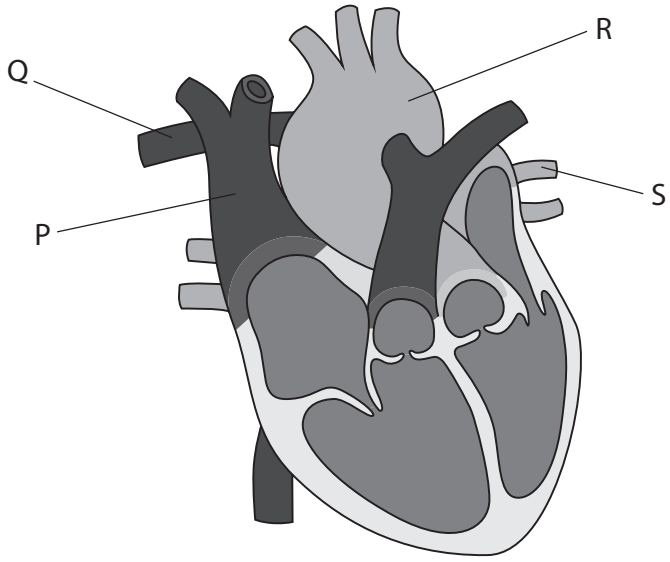
(Total for Question 3 = 7 marks)

4 Many animals have a heart and circulation.

(a) The diagram shows a human heart and its major blood vessels, labelled P, Q, R and S.



(i) Which pair of blood vessels transports blood to and from the lungs?

(1)

- ☒ **A** P and Q
- ☒ **B** Q and S
- ☒ **C** R and P
- ☒ **D** S and R

(ii) Which blood vessels have valves along their length?

(1)

- ☒ **A** P
- ☒ **B** P and R
- ☒ **C** Q
- ☒ **D** Q and R

(iii) Which blood vessel does the coronary artery branch from?

(1)

- ☒ **A** P
- ☒ **B** Q
- ☒ **C** R
- ☒ **D** S

(b) Capillaries enable the movement of molecules between the blood and cells.

The distance the molecules diffuse between the blood and cells affects the rate of diffusion. This is the diffusion distance.

(i) Name **two** other factors that affect the rate of diffusion.

(1)

1 .....

2 .....

(ii) Name the law of diffusion that can be used to calculate the rate of diffusion.

(1)

.....

(c) The table shows the time taken for a molecule to diffuse over different diffusion distances.

Diffusion distance	Diffusion distance / μm	Time taken to diffuse the distance	Time taken to diffuse the distance / milliseconds
1 μm	1	0.5 milliseconds	0.5
10 μm	10	50.0 milliseconds	50.0
100 μm	100	5.0 seconds	
1 mm		8.3 minutes	

(i) Complete the table to show the missing values.

(2)

(ii) Explain why it is important for body cells to be close to capillaries to meet the demands of respiration.

Use the information in the question and the table to support your answer.

(3)

(Total for Question 4 = 10 marks)

5 Haemophilia is a group of rare conditions that affects the ability of the blood to clot.

These conditions are caused by mutations in the genes coding for factors involved in the blood clotting process.

(a) Haemophilia is inherited in a similar way to red-green colour blindness and most people who have it are male.

Explain why most people who have haemophilia are male.

(4)

(b) Two types of haemophilia are haemophilia A and haemophilia B.

In 2021, there were 7.87×10^9 people in the world.

There were 185 218 people with haemophilia A and 37 998 people with haemophilia B.

(i) Calculate the ratio of people with haemophilia A to those with haemophilia B. Give your answer to **two** significant figures.

(2)

Ratio ..... : 1

(ii) Which is the percentage of the world population who had haemophilia A, in 2021?

(1)

- ☒ **A** 2.35×10^5
- ☒ **B** 2.35×10^3
- ☒ **C** 2.35×10^{-3}
- ☒ **D** 2.35×10^{-5}

(iii) The number of people with haemophilia is only an estimate.

Give **one** reason why this is only an estimate.

(1)

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(c) In haemophilia, activation of the blood clotting pathway results in less thrombin being produced than in healthy individuals.

Explain how reduced thrombin will affect blood clotting.

(3)

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(Total for Question 5 = 11 marks)

6 Glucose is an example of a monosaccharide.

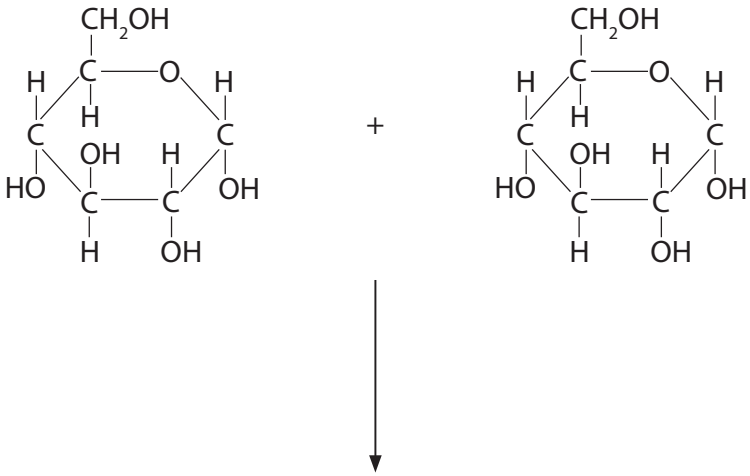
Monosaccharides join together to form disaccharides, oligosaccharides and polysaccharides.

Oligosaccharides contain from three to ten monosaccharides.

(a) The diagram shows two glucose molecules.

Complete the diagram to show how these two molecules join by a glycosidic bond to form **two** products.

(3)



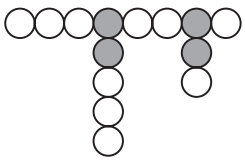
(b) Starch is a polysaccharide composed of amylose and amylopectin.

Digestion of starch begins in the mouth by an enzyme called amylase.

This amylase can break only 1–4 glycosidic bonds.

Only disaccharides and oligosaccharides are produced during this reaction.

(i) The diagram shows part of an amylopectin molecule.



Key

○ glucose molecule joined by 1–4 glycosidic bonds

● glucose molecule joined by 1–4 and 1–6 glycosidic bonds

Draw **one** disaccharide and **two** different oligosaccharides that could be produced following the digestion of this part of amylopectin by this amylase.

(2)

(ii) Explain why this amylase is able to break only 1–4 glycosidic bonds.

(2)

(c) The digestion of carbohydrates is completed in the small intestine.

Glucose is then absorbed into the bloodstream.

(i) Suggest how disaccharides and oligosaccharides are broken down in the small intestine.

Give reasons for your answer.

(3)

(ii) The absorption of glucose into the bloodstream requires membrane transport proteins.

Explain why glucose cannot diffuse into the bloodstream.

(2)

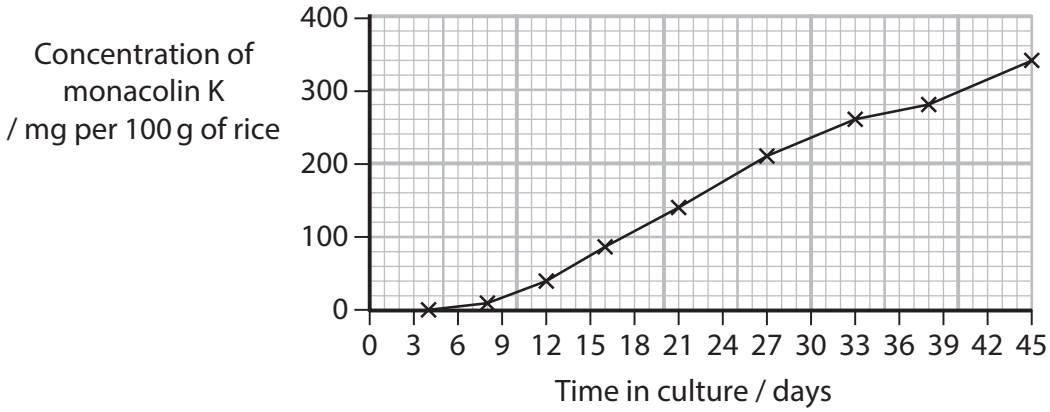
(Total for Question 6 = 12 marks)

7 Statins are used in the prevention and treatment of cardiovascular disease (CVD).

Red yeast rice (RYR) is a source of food and medicine in Asia. It is produced by the fermentation of rice by yeast.

Red yeast rice contains monacolin K, which is similar to a statin.

(a) The graph shows the production of monacolin K during the fermentation of rice by yeast.



Calculate the mean rate of production of monacolin K in this culture, in the 45-day time period.

Give your answer to **two** decimal places.

(2)

Answer ..... mg per 100 g of rice per day

*(b) Scientists have studied the effects of RYR on lipid levels.

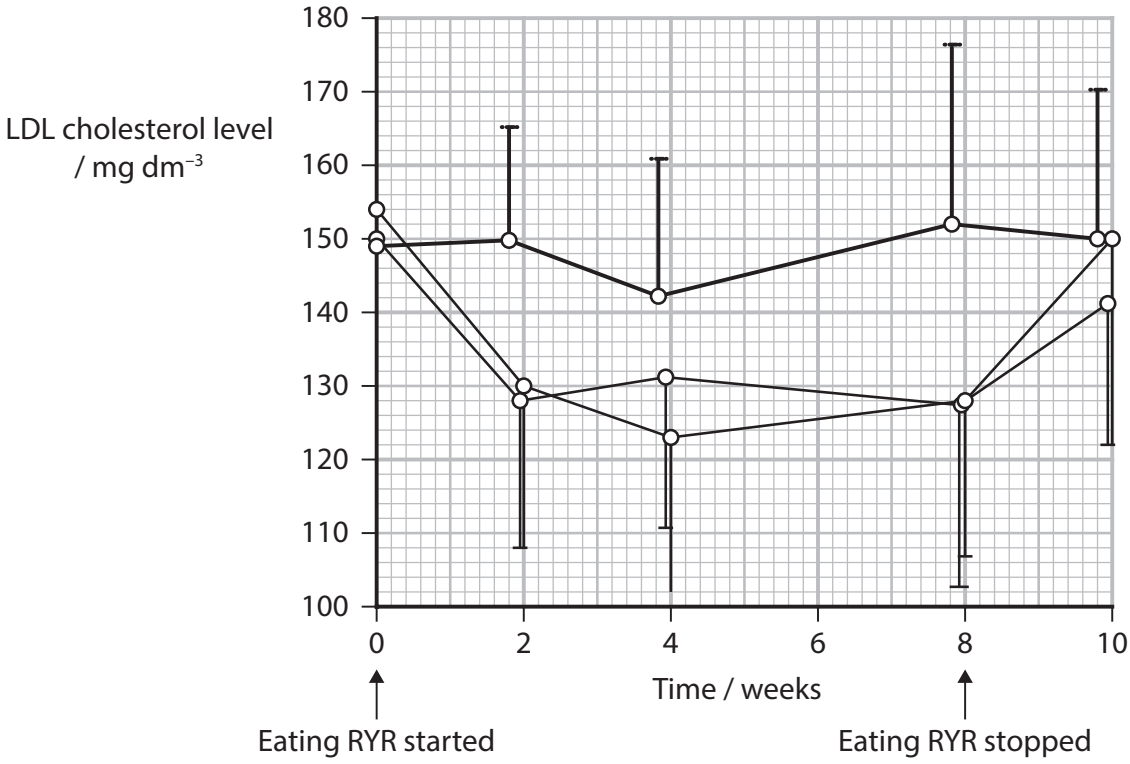
The table shows the results of four studies on the effects of eating RYR on lipid levels.

Study	Mass of RYR / mg per day	Percentage change in lipid levels (%)		
		Decrease in total cholesterol	Decrease in LDL cholesterol	Change in HDL cholesterol
1	340	16 to 17	21 to 24	Between a decrease of 3 and an increase of 3
2	1200	20	34	Increase of 18
3	2400	13	23	No data
4	1200	13	23	No data
	2400	24	32	No data

Graph 1 shows the effects of eating RYR daily on LDL cholesterol levels.

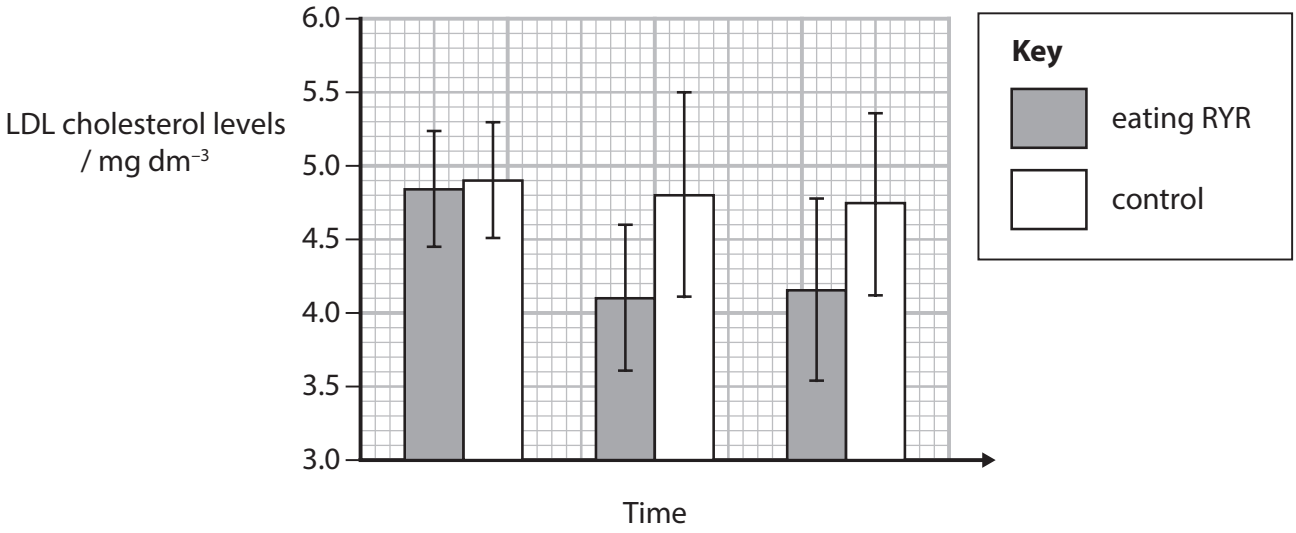
It also shows the changes in levels of LDL cholesterol when eating RYR was stopped.

The investigation included a control group that did not eat RYR.



Graph 1

Graph 2 shows the results of another study where the effect of eating RYR on LDL cholesterol levels was compared with a control group.



Graph 2

Discuss the limitations of using the results of these studies to draw conclusions about the effects of RYR on lipid levels.

(6)

(c) Treatment with statins can have side effects.

(i) Name **two** possible side effects of being treated with statins.

(1)

1 .....

2 .....

(ii) Describe how an investigation could be designed to identify any side effects of treatment with monacolin K.

(4)

(iii) Suggest **two** problems when assessing possible side effects resulting from treatment with monacolin K in an investigation.

(2)

1 .....

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2 .....

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(Total for Question 7 = 15 marks)

8 The role of red blood cells is to transport oxygen around the body.

The oxygen-carrying capacity of red blood cells varies from species to species.

The oxygen-carrying capacity depends partly on the size and structure of the red blood cells and their haemoglobin content.

(a) Describe the structure of a haemoglobin molecule.

(3)

*(b) The table shows some information about red blood cells from four species of air-breathing mammals.

The species are listed by decreasing size.

Species of mammal	Mean number of red blood cells per dm^3 of blood	Mean mass of haemoglobin per cell / pg	Mean cell volume / μm^3	Oxygen-carrying capacity / cm^3 oxygen per dm^3 of blood
Beluga whale	3.3×10^{12}	57	134	259
Camel	1.1×10^{13}	14	319	211
Man	5.0×10^{12}	29	90	196
Goat	1.6×10^{13}	7	18	139

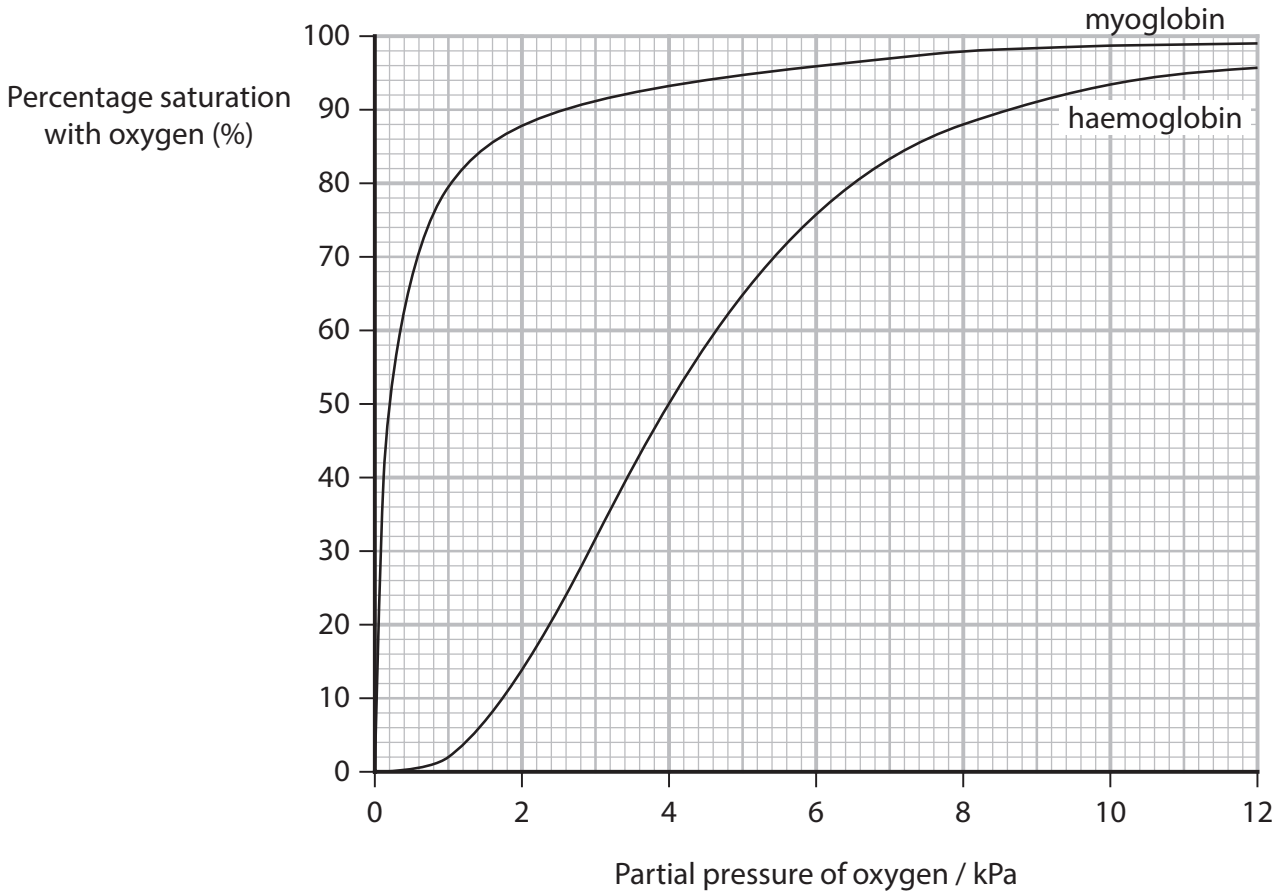
Explain the relationships between the sizes of these species of mammal, the characteristics of their red blood cells and their oxygen-carrying capacity.

Use the information in the table to support your answer.

(6)

(c) The graph shows the oxygen dissociation curve for haemoglobin and myoglobin.

Myoglobin is present inside muscle cells and acts as an oxygen store.



(i) The decrease in percentage saturation with oxygen of myoglobin from 6 kPa to 4 kPa is 3%.

Calculate the difference between this decrease and the decrease for haemoglobin from 6 kPa to 4 kPa.

(2)

Answer ..... %

(ii) Describe the effect of the partial pressure of oxygen on the percentage saturation with oxygen of myoglobin.

Use values from the graph to support your answer.

(2)

(iii) Suggest why the dissociation curve for myoglobin is to the left of the curve for haemoglobin.

(2)

(Total for Question 8 = 15 marks)

TOTAL FOR PAPER = 80 MARKS

Please check the examination details below before entering your candidate information

Candidate surname	Other names

Centre Number | Candidate Number

Pearson Edexcel International Advanced Level

Tuesday 8 October 2024

Morning (Time: 1 hour 30 minutes)

Paper reference **WBI11/01**

Biology

International Advanced Subsidiary/Advanced Level
UNIT 1: Molecules, Diet, Transport and Health

You must have:
Scientific calculator, ruler, HB pencil

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided – *there may be more space than you need.*
- Calculators may be used.
- You must **show all your working out** with your answer **clearly identified** at the **end of your solution**.

Information

- The total mark for this paper is 80.
- The marks for **each** question are shown in brackets – *use this as a guide as to how much time to spend on each question.*
- In questions marked with an **asterisk** (*****), marks will be awarded for your ability to structure your answer logically, showing how the points you make are related or follow on from each other where appropriate.

Advice

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

Turn over ▶

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V:1/1/1/1/

P 7 8 3 8 4 A 0 1 3 2

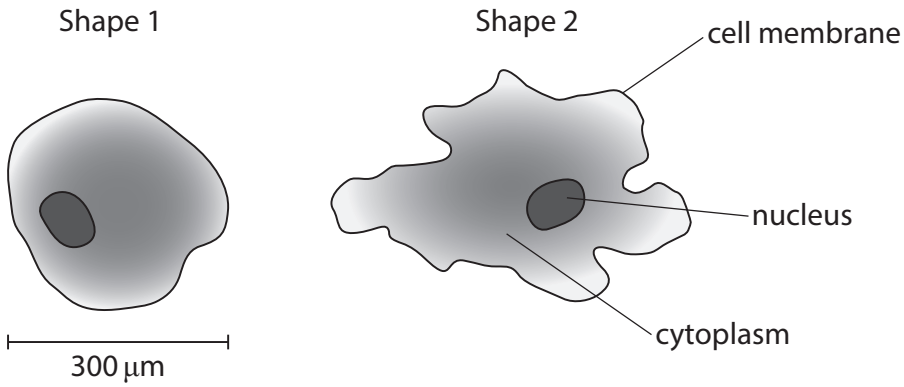
Pearson

Answer ALL questions. Write your answers in the spaces provided.

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

1 Amoeba are single-celled organisms that live in water. They are able to change their shape.

The diagram shows two different shapes that one amoeba can make.



(a) An amoeba changes shape by pushing cytoplasm against the cell membrane, forming long thin projections.

State the property of the cell membrane that enables the amoeba to change shape.

(1)

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(b) Gas exchange in an amoeba takes place across its cell membrane.

(i) The amoeba can be roughly spherical, as shown in Shape 1.

Which is the surface area of the amoeba in this shape?

Use the formula:

surface area of a sphere = $4\pi r^2$

(1)

☒ **A** $90\,000\pi\ \mu m^2$

☒ **B** $90\,000\pi\ \mu m^3$

☒ **C** $360\,000\pi\ \mu m^2$

☒ **D** $360\,000\pi\ \mu m^3$

(ii) The mass of the amoeba stays the same when it changes from Shape 1 to Shape 2.

Which row of the table shows what happens to the surface area and volume of this amoeba when it changes to Shape 2?

(1)

		surface area	volume
☒	**A**	decreases	decreases
☒	**B**	increases	increases
☒	**C**	increases	stays the same
☒	**D**	stays the same	stays the same

(iii) Explain why an amoeba can rely on diffusion to supply the oxygen it needs.

(2)

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(Total for Question 1 = 5 marks)

2 During the development of a human, the structure of haemoglobin changes.

In the developing fetus the main oxygen-carrying molecule is fetal haemoglobin.

Towards the end of fetal development, fetal haemoglobin is replaced by adult forms of haemoglobin.

(a) Blood may contain 5.3 million red blood cells in 1 mm^3 of blood.

One red blood cell can contain 270 million haemoglobin molecules.

Calculate the number of haemoglobin molecules in 1 mm^3 of blood.

Express your answer in standard form.

(1)

Answer .....

(b) Which of the following statements about the structure of haemoglobin are correct?

1. It is a fibrous protein
2. It has quaternary structure
3. It contains a non-protein haem group

(1)

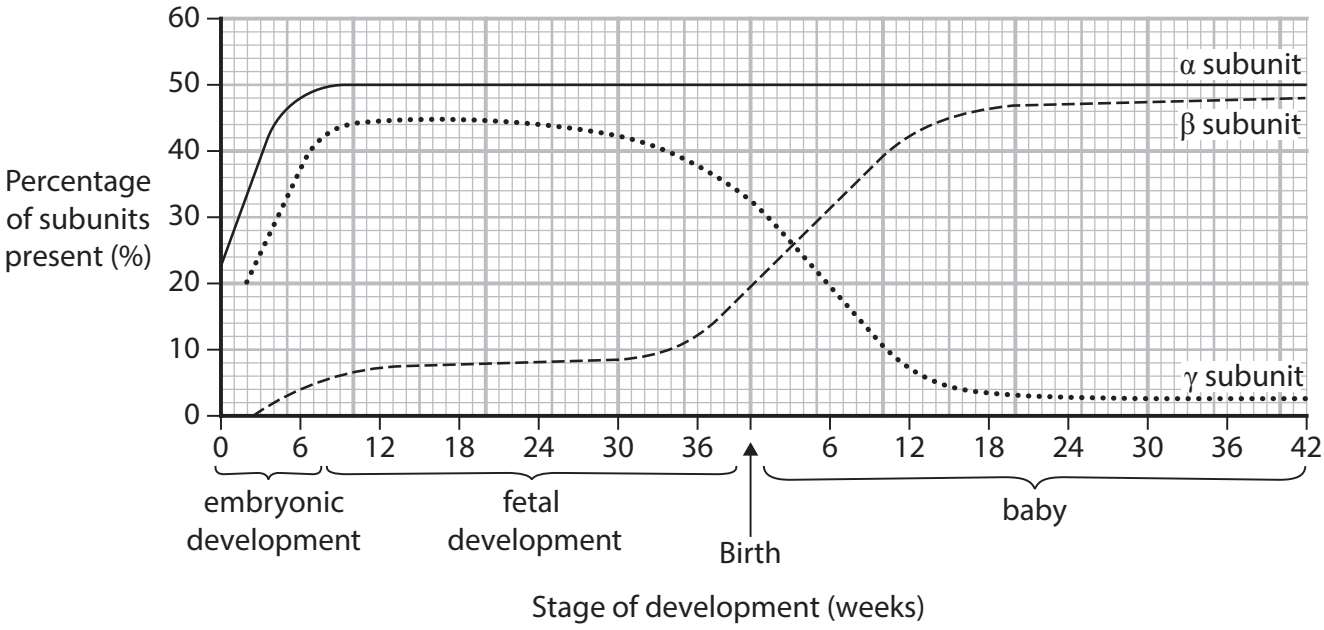
☒ **A** 1 only

☒ **B** 3 only

☒ **C** 1 and 2 only

☒ **D** 2 and 3 only

(c) The graph shows the changes for three types of haemoglobin subunits present during each stage of development.



(i) Describe the changes in these types of subunits present during each stage of development.

(3)

(ii) The oxygen affinity of fetal haemoglobin is different from adult haemoglobin.

Explain why this difference ensures the fetus obtains enough oxygen during development.

(2)

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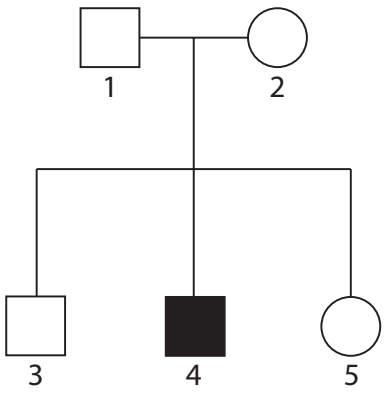
(Total for Question 2 = 7 marks)

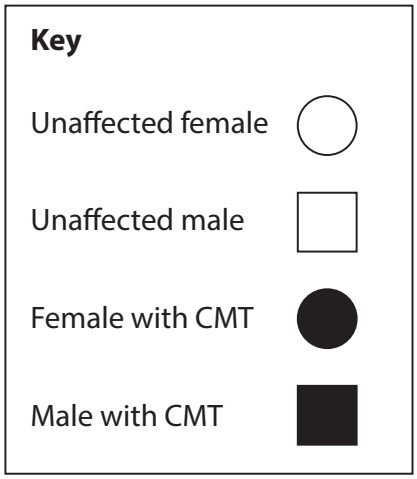
3 Charcot-Marie-Tooth (CMT) is an inherited disease that results in the gradual loss of function and sensation in the hands, arms, legs and feet.

Over 100 different gene mutations have been identified that cause CMT.

(a) The pedigree diagram shows the inheritance of one form of CMT in part of a family.

The allele for CMT can be represented by the letter c in this **recessive** pattern of inheritance.





(i) Which row of the table shows the genotype and phenotype for individual 1?

(1)

	genotype	phenotype
☒ **A**	CC	unaffected homozygous
☒ **B**	Cc	unaffected heterozygous
☒ **C**	unaffected heterozygous	CC
☒ **D**	unaffected homozygous	Cc

(ii) Which allele combinations could individual 3 have?

(1)

- ☒ **A** CC only
- ☒ **B** cc only
- ☒ **C** CC or cc
- ☒ **D** CC or Cc

(iii) What is the probability that a fourth child would be a female with CMT?

(1)

- ☒ **A** 1 in 2
- ☒ **B** 1 in 4
- ☒ **C** 1 in 8
- ☒ **D** 1 in 16

(b) Other forms of CMT show a dominant pattern of inheritance.

(i) In the USA, 5% of people with CMT have one of these dominant forms of the disease.

In the USA, there are a total of 126 000 people with all forms of CMT.

Calculate the number of people in the USA who have one of these dominant forms of CMT.

(1)

Answer .....

(ii) An individual with a dominant form of CMT will have the allele combination TT or Tt.

Draw a genetic diagram to show the possible allele combinations of the children of the following parents:

- parent 1 does not have CMT
- parent 2 has the allele combination Tt

Indicate whether each child will have CMT or be unaffected.

(3)

(c) Another form of CMT can be inherited as a sex-linked trait on the X chromosome.

Explain why a male with CMT **cannot** pass the disease on to his **sons**.

(2)

(Total for Question 3 = 9 marks)

4 The circulatory system and the cardiac cycle ensure that all the cells of the body are supplied with their requirements.

(a) The table shows the diameter of the lumens of an aorta and a capillary, and the thickness of their walls.

Type of blood vessel	Diameter of lumen	Thickness of wall / mm
aorta	2.5 cm	2.0
capillary	0.14 μm	0.001

(i) How many times greater is the diameter of the lumen of the aorta than the diameter of the lumen of the capillary?

(1)

☒ **A** 17 800

☒ **B** 17 900

☒ **C** 178 000

☒ **D** 179 000

(ii) Explain why the wall of the aorta is thicker than the wall of a capillary.

(3)

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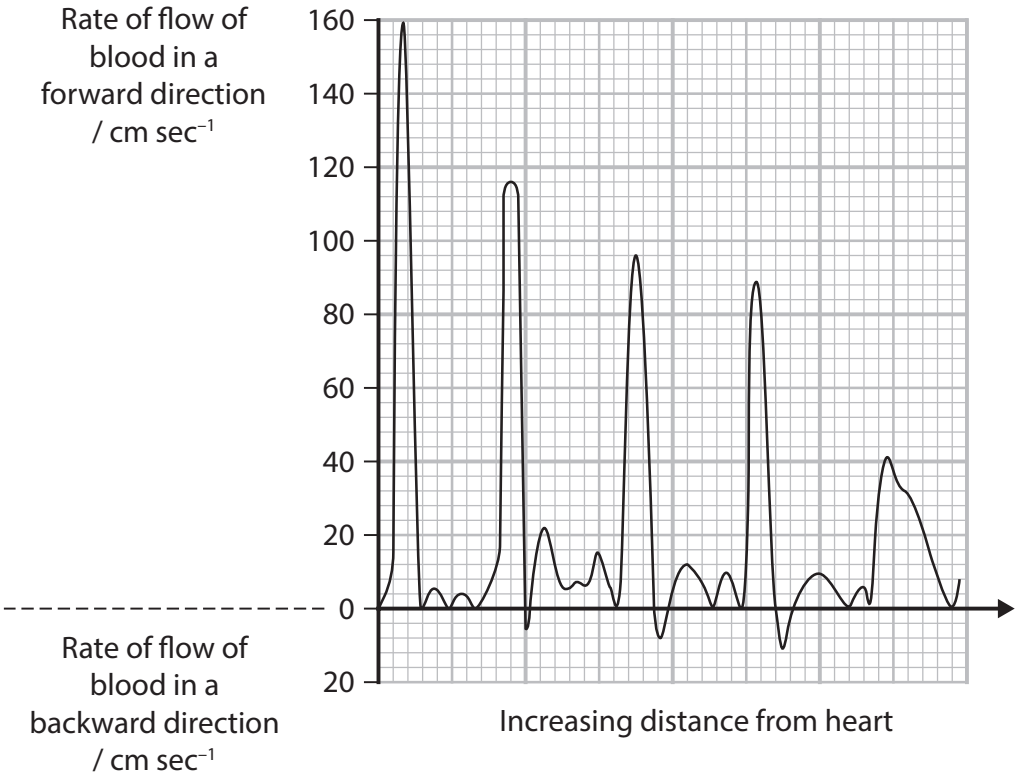
(b) The table shows the durations of ventricular diastole and ventricular systole at two different heart rates.

Heart rate / beats per minute	Duration of ventricular diastole / seconds	Duration of ventricular systole / seconds
75	0.53	0.27
200	0.14	0.16

Determine the relationship between heart rate and the duration of ventricular diastole and ventricular systole.

(2)

(c) The graph shows the rate of flow of blood through the aorta of a dog with increasing distance from the heart.



Explain the changes in rate and direction of flow of blood through this aorta.

Use the information in the graph to support your answer.

(3)

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(Total for Question 4 = 9 marks)

5 Warfarin is used as an anticoagulant to treat some patients.

Patients respond differently to this drug. This makes it difficult for doctors to select a safe but effective dose of warfarin to give to each patient.

Factors that affect the response of a patient to warfarin include age, body mass, liver function and genetic makeup.

(a) Explain why a safe but effective dose of warfarin needs to be given to a patient.

(2)

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(b) There are two genes that code for proteins that affect warfarin and the blood clotting process.

Gene M:

- codes for enzyme M that breaks down warfarin into inactive molecules
- has many alleles and two of these code for much slower breakdown of warfarin.

Gene V:

- codes for enzyme V that converts vitamin K into an active form that triggers the blood clotting process
- one version of this gene results in a decreased production of the messenger RNA (mRNA) needed for the synthesis of enzyme V.

(i) Describe the role of mRNA in the production of enzymes.

(2)

*(ii) Pharmacogenomics analyses the genetic profile of individuals.

This analysis is used to determine the appropriate doses of a drug for individual patients.

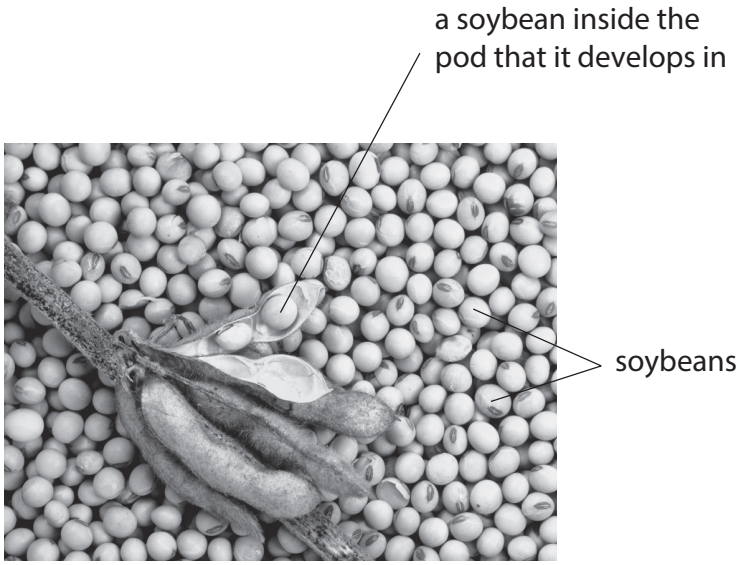
Discuss the possible use of pharmacogenomics in selecting appropriate doses of warfarin for individual patients.

Use the information in the question and your own knowledge of the blood clotting process and genetic screening to support your answer.

(6)

(Total for Question 5 = 10 marks)

6 The photograph shows some soybeans.



(a) Eating soybeans may reduce cholesterol and low-density lipoproteins (LDLs) in the blood.

Explain why eating soybeans may reduce the risk of heart disease.

(3)

(b) The extent to which soybeans reduce cholesterol depends on the variety of soybeans. This reduction is influenced by two proteins found in soybeans, glycinin and β-conglycinin.

Give **two** ways that the primary structure of two proteins could differ from each other.

(1)

1 .....

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2 .....

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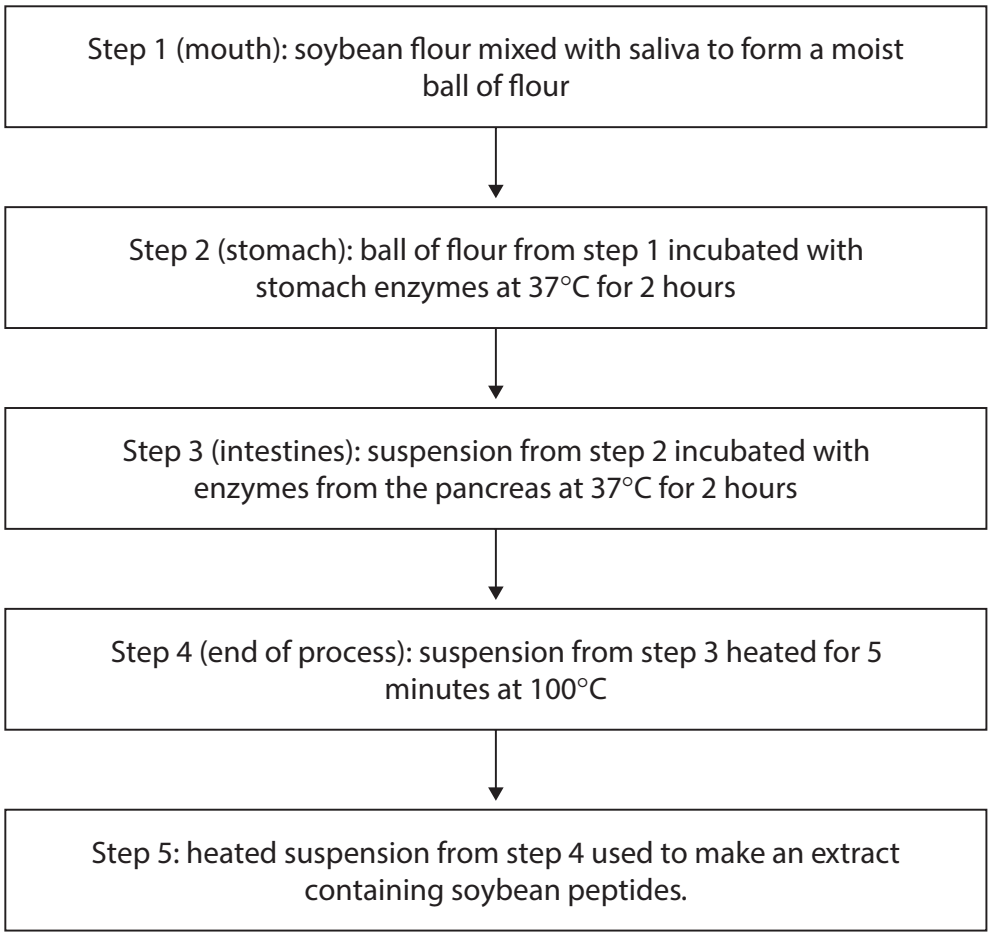
(c) The effect of soybean extracts on cholesterol production by liver cells growing in culture was investigated.

Scientists produced fat-free soybean flour and digested it with enzymes, in a way that copied digestion in the human digestive system.

The diagram shows some of the steps used.



(i) Explain why the scientists used digested soybeans to make the extract for this investigation.

(2)

(ii) Suggest why the soybean flour was incubated with different enzymes in steps 2 and 3.

(1)

(iii) Explain why the soybean flour and enzymes were incubated at 37 °C for 2 hours in steps 2 and 3.

(2)

37 °C

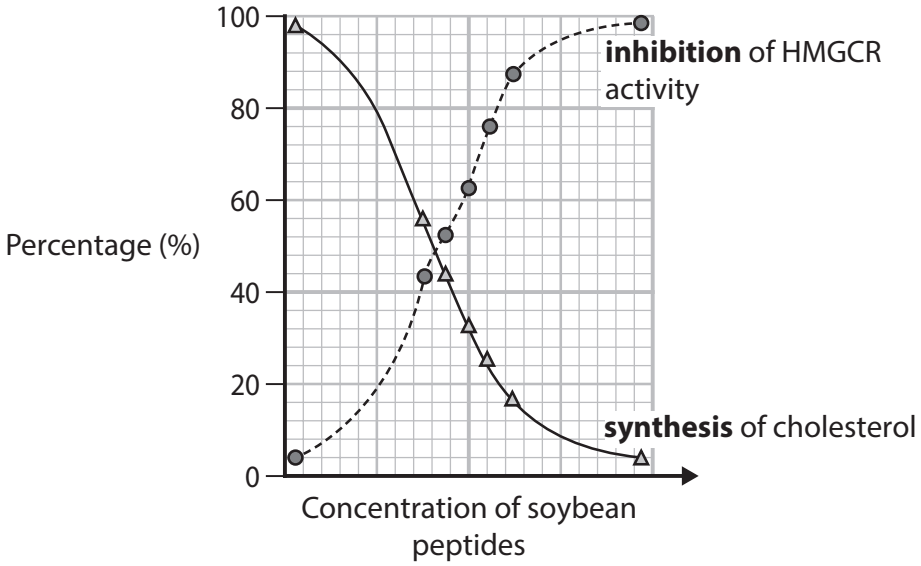
2 hours

(d) The soybean peptides, at different concentrations, were incubated with the liver cells growing in culture.

The enzyme HMGCR is involved in the synthesis of cholesterol.

The effect of soybean peptides on the activity of this enzyme and the synthesis of cholesterol was measured.

The graph shows the results.



Explain why eating soybeans may reduce cholesterol levels in the blood.

Use the information in the graph to support your answer.

(3)

(Total for Question 6 = 12 marks)

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QUESTION 7 BEGINS ON THE NEXT PAGE.

7 Scientists investigated the numbers and types of mutations in different species of animal.

Samples of tissue were collected from living animals of each species and the types of mutation determined.

(a) The types of mutation were classed as either substitution mutations or insertion and deletion mutations.

The table shows the results of this investigation.

Species of animal	Number of animals sampled	Range of number of mutations per cell	
		Substitution	Insertion and deletion
Naked mole rat	3	100 to 850	10 to 50
Mouse	10	300 to 2 000	50 to 400
Dog	3	1 000 to 3 000	50 to 300
Human	8	200 to 350	10 to 200

(i) Describe how these types of mutation affect the **DNA base sequence** of a gene.

(2)

(ii) Explain why these animals can survive with a greater number of substitution mutations than insertion and deletion mutations.

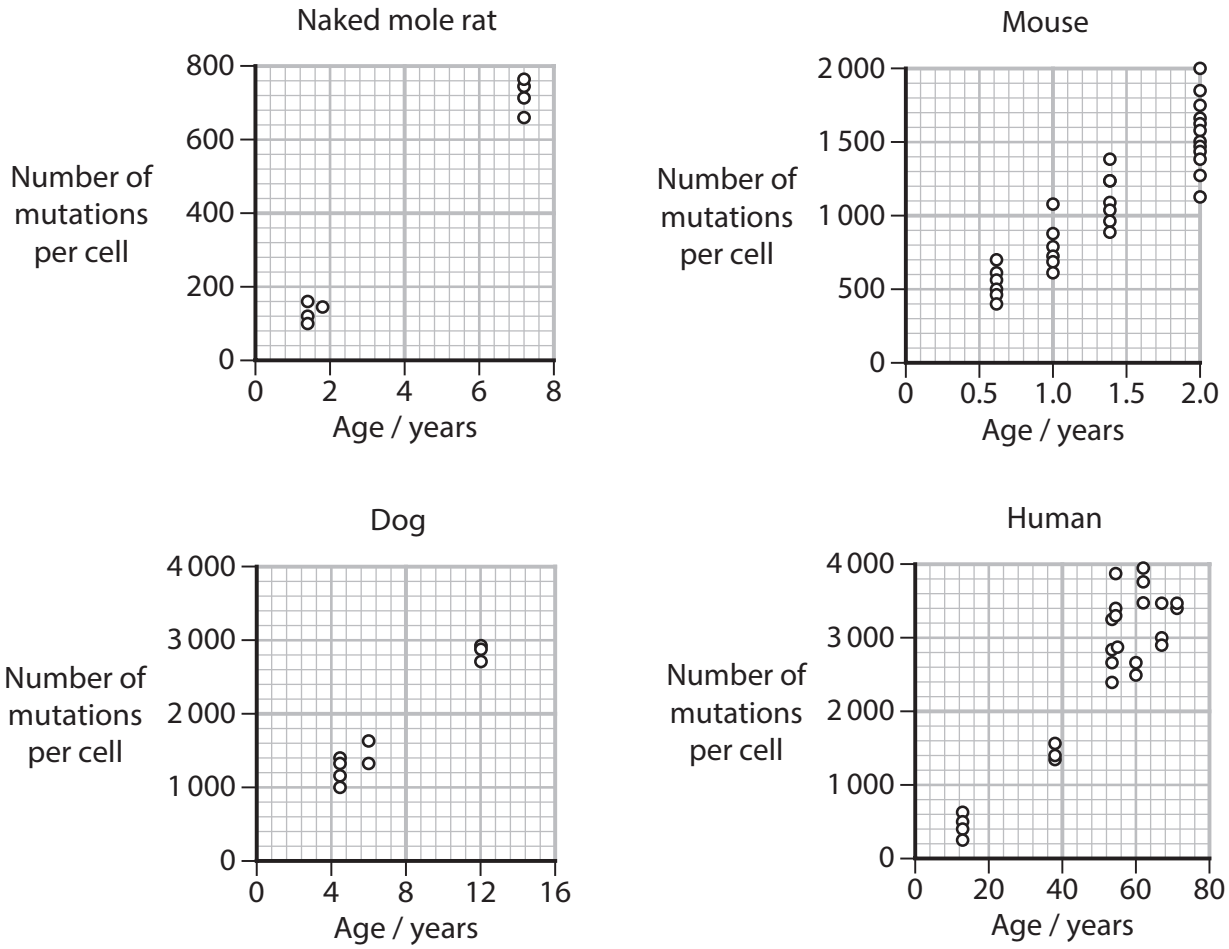
(4)

(iii) Suggest which set of data is the most valid.

Give a reason for your answer.

(1)

(b) The graphs show the number of mutations per cell during the lifespans of these four animals.



(i) Calculate the mean mutation rate for the mouse.

Draw a line of best fit onto the graph to help you.

(2)

Answer ..... number of mutations per cell year^{-1}

(ii) Describe **three** conclusions that can be made from these graphs.

(3)

1 .....

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2 .....

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3 .....

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(iii) Suggest **two** reasons for the differences in the number of mutations per cell of these species of animal.

(2)

1 .....

.....

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2 .....

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(Total for Question 7 = 14 marks)

8 The photograph shows two avocados.

(a) Avocados are high in unsaturated fatty acids and low in saturated fatty acids.

Compare and contrast the structure of an unsaturated fatty acid and the structure of a saturated fatty acid.

(3)

(b) The effect of eating avocados each week on the risk of coronary heart disease (CHD) was investigated.

A group of men and women who had no signs of cardiovascular disease (CVD) or stroke were selected. They were all between the ages of 30 and 75.

The group ate avocados each week to replace animal products in their diet whenever possible.

The group all completed a questionnaire about the food they ate at the start of the investigation and every four years after that for over 30 years.

(i) There were 41 701 men and 68 786 women in the group.

Which is the ratio of men to women?

(1)

☒ **A** 0.6 : 1

☒ **B** 1 : 0.6

☒ **C** 1 : 2

☒ **D** 2 : 1

*(ii) Describe the questions that need to be in the questionnaire so that appropriate information can be gathered for this investigation.

Give reasons for choosing these questions.

(6)

(iii) Comment on the validity of the methods used in this investigation.

(4)

(Total for Question 8 = 14 marks)

TOTAL FOR PAPER = 80 MARKS