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

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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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

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(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)

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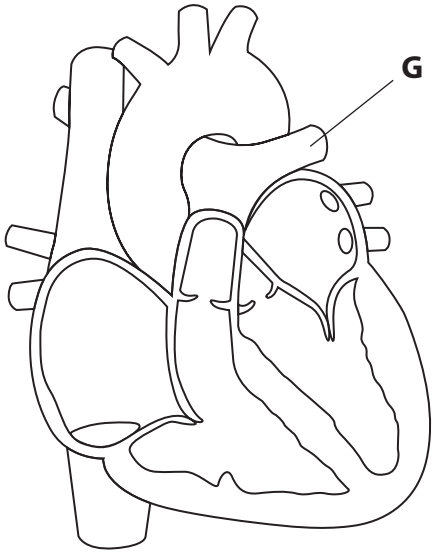
2 The cardiac cycle describes the events that take place in the heart during one complete heartbeat.

(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

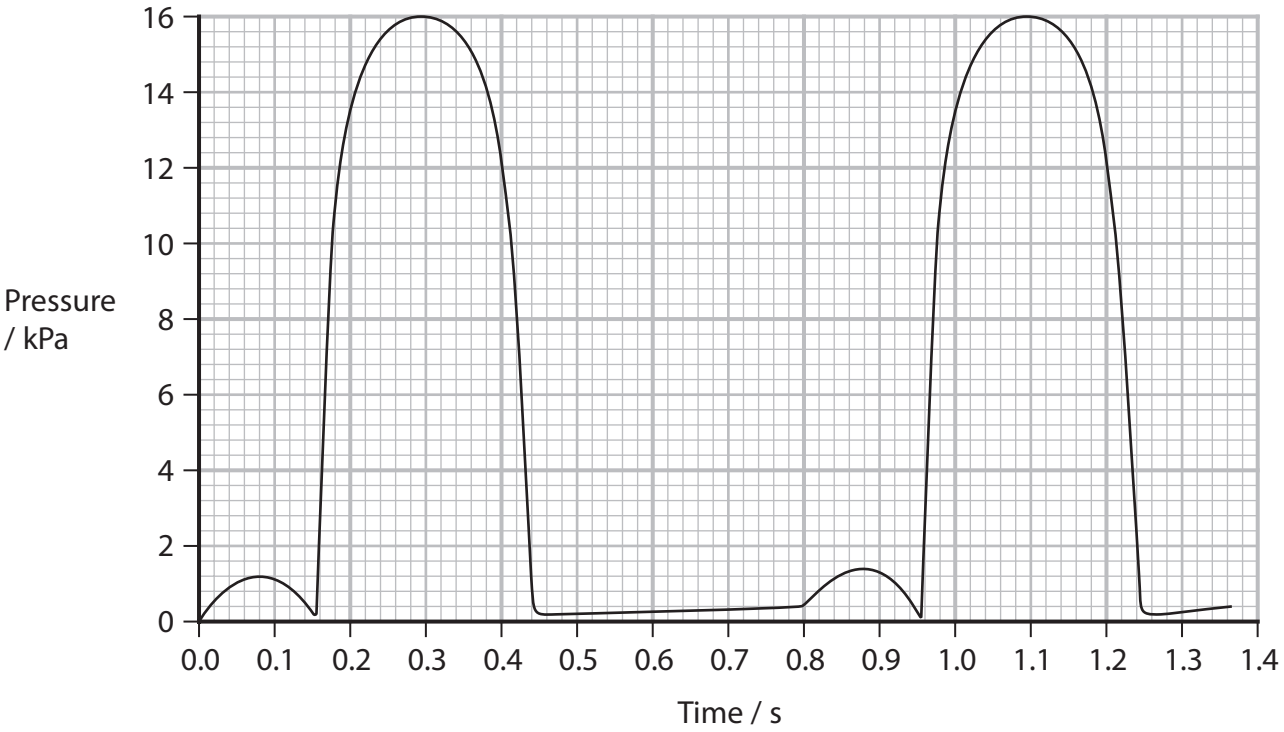
☒ **D** vena cava

(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}

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(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)

(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

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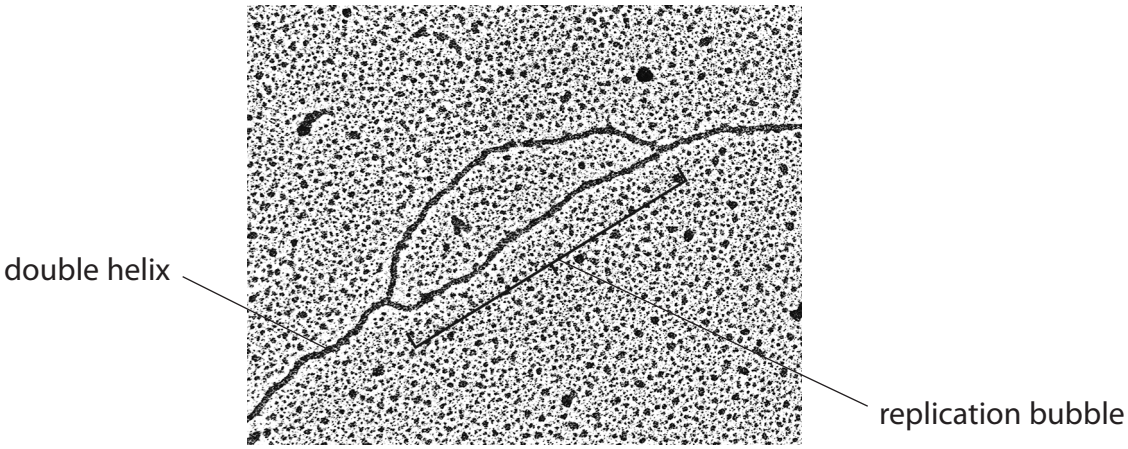
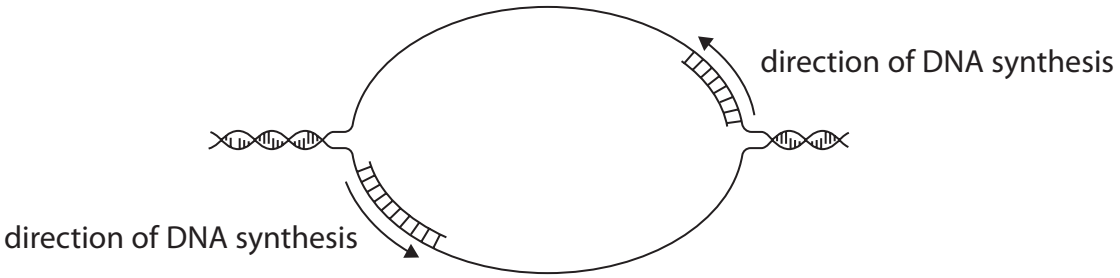
(c) In human cells, replication of DNA occurs at several sites along the molecule. These sites are called replication bubbles.

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)

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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)

(Total for Question 4 = 7 marks)

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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.

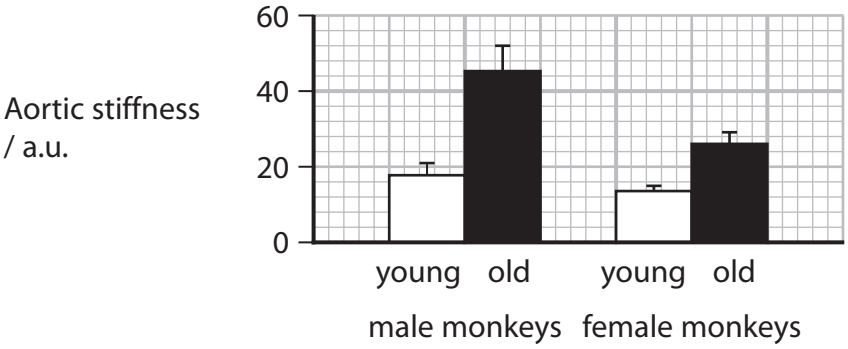
(2)

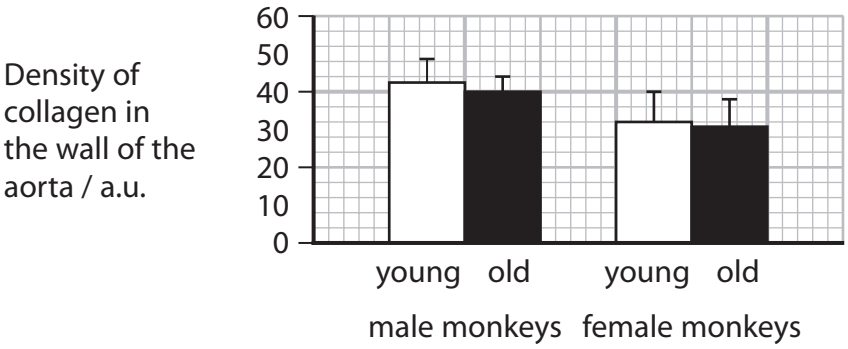
*(b) Age and sex affect the types and density of collagen found in the wall of the aorta.

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.

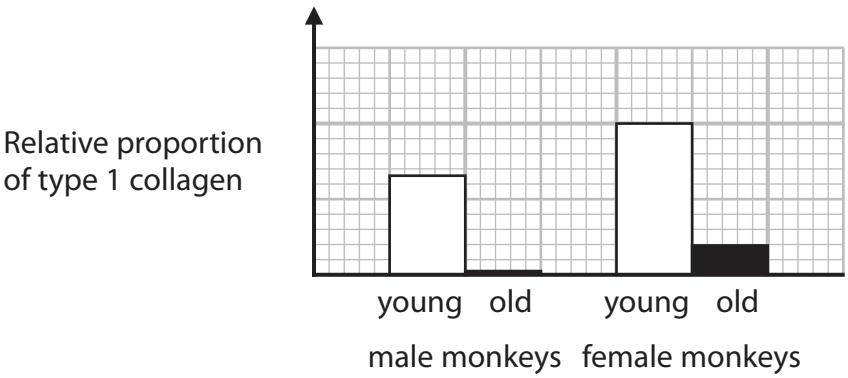
The graphs show the results of this study.





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.



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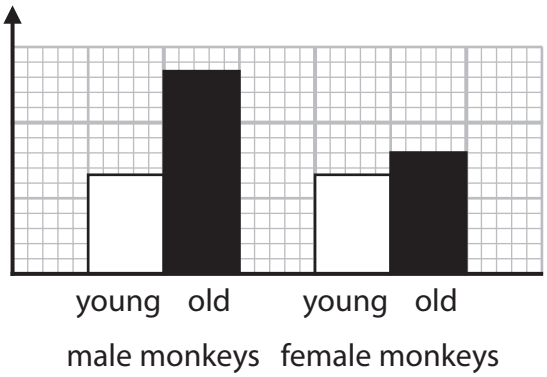
Relative proportion of type 8 collagen



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)

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

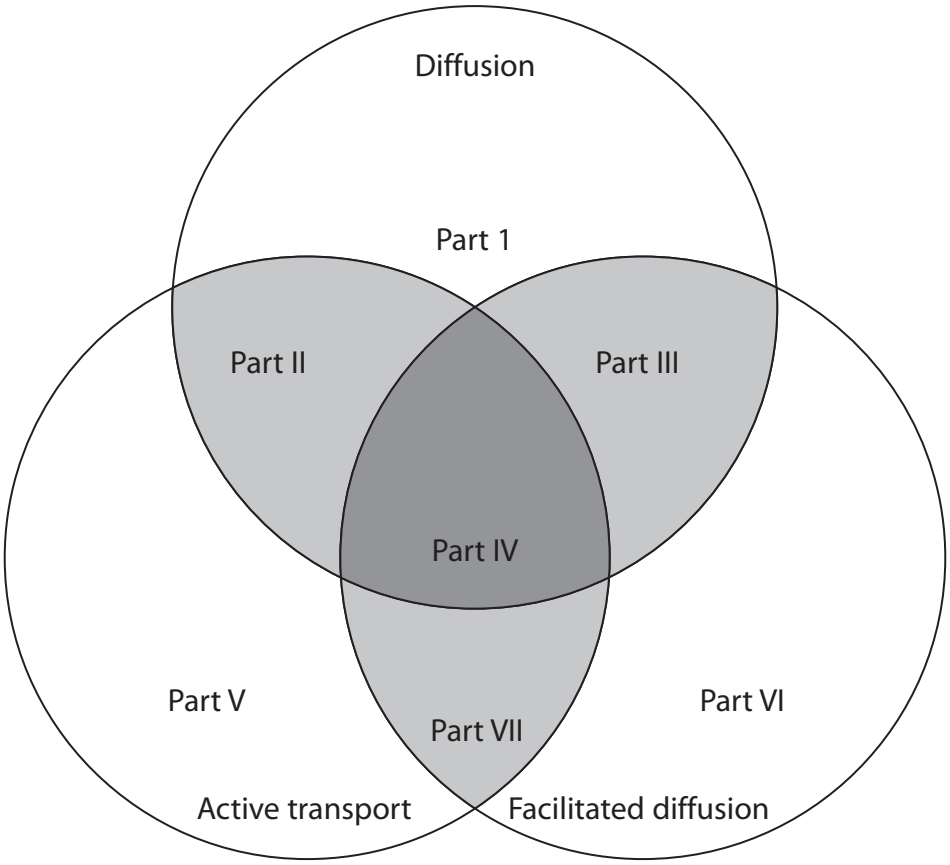
Processes by which substances can move into a cell or out of a cell include diffusion, facilitated diffusion, active transport and osmosis.

(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

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(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.



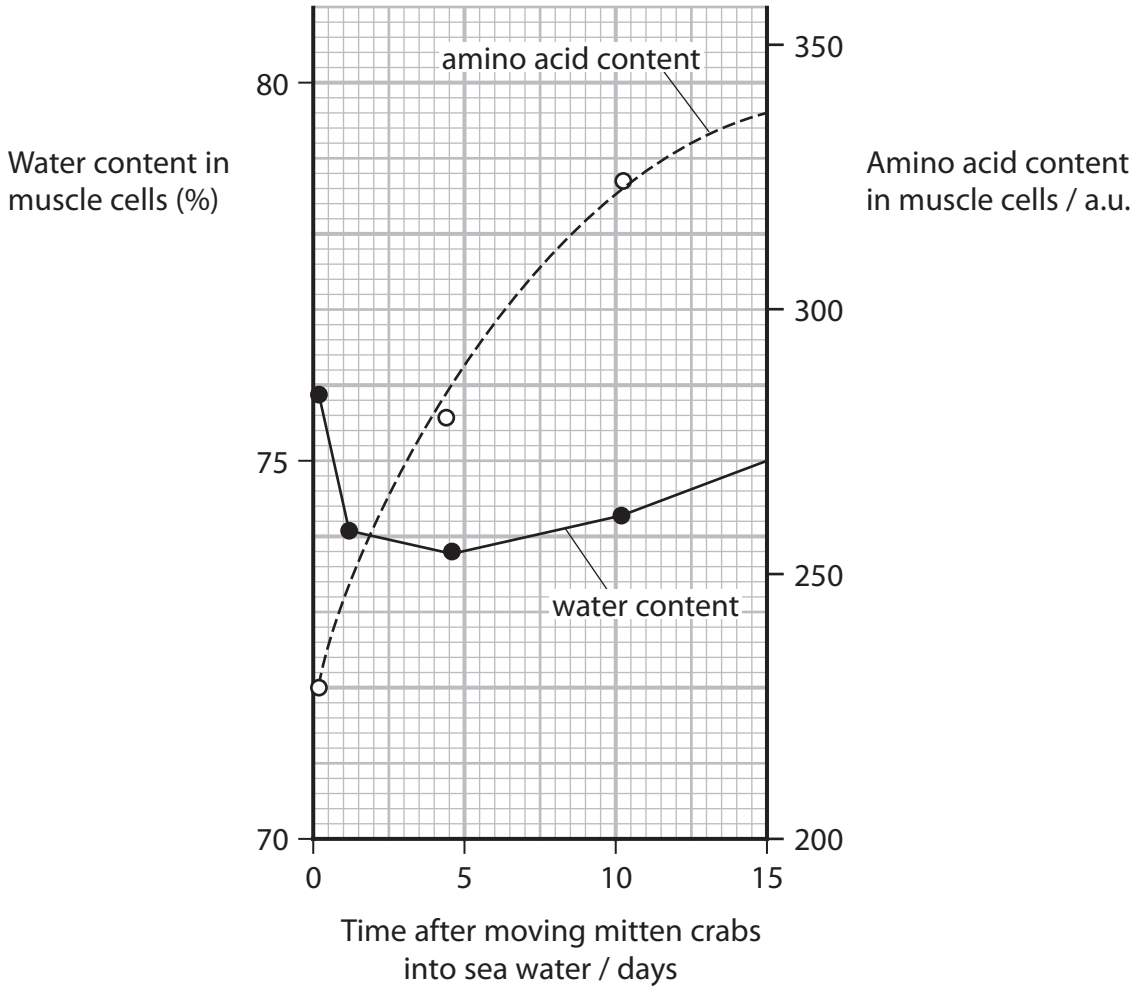
(Source: © WILDLIFE GmbH / Alamy Stock Photo)

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.



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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)

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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)

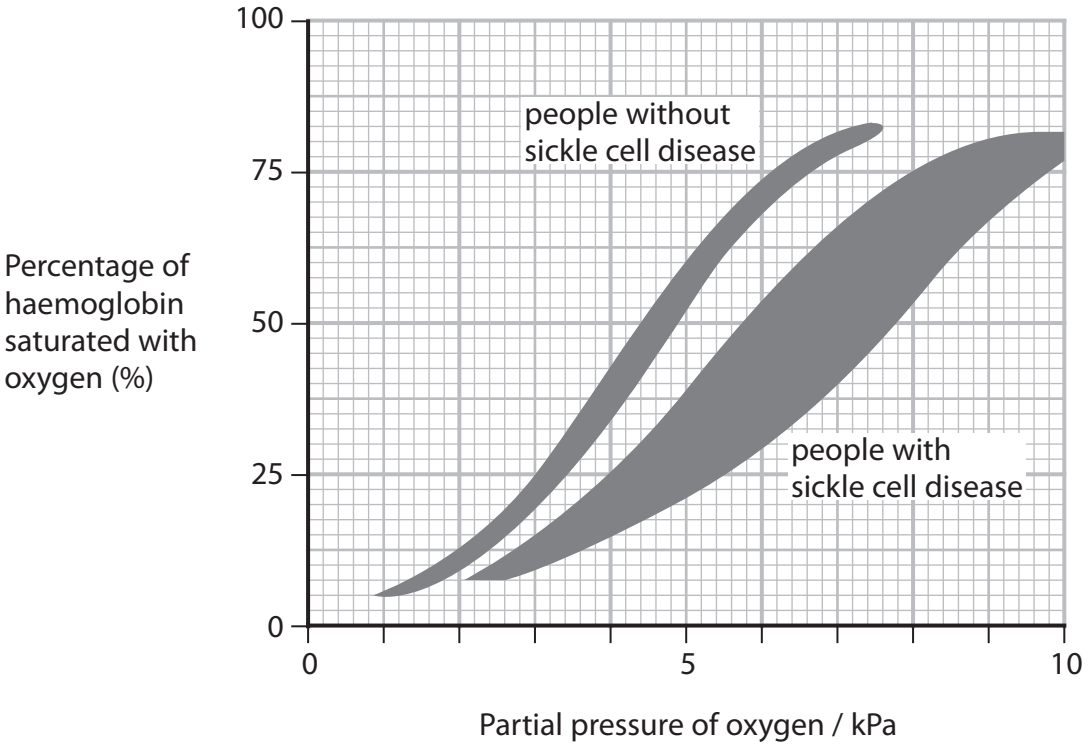
Answer .....

(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.



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(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

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