



**Organisation**  
**Higher**

Name: \_\_\_\_\_

Class: \_\_\_\_\_

Date: \_\_\_\_\_

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Time: **168 minutes**

Marks: **164 marks**

Comments:

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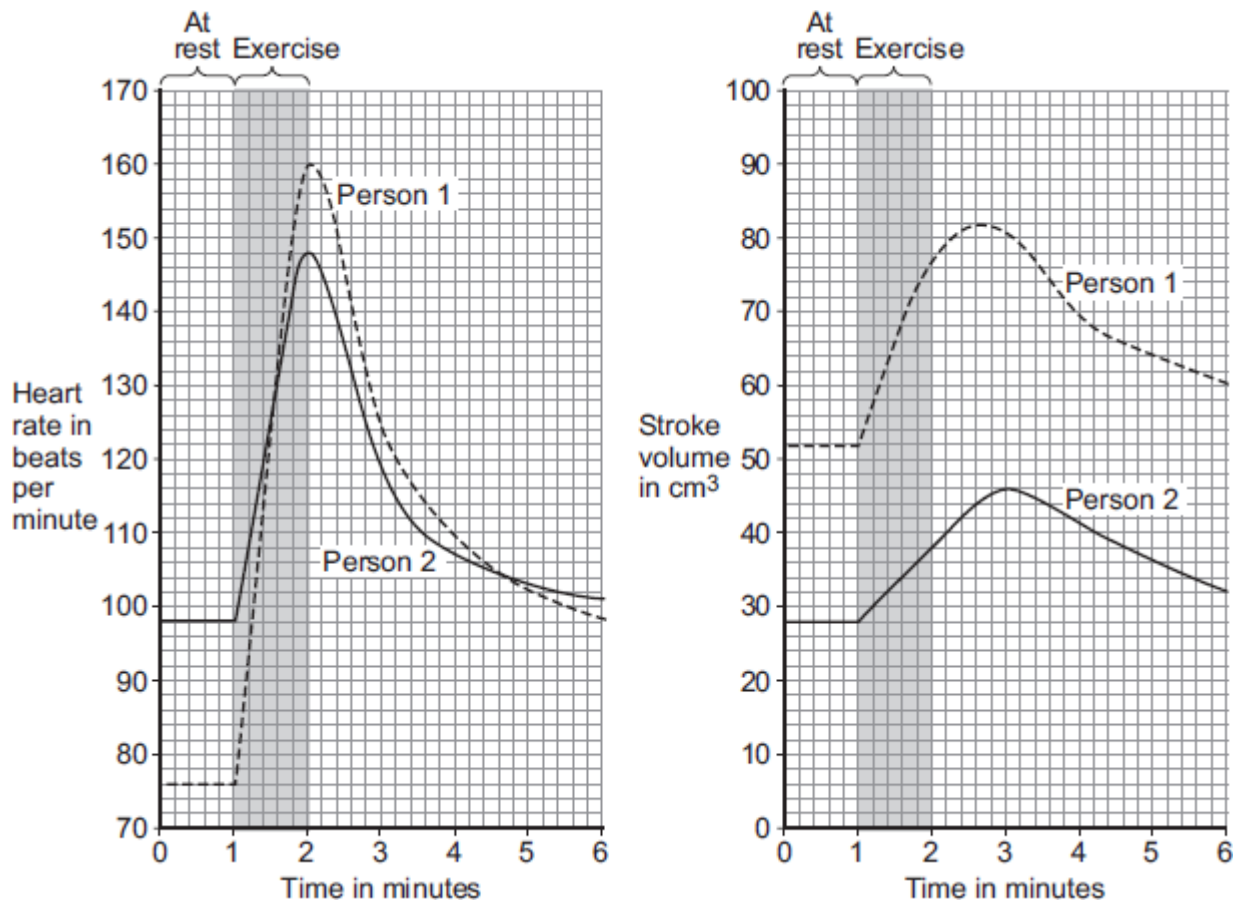
**Q1.**

During exercise, the heart beats faster and with greater force.

The 'heart rate' is the number of times the heart beats each minute. The volume of blood that travels out of the heart each time the heart beats is called the 'stroke volume'.

In an investigation, **Person 1** and **Person 2** ran as fast as they could for 1 minute. Scientists measured the heart rates and stroke volumes of **Person 1** and **Person 2** at rest, during the exercise and after the exercise.

The graph below shows the scientists' results.



- (a) The 'cardiac output' is the volume of blood sent from the heart to the muscles each minute.

$$\text{Cardiac output} = \text{Heart rate} \times \text{Stroke volume}$$

At the end of the exercise, **Person 1's** cardiac output =  $160 \times 77 = 12\,320 \text{ cm}^3$  per minute.

Use information from **Figure above** to complete the following calculation of **Person 2's** cardiac output at the end of the exercise.

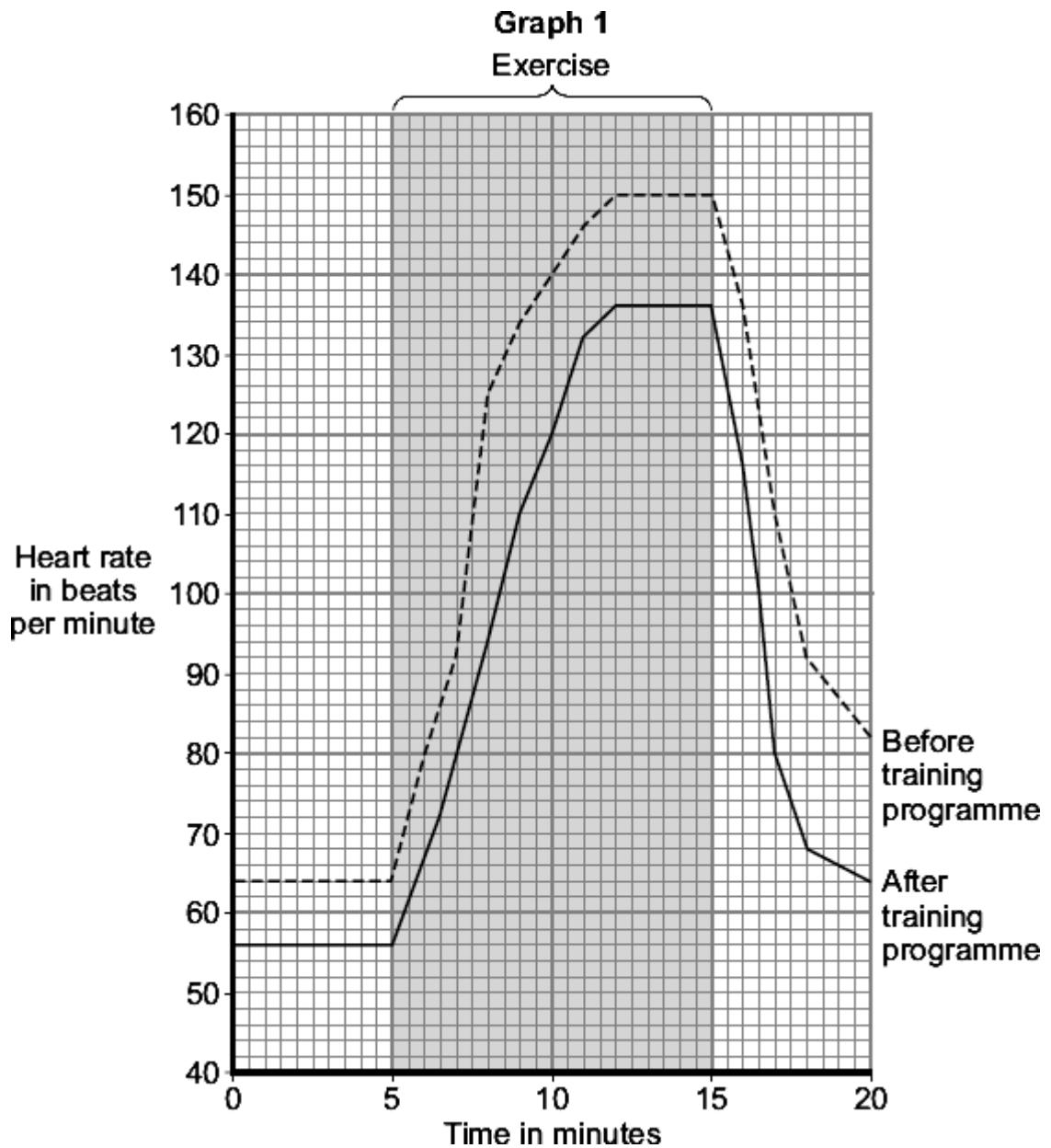
At the end of the exercise:

**Person 2's** heart rate = \_\_\_\_\_ beats per minute

**Person 2's** stroke volume = \_\_\_\_\_  $\text{cm}^3$

**Person 2's** cardiac output = \_\_\_\_\_  $\text{cm}^3$  per minute





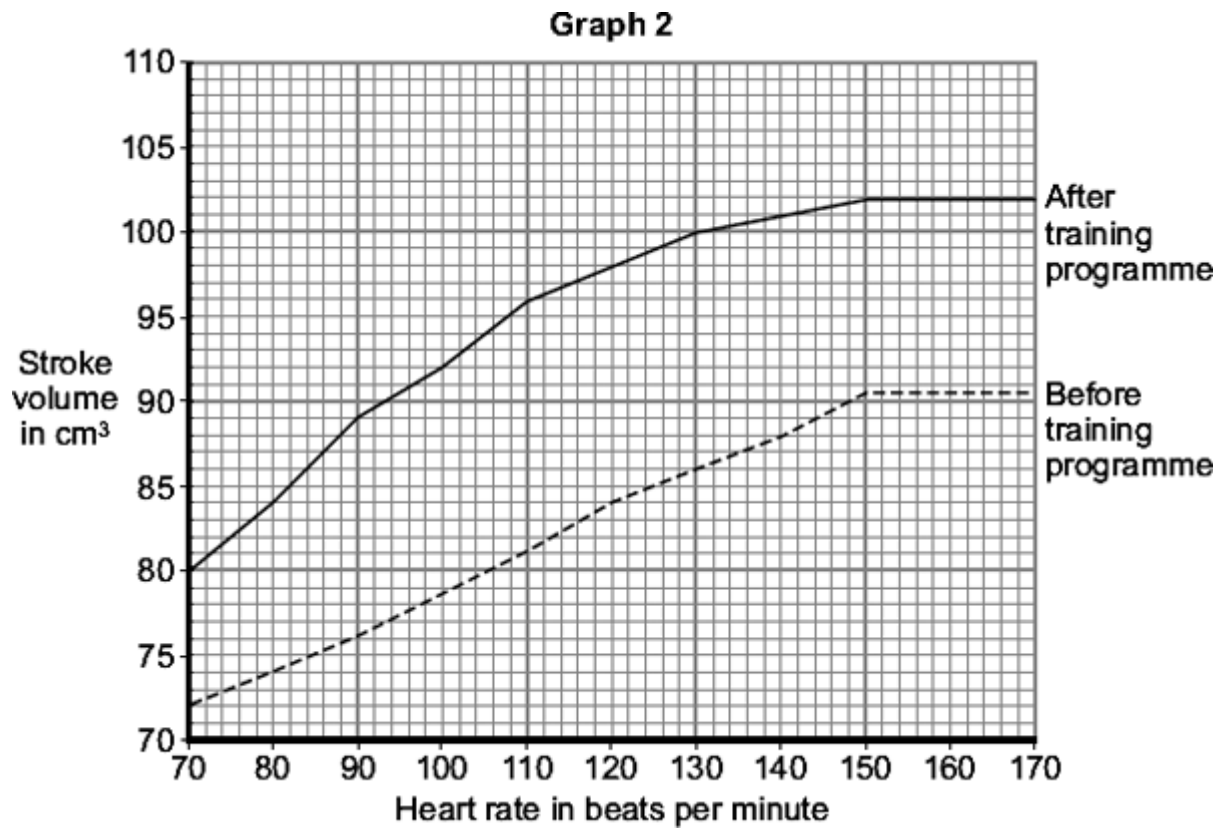
- (a) (i) Use **Graph 1** to find the heart rate of the **trained** athlete 5 minutes after the start of the exercise.

Heart rate = \_\_\_\_\_ beats per minute

(1)

The stroke volume of the heart is the volume of blood pumped out of the left side of the heart in one heart beat.

**Graph 2** shows the relationship between the stroke volume and the heart rate before and after the athlete did the training programme.



(ii) The *cardiac output* is defined as

$$\text{cardiac output} = \text{heart rate} \times \text{stroke volume}$$

Calculate the cardiac output of the **trained** athlete 5 minutes after the start of the exercise. Use your answer to part (a)(i), and information from **Graph 2**.

Show clearly how you work out your answer.

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Cardiac output = \_\_\_\_\_ cm<sup>3</sup> blood per minute

(2)

(b) **Graph 1** shows that, for the same amount of exercise, the heart of the trained athlete was beating more slowly than it did before the training programme.

Use information from **Graph 2** to explain why.

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(2)

(c) An increased cardiac output will provide more oxygen and more glucose to the working muscles.

Explain how this helps the athlete during exercise.

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(4)  
(Total 9 marks)

**Q3.**

Plants exchange substances with the environment.

- (a) Plant roots absorb water mainly by osmosis.  
Plant roots absorb ions mainly by active transport.

Explain why roots need to use the two different methods to absorb water and ions.

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(4)

- (b) What is meant by the *transpiration stream*?

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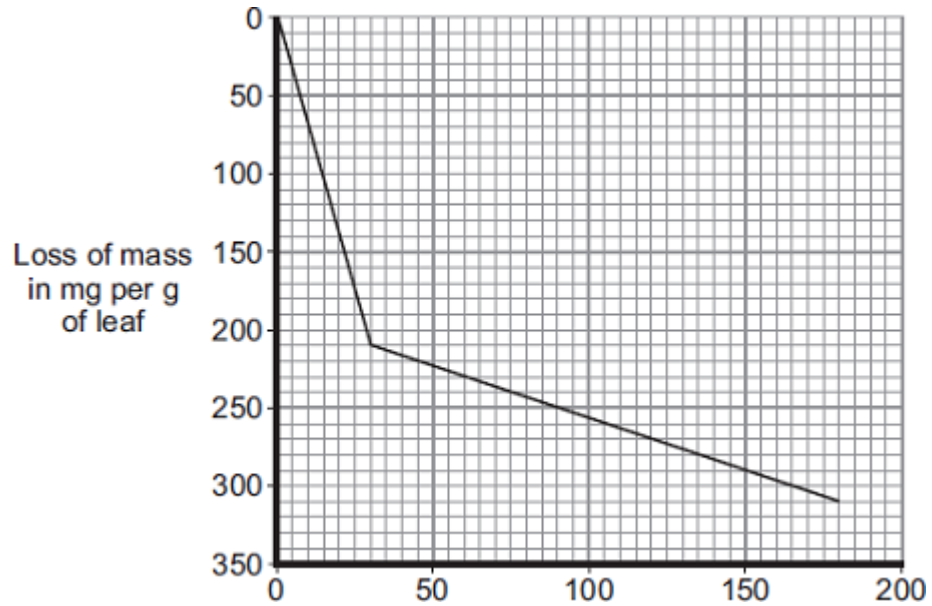
(3)

- (c) Students investigated the loss of water vapour from leaves.

The students:

- cut some leaves off a plant
- measured the mass of these leaves every 30 minutes for 180 minutes.

The graph shows the students' results.



- (i) The rate of mass loss in the first 30 minutes was 7 milligrams per gram of leaf per minute.

Calculate the rate of mass loss between 30 minutes and 180 minutes.

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Rate of mass loss = \_\_\_\_\_ milligrams per gram of leaf per minute

(2)

- (ii) The rate of mass loss between 0 and 30 minutes was very different from the rate of mass loss between 30 and 180 minutes.

Suggest an explanation for the difference between the two rates.

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(2)

(Total 11 marks)

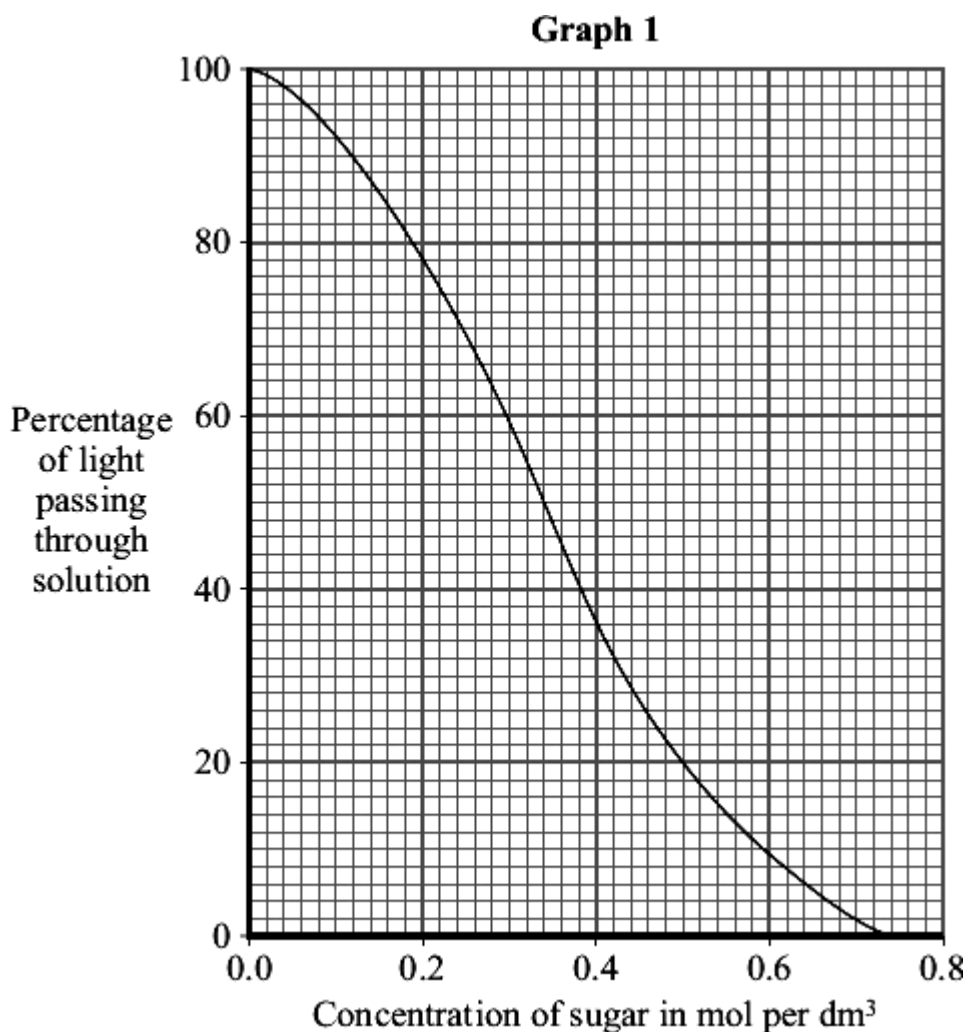
#### Q4.

Starch is broken down into sugar by amylase. Amylase is produced in the salivary glands.

- (a) Name **two** other organs in the digestive system which produce amylase.

- (b) A colorimeter measures colour intensity by measuring the percentage of light that passes through a solution.

**Graph 1** shows the percentage of light passing through sugar solutions of different concentrations to which a test reagent has been added.



Students used a colorimeter to compare the starch-digesting ability of amylase enzymes obtained from two organs, **P** and **Q**.

- The students collected 5 cm<sup>3</sup> samples of amylase from **P** and **Q** and placed them into a water-bath at 40 °C.
- Two test tubes containing 10 cm<sup>3</sup> samples of starch solution were also placed into the water-bath.
- All the tubes were left in the water-bath for 10 minutes.
- Each amylase sample was added to one of the tubes containing the starch solution.
- The test tubes were placed back into the water-bath.
- Every minute, a few drops were taken from each tube, the test reagent was added and the percentage of light passing through this solution was measured in the colorimeter.



The tubes containing amylase samples and starch solution were left in the water-bath for ten minutes before the amylase was added to the starch.

Explain why.

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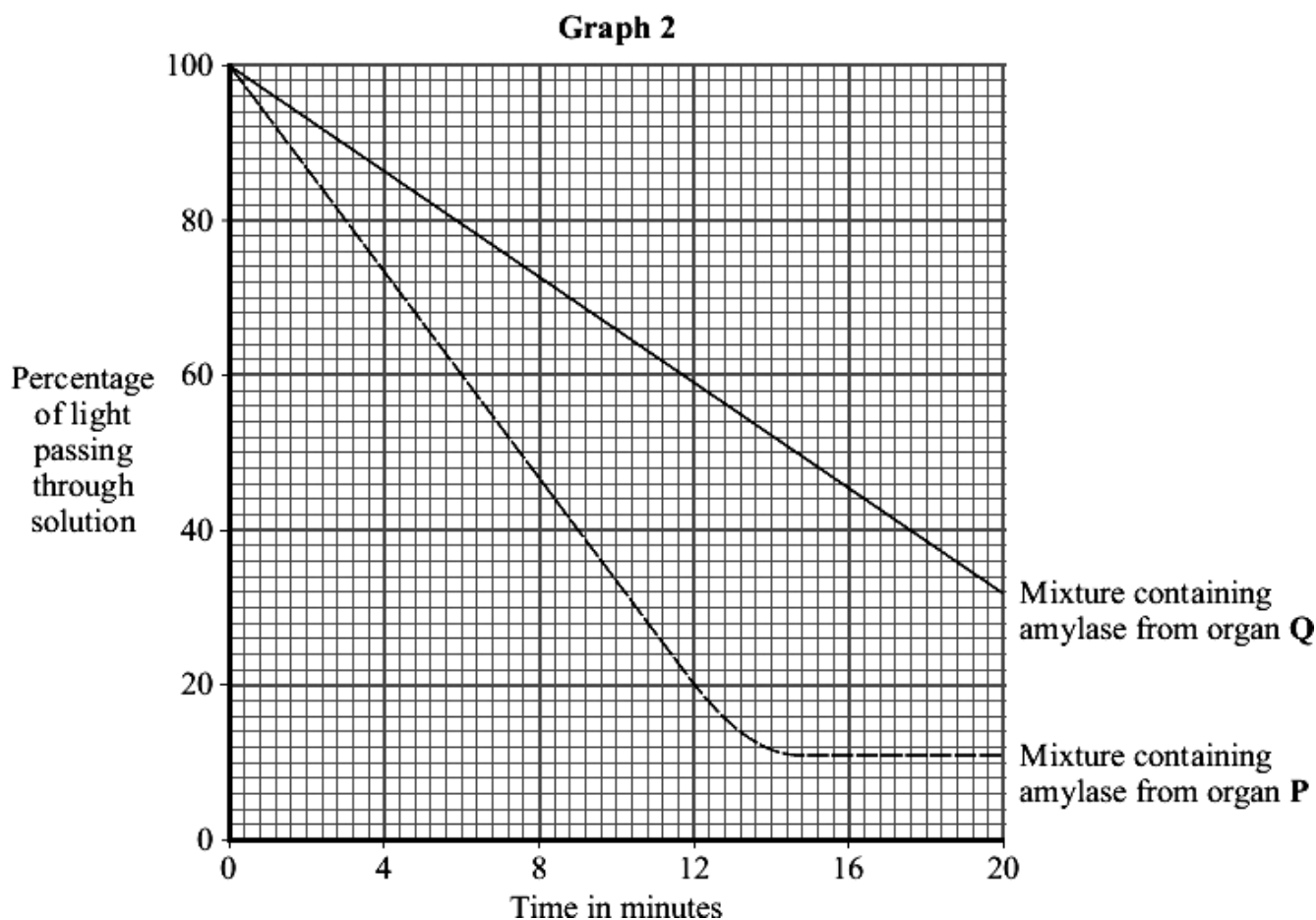
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(2)

- (c) **Graph 2** shows how the readings from the colorimeter changed over the next 20 minutes.



- (i) Use **Graph 1** and **Graph 2** to determine the concentration of sugar in the mixture from organ **Q** after 20 minutes.

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Answer \_\_\_\_\_ mol per dm<sup>3</sup>

(1)

- (ii) Use your answer to (c)(i) to calculate the rate at which sugar was produced in the mixture containing amylase from organ **Q**.

Show clearly how you work out your answer.

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Answer \_\_\_\_\_ mol per dm<sup>3</sup> per minute

(2)

- (iii) Suggest why the amount of light passing through the mixture from organ **P** did not change after 16 minutes.

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(1)

- (iv) One of the students suggested that they could have completed their experiment more quickly if the temperature of the water-bath had been set at 80 °C.

This would **not** have been the case.

Explain why.

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(2)

(Total 10 marks)

**Q5.**

The villi of the small intestine absorb the products of digestion.

The diagram shows two villi. It also shows parts of some of the surface cells of a villus, as seen with an electron microscope.



**Q6.**

Fresh milk is a mixture of compounds including fat, protein and about 5 % lactose sugar. Lactose must be digested by the enzyme lactase, before the products can be absorbed.

Lactase can be added to fresh milk to pre-digest the lactose. This makes 'lactose-free' milk, which is suitable for people who do not produce enough lactase of their own.

A student investigated the effect of changing pH and temperature on the digestion of lactose in milk.

The results are shown in **Tables 1** and **2**.

**Table 1**  
Effect of pH

pH	Time taken to digest lactose in minutes
4.0	20
5.0	18
6.0	13
7.0	7
8.0	5
9.0	6

**Table 2**  
Effect of temperature

Temperature in °C	Time taken to digest lactose in minutes
30	20
35	14
40	11
45	6
50	12
55	23

- (a) The label on a carton of lactose-free milk states:

'Lactase is normally produced in the stomach of mammals.'

The results in **Table 1** show that this statement is unlikely to be true.

Explain how.

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(2)

(b) Explain as fully as you can the results shown in **Table 2**.

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(3)

(c) Bile is produced in the liver and is released into the small intestine.

Explain how bile helps the digestion of milk.

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(2)

(Total 7 marks)

**Q7.**

Oxygen is transported round the body by the blood.

Blood leaving the human lung can carry about 250 milligrams of oxygen per litre. However, only 7 milligrams of oxygen will dissolve in one litre of water at body temperature.

(a) Suggest an explanation for the difference.

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(2)

(b) Blood leaving the skeletal muscles during exercise may contain only 30 milligrams of oxygen per litre.

Explain what causes the difference in oxygen concentration between the blood leaving the lungs and the blood leaving the skeletal muscles.

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(4)  
(Total 6 marks)

**Q8.**

The concentration of cholesterol in the blood affects people's health.

(a) Give **two** factors that affect the concentration of cholesterol in the blood.

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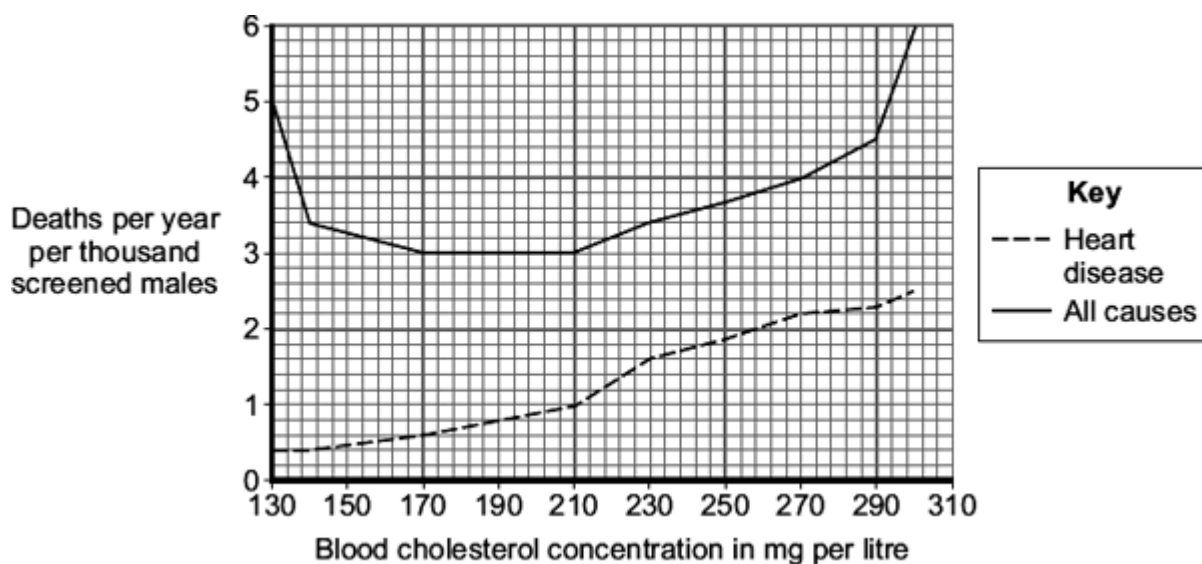
2. \_\_\_\_\_

(2)

(b) Doctors screened men for blood cholesterol concentration.

The doctors then compared death rates from heart disease with deaths from all causes in this screened group.

The graph shows the results.



(i) Which is the best conclusion that can be drawn from the data?

Tick (✓) **one** box.

There is a positive correlation between blood cholesterol concentration and deaths from all causes.

There is a negative correlation between blood cholesterol concentration and deaths from all causes.

Blood cholesterol concentration is only one of several factors affecting death from all causes.

(1)

- (ii) Based on the data in the graph **only**, which is the ideal range for blood cholesterol concentration?

Range \_\_\_\_\_ to \_\_\_\_\_ mg cholesterol per litre.

(1)

(Total 4 marks)

### Q9.

There are enzymes in biological washing powders. Biological washing powder has to be used at temperatures below 45 °C.

- (a) The enzymes in biological washing powders do **not** work on the stains on clothes at temperatures above 45 °C.

Explain why.

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(2)

- (b) Some bacteria, called thermophilic bacteria live in hot springs at temperatures of 80 °C.

Scientists have extracted enzymes from these thermophilic bacteria. These enzymes are being trialled in industrial laundries.

The laundries expect to increase the amount of clothes they can clean by using enzymes from thermophilic bacteria instead of using the biological washing powders the laundries use now.

- (i) The laundries expect to be able to increase the amount of clothes that they can clean each day.

Suggest why.

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(2)

- (ii) Using washing powders with enzymes from thermophilic bacteria may be more harmful to the environment than using the biological washing powders that laundries use now.

Suggest why.

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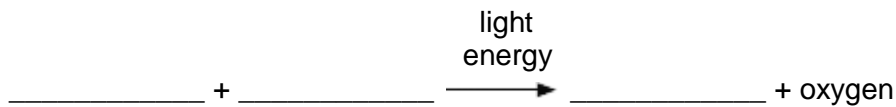
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(2)

(Total 6 marks)

**Q10.**

- (a) Complete the equation for photosynthesis.



(2)

- (b) Scientists investigated how temperature affects the rate of photosynthesis. The scientists grew some orange trees in a greenhouse. They used discs cut from the leaves of the young orange trees.

The scientists used the rate of oxygen production by the leaf discs to show the rate of photosynthesis.

- (i) The leaf discs did not produce any oxygen in the dark.

Why?

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(1)

- (ii) The leaf discs took in oxygen in the dark.

Explain why.

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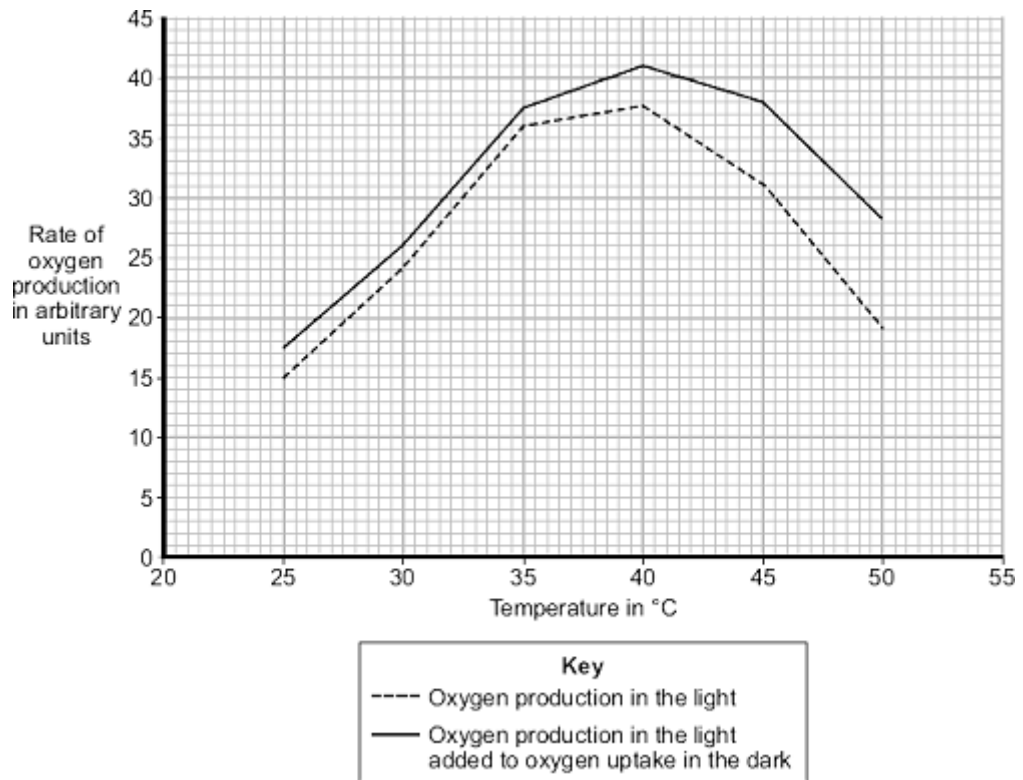
(2)



- (c) In their investigation, the scientists measured the rate of oxygen release by the leaf discs in the light. The scientists then measured the rate of oxygen uptake by the leaf discs in the dark.

The graph shows the effect of temperature on

- oxygen production in the light
- oxygen production in the light added to oxygen uptake in the dark.



Use the information from the graph to answer each of the following questions.

- (i) Describe the effect of temperature on oxygen production in the light.

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(2)

- (ii) Explain the effect of temperature on oxygen production in the light when the temperature is increased:

from 25 °C to 35 °C

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from 40 °C to 50 °C.

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(2)

- (d) A farmer in the UK wants to grow orange trees in a greenhouse. He wants to sell the oranges he produces at a local market. He decides to heat the greenhouse to 35 °C.

Explain why he should **not** heat the greenhouse to a temperature higher than 35 °C. Use information from the graph in your answer.

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(3)

(Total 12 marks)

**Q11.**

The pancreas and the liver are both involved in the control of the concentration of glucose in the blood.

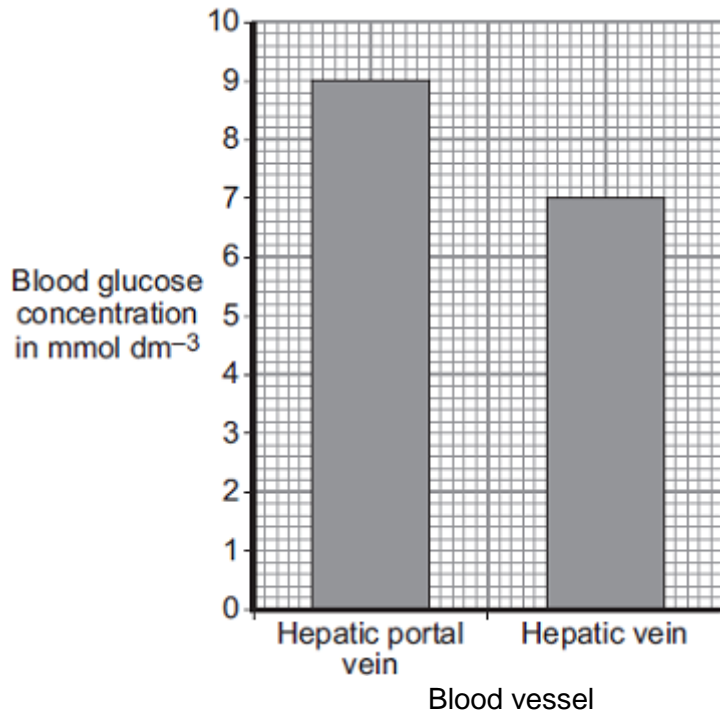
The liver has two veins:

- the hepatic portal vein taking blood from the small intestine to the liver
- the hepatic vein taking blood from the liver back towards the heart.

Scientists measured the concentration of glucose in samples of blood taken from the hepatic portal vein and the hepatic vein. The samples were taken 1 hour and 6 hours after a meal.

**Graph 1** shows the concentration of glucose in the two blood vessels 1 hour after the meal.

**Graph 1**



- (a) The concentration of glucose in the blood of the two vessels is different. Explain why.

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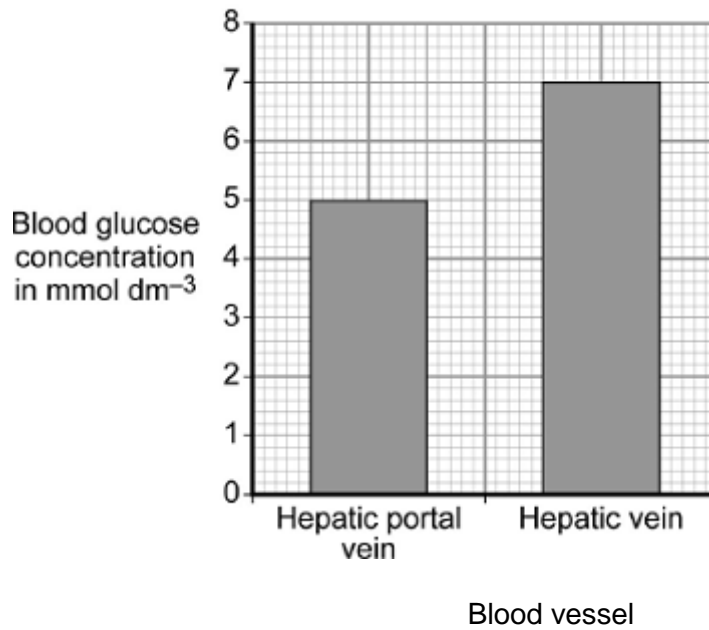
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(3)

- (b) **Graph 2** shows the concentration of glucose in the two blood vessels 6 hours after the meal.

**Graph 2**



- (i) The concentration of glucose in the blood in the hepatic portal vein 1 hour after the meal is different from the concentration after 6 hours.

Why?

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(1)

- (ii) The person does **not** eat any more food during the next 6 hours after the meal.

However, 6 hours after the meal, the concentration of glucose in the blood in the hepatic vein is higher than the concentration of glucose in the blood in the hepatic portal vein.

Explain why.

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(3)

(Total 7 marks)

### Q12.

The number of cases of Type 2 diabetes in the UK is increasing rapidly.

- (a) Describe how insulin and glucagon help control the blood sugar concentration in a

healthy person.

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(6)

(b) What is Type 2 diabetes?

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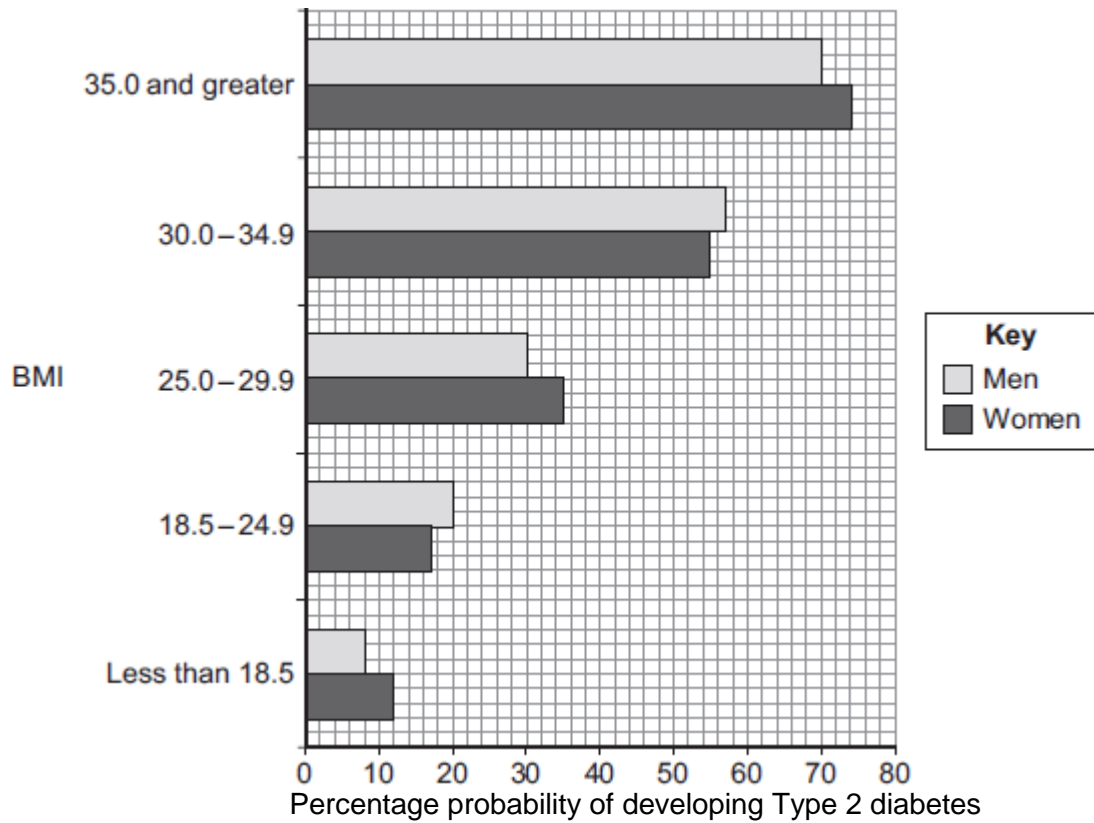
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(1)

(c) Body mass index (BMI) is a person's body weight divided by the square of his or her height.

(i) **Graph 1** shows the relationship between BMI and the percentage probability of developing Type 2 diabetes.

**Graph 1**



Suggest an explanation for the relationship between BMI and the risk of developing Type 2 diabetes.

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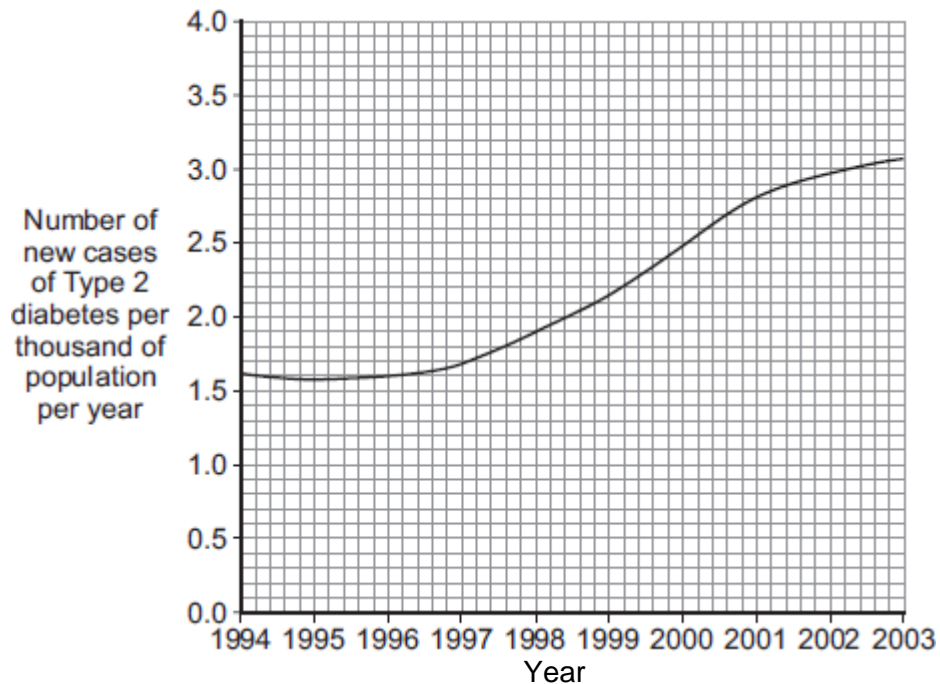


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(2)

- (ii) **Graph 2** shows changes in the number of new cases of Type 2 diabetes in the UK.

**Graph 2**



Suggest explanations for the trend shown by the data in **Graph 2**.

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(3)

(Total 12 marks)

**Q13.**

Fresh milk is a mixture of compounds including lipid, protein and about 5% lactose sugar.

Lactose must be digested by the enzyme lactase, before the products can be absorbed.

Lactase can be added to fresh milk to pre-digest the lactose. This makes 'lactose-free' milk, which is suitable for people who do not produce enough lactase of their own.

A student investigated the effect of changing pH and temperature on the digestion of lactose in milk.

The results are shown in **Tables 1** and **2**.

**Table 1**  
Effect of pH

pH	Time taken to digest lactose in minutes

**Table 2**  
Effect of temperature

Temperature in °C	Time taken to digest lactose in minutes

4.0	20
5.0	18
6.0	13
7.0	7
8.0	5
9.0	6

25	20
30	14
35	11
40	6
45	29
50	No digestion

(a) The label on a carton of lactose-free milk states:

‘Lactase is normally produced in the stomach of mammals.’

The results in **Table 1** suggest that this statement is **not** true.

Explain how.

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(2)

(b) Explain, as fully as you can, the results shown in **Table 2** .

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(3)

(c) Bile is produced in the liver and is released into the small intestine.

Bile helps the digestion of lipid in the milk.

Describe how.

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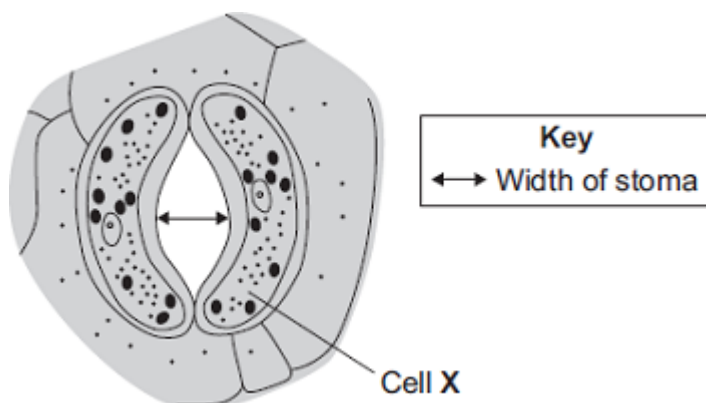


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**Q14.**

Plant leaves have many stomata.  
The diagram shows a stoma.



(a) Name cell **X** \_\_\_\_\_

(1)

(b) The table shows the mean widths of the stomata at different times of the day for two different species of plant.  
Species **A** grows in hot, dry deserts.  
Species **B** grows in the UK.

	Time of day in hours	Mean width of stomata as a percentage of their maximum width	
		Species A	Species B
Dark	0	95	5
	2	86	5
	4	52	6
Light	6	6	40
	8	4	92
	10	2	98
	12	1	100
	14	0	100
	16	1	96
	18	5	54

Dark	20	86	6
	22	93	5
	24	95	5

The data in the table show that species **A** is better adapted than species **B** to living in hot, dry deserts.

Explain how.

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(4)

(Total 5 marks)

**Q15.**

(a) Blood is made up of four main components.

Red blood cells and white blood cells are two of these components.

Describe the functions of the **two** other components of blood.

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(2)

(b) The heart is often described as a **double pump**.

Describe why.

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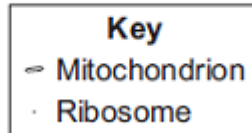
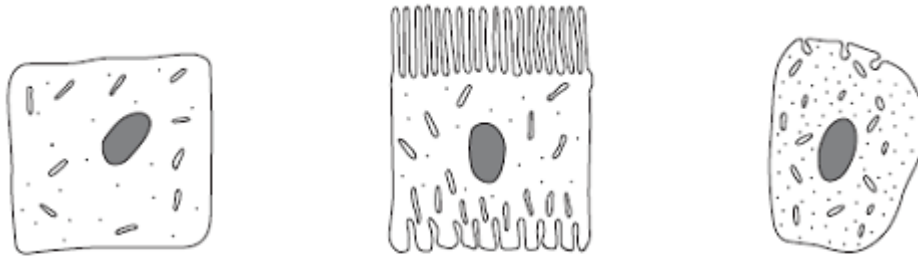
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(1)







(a) Which cell, **A**, **B** or **C**, appears to be best adapted to increase diffusion into or out of the cell?

Give **one** reason for your choice.

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(1)

(b) (i) Cell **C** is found in the salivary glands.

Name the enzyme produced by the salivary glands.

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(1)

(ii) Use information from the diagram to explain how cell **C** is adapted for producing this enzyme.

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(2)

(Total 4 marks)

**Q18.**

The leaves of most plants have stomata.

(a) (i) Name the cells which control the size of the stomata.

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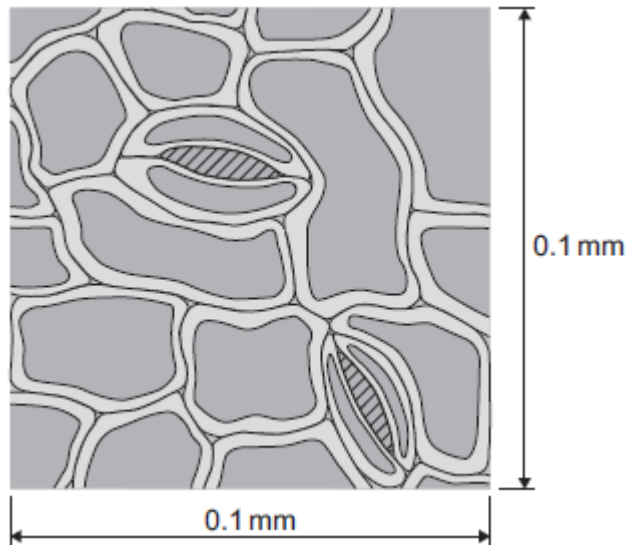
(1)

(ii) Give **one** function of stomata.

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(1)

(b) The image below shows part of the surface of a leaf.



The length and width of this piece of leaf surface are both 0.1 mm.

(i) Calculate the number of stomata per  $\text{mm}^2$  of this leaf surface.

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_ per  $\text{mm}^2$

(2)

(ii) A different plant species has 400 stomata per  $\text{mm}^2$  of leaf surface.

Having a large number of stomata per  $\text{mm}^2$  of leaf surface can be a disadvantage to a plant.

Give **one** disadvantage.

\_\_\_\_\_

\_\_\_\_\_

(1)

(c) A student investigated the loss of water from plant leaves.

The student did the following:

- Step 1: took ten leaves from a plant
- Step 2: weighed all ten leaves
- Step 3: hung the leaves up in a classroom for 4 days
- Step 4: weighed all ten leaves again
- Step 5: calculated the mass of water lost by the leaves

- Step 6: repeated steps 1 to 5 with grease spread on the upper surfaces of the leaves
- Step 7: repeated steps 1 to 5 with grease spread on both the upper and lower surfaces of the leaves.

All the leaves were taken from the same type of plant.

The table below shows the student's results.

Treatment of leaves	Mass of water the leaves lost in g
No grease was used on the leaves	0.98
Grease on upper surfaces of the leaves	0.86
Grease on upper and lower surfaces of the leaves	0.01

- (i) What mass of water was lost in 4 days through the upper surfaces of the leaves?

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Mass = \_\_\_\_\_ g

(1)

- (ii) Very little water was lost when the lower surfaces of the leaves were covered in grease.

Explain why.

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(3)

(Total 9 marks)

### Q19.

Malignant tumours are called cancers.

- (a) Describe how a tumour can spread to different parts of the body.

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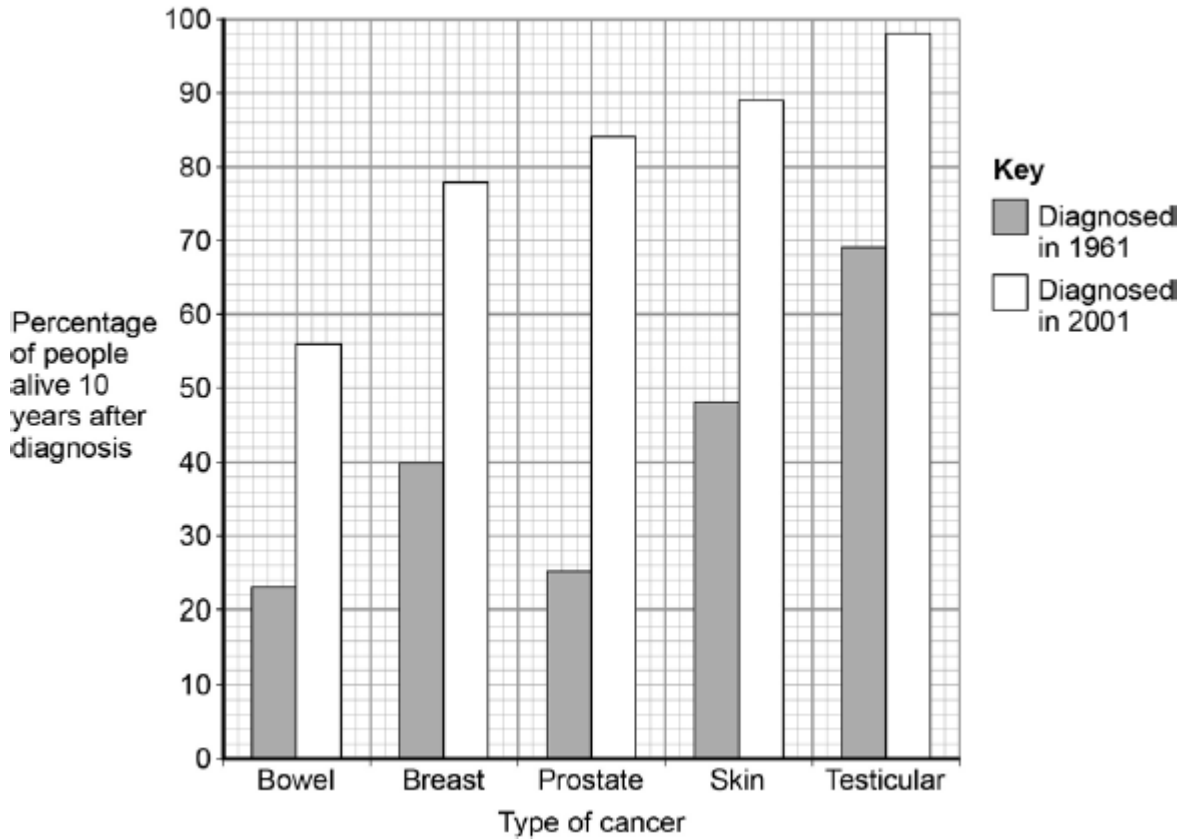


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(b) Survival rates for people with cancer have improved a lot.

Some people who are alive 10 years after diagnosis are considered to be cured.

The figure below shows data for people diagnosed with cancer in 1961 and 2001.



Look at the data in the figure above for skin cancer.

Calculate the percentage increase in the survival rate of people diagnosed with skin cancer in 1961 compared to 2001.

Give your answer to **three** significant figures.

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Survival rate increase = \_\_\_\_\_ %

(c) Look at the data in the figure above for bowel and prostate cancer.

Compare the survival rates for bowel and prostate cancer.

Suggest reasons for the comparisons you have made.

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(4)  
(Total 8 marks)

**Q20.**

Coronary heart disease (CHD) can be caused by many factors.

The table below shows data related to CHD for five countries.

Country	Number of deaths from CHD per 100 000 population per year	Percentage of the population who smoke tobacco	Percentage of the population who drink alcohol heavily	Amount of fruit and vegetables eaten in kg per person per year
A	285	36	19	180
B	251	63	34	404
C	186	47	36	251
D	149	23	34	218
E	128	27	12	222

(a) Name **one** risk factor for CHD that is **not** shown in the table above.

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(1)

(b) A student concludes that the main cause of CHD is not eating enough fruit and vegetables.

Give **three** reasons why the student's conclusion is **not** correct.

Use information from the table above.

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(3)

(c) Explain how the build-up of fatty material can damage the heart.

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(4)

(d) Describe how statins can help to reduce deaths from CHD.

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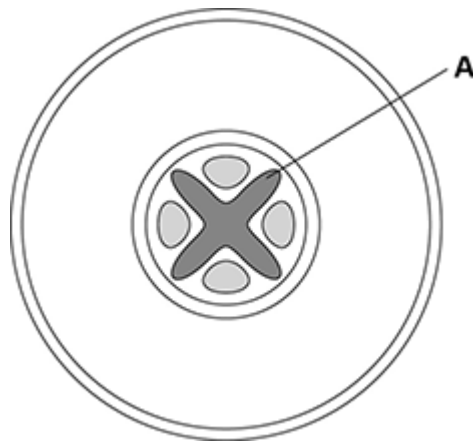
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(2)

(Total 10 marks)

**Q21.**

The figure below shows a cross-section through a plant root.



(a) What is tissue **A**?

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(b) A student is given samples of two fluids.

One fluid is from the phloem of a plant and one from the xylem of a plant.

The student is asked to work out which fluid is from the phloem and which is from the xylem.

She measures the pH and the concentrations of sugar, nitrate ions and potassium ions of each fluid.

The table below shows the student's results.

	Fluid A	Fluid B
pH	7.3	5.6
Sugar in mg / cm <sup>3</sup>	118	1.18
Nitrate ions in mg / cm <sup>3</sup>	10	600
Potassium ions in µg / cm <sup>3</sup>	1.18	2500

Which fluid is from the phloem, and which is from the xylem?

Explain your answer.

Use the information from the table above.

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(4)

(c) In fluid **A**, how many times greater is the concentration of sugar than the concentration of potassium ions?

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(2)

(d) The concentration of potassium ions in the soil is 3.9 µg / cm<sup>3</sup>

The concentration of potassium ions in the root tissue is 2500 µg / cm<sup>3</sup>

Explain why the concentration is so much higher in the roots than in the soil.

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**(3)**  
**(Total 10 marks)**

## Mark schemes

### Q1.

(a) 5624

**allow 2 marks** for:

- correct HR = 148 **and** correct SV = 38 plus wrong answer / no answer

**or**

- only one value correct **and** ecf for answer

**allow 1 mark** for:

- incorrect values **and** ecf for answer

**or**

- only one value correct

3

(b) (i) **Person 2** has low(er) stroke volume / SV / described  
eg **Person 2** pumps out smaller volume each beat  
do **not** allow **Person 2** has lower heart rate

1

(ii) **Person 1** sends more blood (to muscles / body / lungs)

1

(which) supplies (more) oxygen

1

(and) supplies (more) glucose

1

(faster rate of) respiration **or** transfers (more) energy for use

*ignore aerobic / anaerobic*

*allow (more) energy release*

*allow aerobic respiration transfers / releases more energy  
(than anaerobic)*

*do **not** allow makes (more) energy*

1

removes (more) CO<sub>2</sub> / lactic acid / heat

*allow less oxygen debt*

**or** less lactic acid made

**or** (more) muscle contraction / less muscle fatigue

*if no other mark awarded,*

*allow person 1 is fitter (than person 2) for max 1 mark*

1

[9]

### Q2.

(a) (i) 120

1

(ii) 11 760 **or**  
correct answer from candidate's answer to (a)(i)

correct answer with or without working

if answer incorrect

120 × 98 **or**

candidate's answer to (a)(i) × corresponding SV gains 1 mark

if candidate uses dotted line / might have used dotted line(bod) in (a)(i) **and** (a)(ii) no marks for (a)(i) but allow full ecf in (a)(ii) eg 140 × 88 = 12320 gains 2 marks

2

(b) trained athlete has higher stroke volume / more blood per beat

1

same volume blood expelled with fewer beats

**or** for same heart rate more blood is expelled

1

(c) increased aerobic respiration

**or**

decreased anaerobic respiration

*allow correct equation for aerobic respiration*

*accept don't have to respire anaerobically*

1

increased energy supply / need

1

less lactic acid formed

**or** to breakdown lactic acid **or** less O<sub>2</sub>-debt

1

can do more work **or** can work harder / faster / longer

*accept muscle contraction for work*

**or** less fatigue / cramp / pain

1

[9]

### Q3.

(a) solution in soil is more dilute (than in root cells)

*concentration of water higher in the soil (than in root cells)*

1

so water moves from the dilute to the more concentrated region

*so water moves down (its) concentration gradient **or** water*

*moves from a high concentration of water to a lower concentration*

1

concentration of ions in soil less (than that in root cells)

1

so energy needed to move ions

**or**

ions are moved against concentration gradient

*the direction of the concentration gradient must be expressed clearly*

*accept correct reference to water potential or to concentrations of water*

1

(b) any **three** from:

- movement of water from roots / root hairs (up stem)
- via xylem
- to the leaves
- (water) evaporates
- via stomata

3

(c) (i) 0.67/0.7

*accept 0.66, 0.666666... or  $\frac{2}{3}$  or 0.6*

*correct answer gains **2** marks with or without working*

*if answer incorrect allow evidence of  $\frac{100}{150}$  for **1** mark  
do **not** accept 0.6 or 0.70*

2

(ii) during the first 30 minutes

any **one** from:

- it was warmer
- it was windier
- it was less humid
- there was more water (vapour) in the leaves

1

so there was more evaporation

*ignore 'water loss'*

**or**

stomata open during first 30 minutes **or** closed after 30 minutes (1)

so faster (rate of) evaporation in first 30 min **or** reducing (rate of) evaporation after 30 min (1)

1

[11]

**Q4.**

- (a) pancreas  
*either order* 1
- small intestine 1
- (b) any **two** from:
- to give them time to come to temperature of the water-bath  
*accept so (they / both) are at the same temperature*
  - at / near body temperature / best / optimum temperature
  - otherwise reaction would take place at a series of different temperatures  
**or** sensible statement about control / fair test 2
- (c) (i) 0.42  
*allow in range 0.42 to 0.425* 1
- (ii) 0.021  
*correct answer with or without working*  
*allow ecf from (c)(i) ie (c)(i) ÷ 20 correctly calculated for 2 marks*  
*if answer incorrect 0.42 ÷ 20 **or** (c)(i) ÷ 20 gains 1 mark* 2
- (iii) (all) starch digested / gone / used up / turned to sugar  
*allow the amount of sugar stays the same / maximum* 1
- (iv) any **two** from  
*allow reference to active site once only as alternative to first or second bullet point*
- enzyme destroyed / denatured / damaged / shape changed  
*do **not** accept killed*
  - unable to fit (starch molecule)
  - starch can't be digested  
*enzymes don't work is insufficient* 2

[10]

**Q5.**

D – many microvilli (1)

Ex – provide large surface area (1)

**five points made**

**max 3 descriptions**

**max 3 explanations**

D – many capillaries / good blood supply (1)

Ex – maintain concentration / diffusion gradient **or** quickly removes food (1)



D – thin wall / one cell thick surface / capillaries near surface (1)

*allow villi are thin*

*ignore villi are one cell thick*

Ex – short distance for food to travel (1)

D – *many mitochondria* (1)

Ex – provide energy / ATP for active uptake / transport (1)

[5]

**Q6.**

(a) stomach is acidic / has low pH

*allow any pH below 7*

*ignore stomach is not alkaline*

1

lactase works best / well in alkali / high pH / neutral / non-acidic conditions

*allow any pH of 7 and above*

*accept works slowly in acid conditions*

*allow figures from table with a **comparison***

*ignore reference to temperature*

1

(b) any **three** from

- (below 45(°C)) increase in temperature increases rate / *speed* of reaction
- reference to molecules moving faster / colliding faster / harder / more collisions
- optimum / best at 45(°C)  
*allow value(s) in range 41 - 49*
- high temps / above 45(°C) (rate slows due to) denaturation of enzyme /lactase  
*allow synonyms of denaturation but **not** killed*  
*denaturation at high **and** low temperature does **not** gain this mark*  
*ignore body temperature*  
*ignore references to time / pH*

3

(c) any **two** from

- acid neutralised **or** conditions made neutral / alkali  
*accept bile is alkaline*
- (allow) emulsification / greater surface area of fat / lipid  
*allow description of emulsification eg fat is broken down / broken up into droplets*
- enzymes (in small intestine) work (more effectively / better)  
*allow better for enzymes*

2

[7]

**Q7.**

- (a) blood has red (blood) cells / haemoglobin 1
- haemoglobin combines with / carries oxygen  
*ignore 'mix'*  
**NB** Blood can form oxyhaemoglobin = 2 marks 1
- (b) blood gains oxygen / becomes oxygenated (in the lungs)  
*idea of acquiring oxygen must be unambiguous* 1
- blood loses oxygen to the muscles / cells 1
- because muscles are respiring (aerobically) 1
- to provide energy (for exercise) 1

[6]

**Q8.**

- (a) any **two** from:
- diet  
*ignore exercise*  
*accept any reasonable reference to diet*  
*do **not** accept salt / blood pressure*  
*ignore age / gender / HDL / LDL*
  - heredity / genes / genetic makeup
  - reference to cholesterol production by liver 2
- (b) (i) Blood cholesterol concentration is only one of several factors affecting death from all causes 1
- (ii) 170 – 210  
*accept 210 - 170* 1

[4]

**Q9.**

- (a) shape changed / destroyed (above 45 °C)  
*accept denatured*  
*accept active site changed*  
*do **not** accept enzyme killed* 1
- (shape) doesn't fit (other molecules / stain) 1

- (b) (i) any **two** from:
- can wash the clothes at higher temperature
  - so wash / enzyme action will be quicker  
*do not accept idea of bacteria working faster*
  - enzyme not destroyed at high temperature / 80 °C  
*accept denaturation or description*
- 2
- (ii) high(er) temperature / 80 °C uses more energy / fuel
- 1
- more pollution / named (eg carbon dioxide / global warming) (from electricity production)
- or**
- increased release of hot water (into the environment)
- 1

[6]

**Q10.**

- (a) LHS: carbon dioxide **AND** water
- in either order*
- accept CO<sub>2</sub> **and** H<sub>2</sub>O*
- allow CO<sub>2</sub> and H<sub>2</sub>O*
- if names given ignore symbols*
- do not accept CO<sup>2</sup> / H<sup>2</sup>O / Co / CO*
- ignore balancing*
- 1
- RHS: sugar(s) / glucose / starch / carbohydrate(s)
- accept C<sub>6</sub>H<sub>12</sub>O<sub>6</sub>*
- allow C<sub>6</sub>H<sub>12</sub>O<sub>6</sub>*
- do not accept C<sup>6</sup>H<sup>12</sup>O<sup>6</sup>*
- 1
- (b) (i) light is needed for photosynthesis
- or**
- no photosynthesis occurred (so no oxygen produced)
- 1
- (ii) oxygen is needed / used for (aerobic) respiration
- full statement*
- respiration occurs **or** oxygen is needed for anaerobic respiration gains 1 mark*
- 2
- (c) (i) (with increasing temperature) rise then fall in rate
- 1
- use of figures, ie
- max. production at 40 °C

**or** maximum rate of 37.5 to 38

1

(ii) 25 – 35 °C

**either** faster movement of particles / molecules / more collisions  
**or** particles have more energy / enzymes have more energy

1

**or** temperature is a limiting factor over this range

40 – 50 °C

denaturation of proteins / enzymes

*ignore denaturation of cells*

*ignore stomata*

1

(d) above 35 °C (to 40 °C) – little increase in rate

**or** > 40 °C – causes decrease in rate

1

so waste of money **or** less profit / expensive

1

because respiration rate is higher at > 35 °C

**or**

respiration reduces the effect of photosynthesis

1

[12]

### Q11.

(a) (concentration high) in the hepatic portal vein is blood with glucose absorbed from the intestine

1

concentration is lower in the hepatic vein because insulin

1

(has caused) glucose to be converted into glycogen

1

**or**

allows glucose into liver cells

(b) (i) (after 6 hours) most of the glucose has been absorbed from the intestine  
**or** from food into the blood

1

(ii) because glucagon (made in the pancreas) causes

*if biological terms incorrectly spelt they must be phonetically accurate*

*do **not** accept glucagon made / produced by the liver*

1

glycogen to be converted into glucose

1

glucose released into blood

*allow the liver maintains the correct / constant level of glucose in the blood*

1

[7]

**Q12.**

(a) any **six** from:

- hormone(s) / named produced by pancreas
- if blood glucose levels are too high, insulin is produced / released
- allowing glucose to move from the blood into the cells / named eg liver
- glucose is converted to glycogen
- if blood glucose levels fall, glucagon is produced / released
- glycogen is converted to glucose
- causing glucose to be released into the blood

6

(b) diabetes that occurs when the body (cells) do not respond / are less responsive to insulin

1

(c) (i) higher BMIs due to increase in mass / weight (relative to height) / obesity

1

obesity / being overweight / being fat is a (significant) risk factor for Type 2 diabetes

*allow causes Type 2 diabetes*

1

(ii) any **three** from:

- related to described change in diet eg fast foods
- and less exercise
- which increases the chance of obesity / increases BMI
- increased awareness has helped to slow the increase

3

[12]

**Q13.**

(a) stomach is acidic / has low pH

*allow any pH below 7*

*ignore stomach is not alkaline*

1

lactase works best / well in alkali / high pH / neutral / non-acidic conditions

*allow any pH of 7 and above*

*accept works slowly in acid conditions*

*allow figures from table with a **comparison***

*ignore reference to temperature*

1

(b) any **three** from:

- (below 40(°C)) increase in temperature increases rate / speed of reaction

- reference to molecules moving faster / colliding faster / harder / more collisions
- enzyme optimum / works best at 40°C  
*allow value(s) in range 36 – 44*  
*ignore body temperature unless qualified*
- high temperatures (above 40°C) / 45°C / 50°C enzyme denatured  
*allow synonyms for denaturation, but do **not** allow 'killed'*  
*denaturation at high and low temperature does **not** gain this mark*  
*ignore references to time / pH*

3

(c) any **two** from:

- acid neutralised or conditions made neutral / alkali  
*accept bile is alkaline*
- (allow) emulsification / greater surface area (of lipid / fat)  
*allow description of emulsification eg fat broken down / broken up into droplets*  
*do **not** accept idea of chemical breakdown*
- lipase / enzymes (in small intestine) work more effectively / better  
*allow better for enzymes*  
*ignore reference to other named enzymes*

2

[7]

#### Q14.

(a) guard cell

*ignore stoma / stomata*

1

(b) Species A :

*allow converse points for species B*

stomata open in dark / at night **or** close in light / in day

1

stomata closed during warm(est) period **or** open when cool(er)

1

heat (energy) /warmth increases evaporation / transpiration

*must give explicit link between heat and transpiration*

1

reduces water loss / evaporation / transpiration

*ignore photosynthesis*

1

[5]

#### Q15.

(a) plasma transports proteins / dissolved substances / food (molecules) / urea /

hormones  
**or**  
blood cells are suspended in the plasma

1

platelets are involved in blood clotting

1

- (b) the right side of the heart pumps blood to the lungs  
**and**  
the left side of the heart pumps blood around (the rest of) the body

1

- (c) **Level 3 (5–6 marks):**

A detailed and coherent evaluation is provided which considers a range of relevant points and comes to a conclusion consistent with the reasoning.

**Level 2 (3–4 marks):**

An attempt to relate relevant points and come to a conclusion. The logic may be inconsistent at times but builds towards a coherent argument.

**Level 1 (1–2 marks):**

Discrete relevant points made. The logic may be unclear and the conclusion, if present, may not be consistent with the reasoning.

**0 marks:**

No relevant content

**Indicative content**

**pros of statins:**

- decreases blood cholesterol
- slows down build-up of fatty material in arteries
- (so) blood can flow to heart muscle cells

**cons of statins:**

- drug has to be taken regularly **or** may forget to take drug
- drug will need to be taken long-term
- side-effects of taking the drug
- effects of drug will take time to happen

**pros of stents:**

- blocked artery is held open
- (so) blood can flow to heart muscle cells
- will remain in place / work for a long time
- rapid recovery time

**cons of stents:**

- risk of infection from procedure
- risk of surgery eg heart attack
- risk of thrombosis **or** blood clot

a justified conclusion

6

[9]

**Q16.**

A + B most effective (treatment)

*ignore descriptions of LDL levels*

1

D is (the most) effective (treatment)

*D is the best single (treatment)*

1

neither A nor B (alone) are effective

*allow increase risk of heart disease instead of not effective*

1

can't tell if C is effective

**OR**

A + C is not effective

1

[4]

### Q17.

(a) **B**

*no mark for "B" alone, the mark is for B **and** the explanation.*

large(r) surface / area **or** large(r) membrane

*accept reference to microvilli*

*ignore villi / hairs / cilia*

*accept reasonable descriptions of the surface eg folded membrane / surface*

*do **not** accept wall / cell wall*

1

(b) (i) any **one** from:

- (salivary) amylase
- carbohydrase

1

(ii) many ribosomes

*do **not** mix routes. If both routes given award marks for the greater.*

1

ribosomes produce protein

*accept amylase / enzyme / carbohydrase is made of protein*

**or**

(allow)

many mitochondria (1)

mitochondria provide energy to build / make protein (1)

*accept ATP instead of energy*

1

[4]

### Q18.



- (a) (i) guard (cells)  
*allow phonetic spelling* 1
- (ii) any **one** from:  
*ignore reference to cells*
- allow carbon dioxide to enter  
*allow control loss / evaporation of water **or** control transpiration rate*
  - allow oxygen to leave.  
*allow 'gaseous exchange'* 1
- (b) (i) 200  
*correct answer gains 2 marks with or without working*  
*allow 1 mark for  $0.1 \times 0.1 = 0.01$  (mm<sup>2</sup>)* 2
- (ii) more / a lot of / increased water loss  
*allow plant more likely to wilt (in hot / dry conditions)* 1
- (c) (i) 0.12 1
- (ii) the lower surface has most stomata 1
- stomata are now covered / blocked (by grease) 1
- so water cannot escape / evaporate from the stomata  
*ignore waterproof*  
*to gain credit stomata must be mentioned at least once* 1
- [9]**

**Q19.**

- (a) cells can break off  
*allow cells invade other tissues* 1
- travel in blood  
*accept travel in lymph (fluid)* 1
- (b)  $\frac{(89 - 48)}{48} \times 100 = 85.416\bar{6}$  1
- 85.4 (%)  
*allow 85.4 (%) with no working shown for 2 marks)* 1
- (c) any **two** from:
- similar survival rates for diagnosis in 1961

- survival rate (for diagnosis in 2011) is 1.5 times greater for prostate cancer compared to bowel cancer
- (survival rates) have improved for both cancers
- (survival rate) for prostate cancer has improved more  
*accept survival rate for bowel cancer has increased 2.4 times **but** for prostate cancer 3.4 / 3.36 times*

2

plus **two** from:

- earlier diagnosis
- improved screening programmes
- improved drugs
- difference in level of aggression of cancers
- difference in ease of removing tumours  
*reason must be correctly linked to comparison*

2

[8]

### Q20.

- (a) (lack of) exercise

*allow description of type or amount of exercise*

1

*allow other risk factors not mentioned in table, eg high cholesterol levels, blood pressure, levels of obesity, diabetes*

- (b) the second highest death rate has the highest fruit and vegetable consumption  
 the lowest death rates don't have high fruit and vegetable consumption  
 lowest death rates have a low percentage of the population that smokes.

3

- (c) (it builds up) inside the coronary arteries

1

(causing) them to narrow

1

(this) reduces blood flow

1

so less oxygen gets to the heart muscle

1

- (d) (statins) reduce cholesterol in the blood

1

so there is less build up of fatty material (in coronary arteries)

*allow slows the rate of fat deposit*

1

[10]

### Q21.

- (a) xylem

1

- (b) **A** is phloem, **B** is xylem

1

any **three** from:

- phloem transports sugars
- there are more sugars in fluid A
- xylem transports mineral ions / potassium ions / nitrate ions
- there are more mineral ions in fluid B.

3

(c) correct conversion of 1.18  $\mu\text{g}$  to  $\text{mg} / \text{cm}^3$

1

$$\frac{118}{0.00118} = 100\ 000$$

*allow 1 mark for 100 (ie no conversion to mg)*

*allow 100 000 with no working shown for 2 marks*

1

(d) potassium ions are transported into the root

1

against a concentration gradient

1

by active transport

1

**[10]**