

Tuesday 16 May 2023 – Morning

GCSE (9–1) Combined Science B (Twenty First Century Science)

J260/05 Biology (Higher Tier)

Time allowed: 1 hour 45 minutes

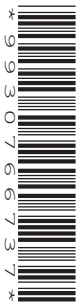


You must have:

- a ruler (cm/mm)

You can use:

- a scientific or graphical calculator
- an HB pencil



Please write clearly in black ink. **Do not write in the barcodes.**

Centre number

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Candidate number

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First name(s)

Last name

INSTRUCTIONS

- Use black ink. You can use an HB pencil, but only for graphs and diagrams.
- Write your answer to each question in the space provided. If you need extra space use the lined pages at the end of this booklet. The question numbers must be clearly shown.
- Answer **all** the questions.
- Where appropriate, your answer should be supported with working. Marks might be given for using a correct method, even if your answer is wrong.

INFORMATION

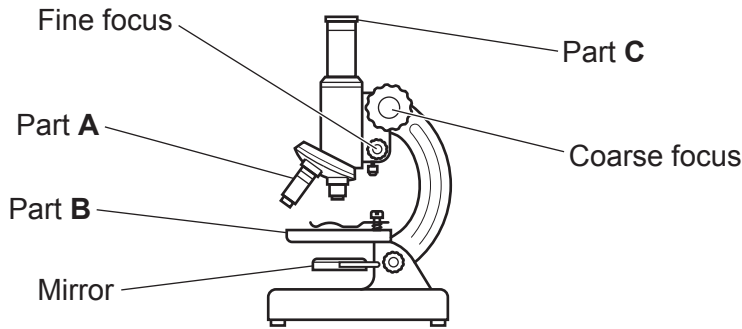
- The total mark for this paper is **95**.
- The marks for each question are shown in brackets [].
- Quality of extended response will be assessed in questions marked with an asterisk (*).
- This document has **28** pages.

ADVICE

- Read each question carefully before you start your answer.

1 A doctor uses a light microscope to look at the chromosomes in human body cells.

(a) The microscope is shown in the diagram.



(i) Draw lines to connect each **part** of the microscope with its correct **name**.

Part	Name
Part A	Eyepiece lens
Part B	Objective lens
Part C	Stage

[1]

(ii) The doctor uses steps **A** to **D** to look at the cells on a slide.

The steps are **not** in the correct order.

- A** Turn the coarse focus until the image is as clear as possible.
- B** Turn the fine focus until the image is as clear as possible.
- C** Adjust the mirror until the image is bright enough to see.
- D** Place the slide under the microscope.

Write the letters in the boxes to show the correct order of the steps.

One has been done for you.

D			
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[1]

(iii) The chromosomes in the cells are **not** clearly visible under the microscope.

Describe **one** thing the doctor can add to the slide to improve the visibility of the chromosomes.

..... [1]

Humans have X and Y sex chromosomes.

(b) The Punnett square shows how X and Y chromosomes are inherited.

		Sperm cells	
		Chromosomes	X
Egg cells	X	XX	XY
	X	XX	XY

(i) What is the probability that a fertilised egg will have the chromosomes XY?

Put a ring around the correct answer.

0 **0.5** **1** **2** [1]

(ii) What is the expected ratio of XX to XY offspring?

Ratio = : [1]

(c) Describe how inheriting a Y chromosome causes the baby to be born with male characteristics.

.....

.....

.....

..... [2]

(d) Some females have a condition called Turner syndrome.

- They only have one X chromosome instead of two.
- There is no cure.
- They need to have their heart, kidneys and reproductive system checked regularly for problems throughout their lives.

A baby can be tested for Turner syndrome before they are born. Their chromosomes are tested using a sample of amniotic fluid from the womb.

Describe benefits **and** risks of doing this test before the baby is born.

.....

.....

.....

.....

.....

.....

[3]

5
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2 Hormones help to control the human body.

(a) Complete the sentences to describe the action of hormones.

Use words from the list.

effectors	faster	glands	longer
receptors	shorter	slower	

Hormones are secreted by

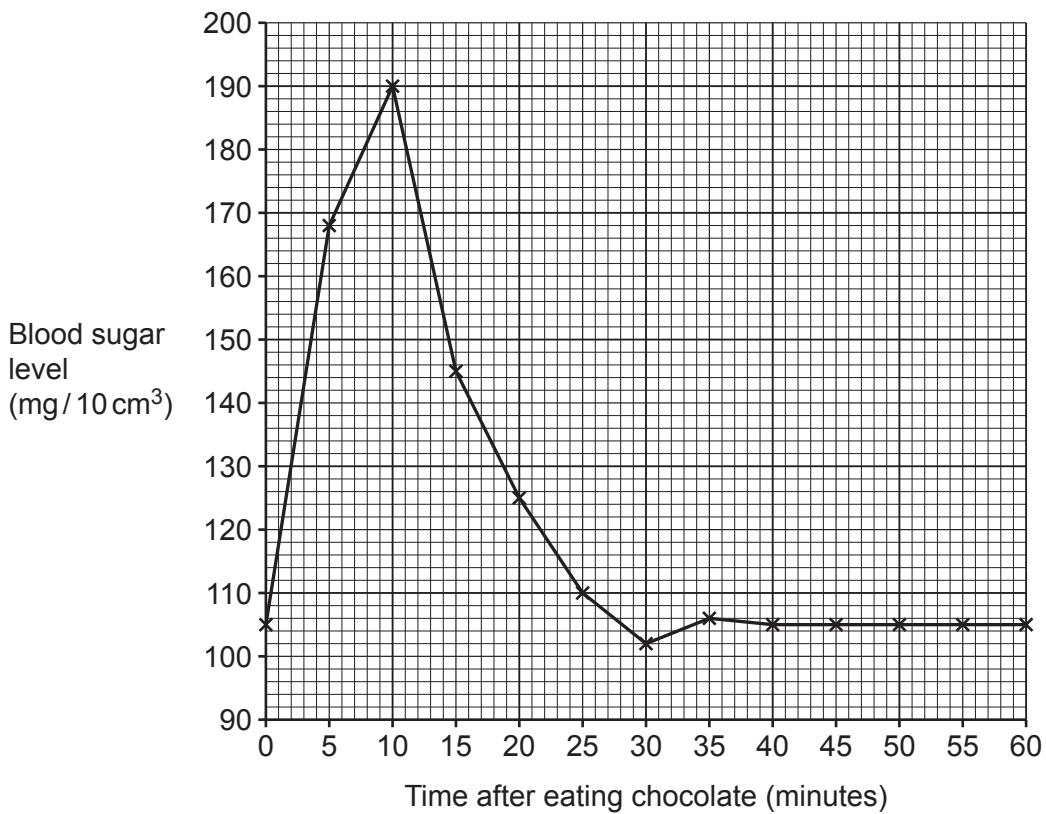
Compared to nervous system responses, hormone responses are usually

..... and-lasting.

[2]

(b) A student measured their blood sugar level every 5 minutes after eating chocolate.

The results are shown in the graph.



(i) Calculate the change in blood sugar level between 10 minutes and 25 minutes after eating the chocolate.

Change in blood sugar level = mg/10 cm³ [2]

(ii) Between which times does the hormone insulin **start** to affect the student's blood sugar level?

Tick (✓) **one** box.

Between 5 minutes and 10 minutes.

Between 15 minutes and 20 minutes.

Between 30 minutes and 35 minutes.

Between 40 minutes and 60 minutes.

[1]

(iii) The student concludes that their normal blood sugar level is 105 mg/10 cm³.

Describe evidence from the graph that supports this conclusion.

.....
.....
.....
..... [2]

(c) Hormones can be used as a contraceptive.

Explain **one** benefit and **one** risk of taking a contraceptive pill containing hormones.

Benefit

.....

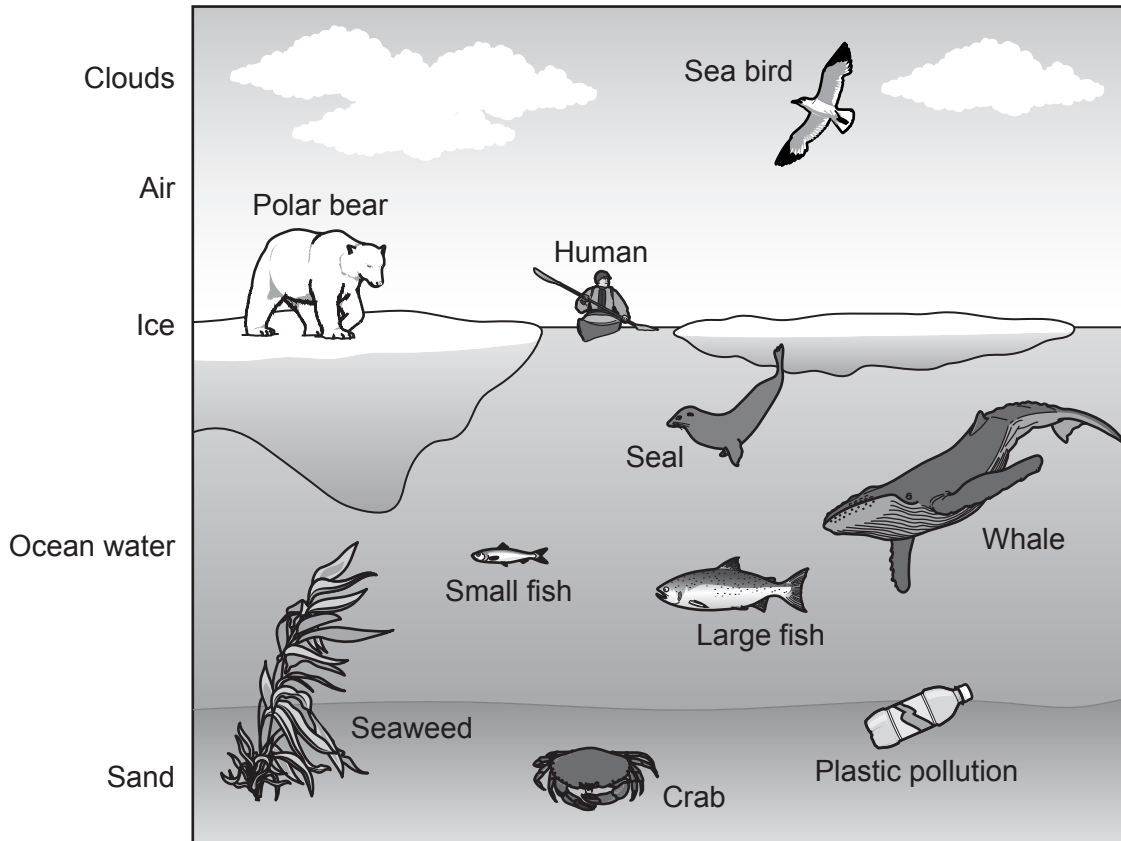
Risk

.....

[2]

3 The diagram shows some of the organisms that live in and around one area of the Arctic Ocean.

The organisms are **not** drawn to scale.



(a) Complete the sentences to describe the levels of organisation in this area.

Use phrases from the list.

- | | | | |
|--------------------|---------------------|---------------------|----------------------|
| a community | a population | an ecosystem | an individual |
|--------------------|---------------------|---------------------|----------------------|

All of the organisms and their environment are

All of the organisms in the area are

All of the polar bears in the area are

One piece of seaweed is

[3]

(b) Complete the table to describe the different parts of this area of the Arctic Ocean.

Tick (✓) **one** box in each **row**.

	It is a biotic part of the ecosystem	It is an abiotic part of the ecosystem	It is not part of the ecosystem
Air			
Human			
Ocean water			
Plastic pollution			
Sea bird			
Seaweed			

[2]

(c) State the name of the substance that the clouds help to cycle through the ecosystem.

..... [1]

(d) Microorganisms in the sand feed on dead organic matter. They use it for cellular respiration and release carbon dioxide into the ocean water.

Explain why releasing this carbon dioxide is essential for the survival of the animals in the area.

.....
.....
.....
.....
.....
.....
..... [3]

4 Scientists are monitoring the spread of a plant disease called ash dieback.

(a) Which type of pathogen causes ash dieback?

..... [1]

(b) **Table 4.1** shows the percentage of trees with ash dieback in four different populations of trees.

Table 4.1

Population	Percentage of trees with ash dieback (%)
1	24
2	17
3	9
4	35

Calculate the mean percentage of trees with ash dieback in these four populations.

Give your answer to **2** significant figures.

Mean percentage = % [3]

11
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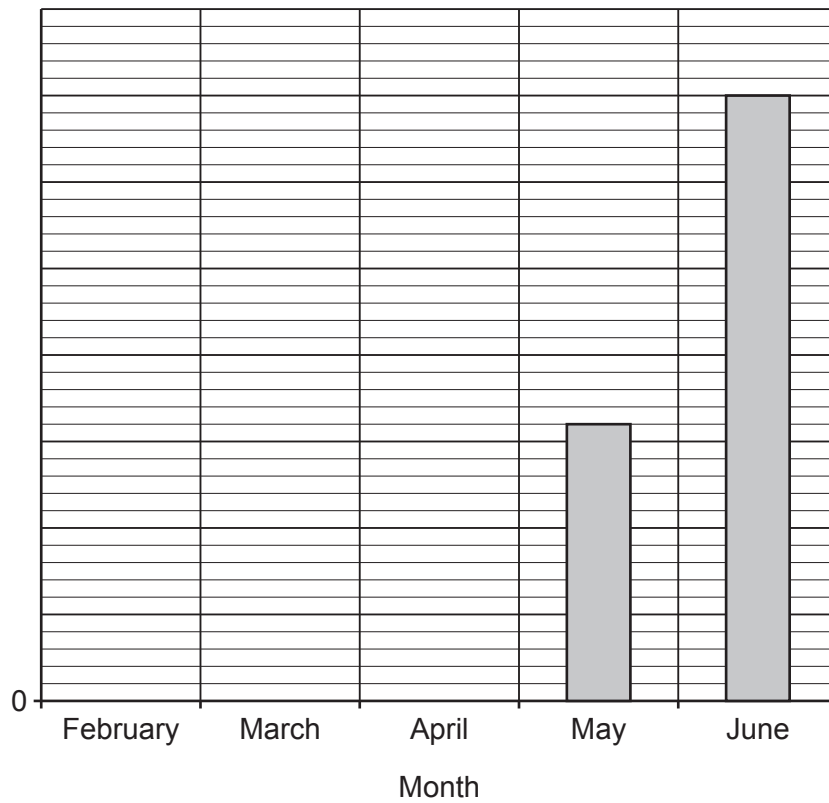
- (c) Scientists recorded the total number of trees with ash dieback in a woodland each month for five months.

The results are shown in **Table 4.2**.

Table 4.2

Month	Total number of trees with ash dieback
February	6
March	8
April	15
May	32
June	70

- (i) Complete the bar chart of the data in **Table 4.2**.



[2]

- (ii) Describe the trend in the data.

.....
 [1]

(iii) Suggest **one** way in which humans could have caused the trend in the data.

.....
..... [1]

(iv) Ash dieback only causes disease in trees.

Explain **one** way in which the trend in the data could negatively affect **animals** in the woodland.

.....
..... [1]

(v) Scientists banned people and pets from entering the forest at the end of June.

Suggest **one other** way in which scientists could try to control the ash dieback in the forest.

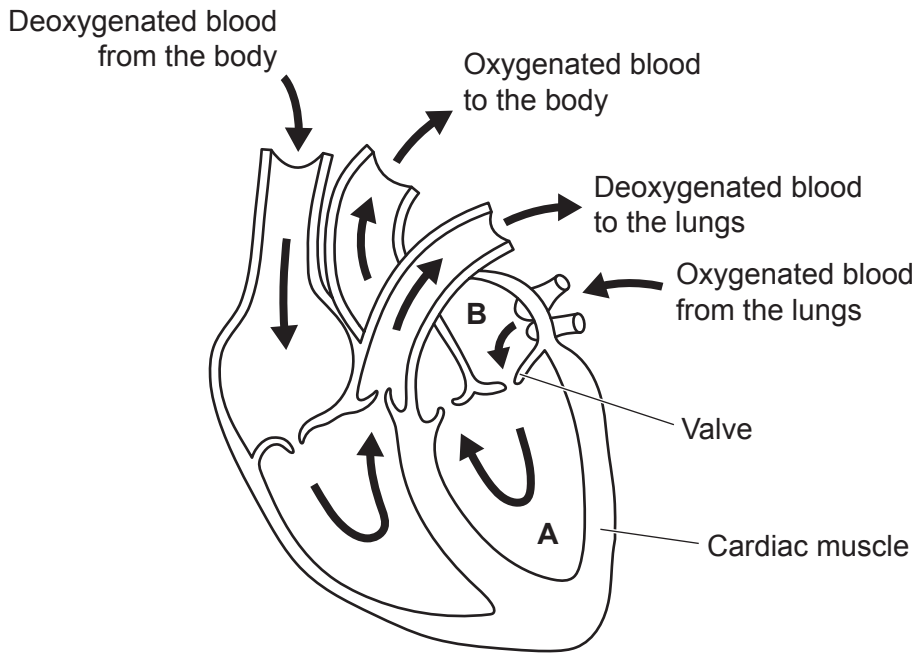
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..... [1]

5 People have a pulse because their heart beats.

(a) Fig. 5.1 is a simple diagram of the human heart.

- Two of the chambers have been labelled **A** and **B**.
- The arrows show the directions in which blood moves.

Fig. 5.1



(i) Explain why chamber **A** has a thick wall of cardiac muscle.

.....

.....

.....

..... [2]

(ii) Why is there a valve between chamber **A** and chamber **B**?

.....

..... [1]

(b) Outside the heart, blood flows through blood vessels.

Complete the table by naming the blood vessels and explaining how their structures are related to their functions.

Blood vessel	Structure of blood vessel	Function of the structure
.....	Wall is thick and very strong
Capillary	To allow rapid diffusion of substances into and out of the blood
.....	To make sure blood only flows towards the heart

[5]

6 Many substances are transported into, around and out of the human body.

(a) Urea is a waste product made by the body.

Complete the sentences to describe what happens to urea.

Urea is transported around the body by the system.

It is removed from the body by the system.

[1]

(b) Water and some other substances needed by body cells are absorbed into the blood by the digestive system.

(i) Complete the table by describing how to test for the presence of each substance absorbed by the digestive system.

Substance	Reagent used in test	Result when the substance is present
Glucose	Benedict's solution	Red-brown precipitate is formed
Lipids	Ethanol
.....	Biuret solution

[3]

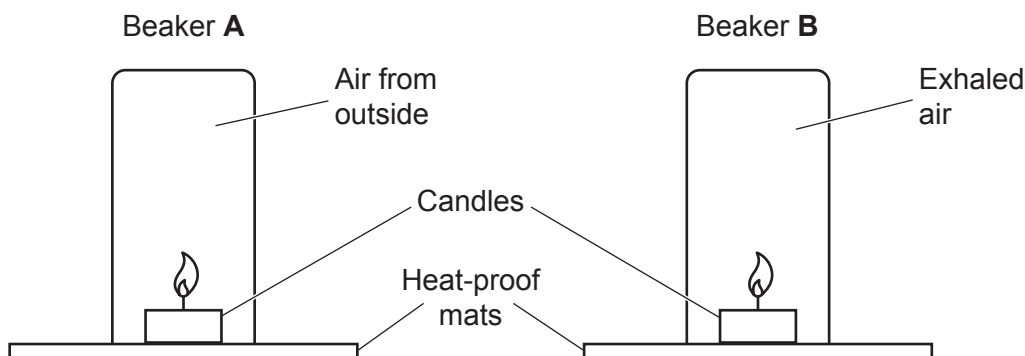
(ii) Why do cells react glucose from the digestive system with oxygen from the gaseous exchange system?

.....
..... [1]

(c) A teacher turns two identical beakers upside-down.

- Beaker **A** is filled with air from outside.
- Beaker **B** is filled with air exhaled by a person.

The teacher places a burning candle inside each beaker, as shown in the diagram. The candles are the same size.



Candles need oxygen to burn. They cannot burn in carbon dioxide.

Predict what will happen to the burning candles.

Use ideas about the gaseous exchange and circulatory systems to explain your prediction.

Prediction

.....

Explanation

.....

.....

.....

.....

.....

[4]

7 Not all carrots are orange.

Farmers first grew carrots as a crop 5000 years ago in the hot, dry environment in the Middle East.

- (a) At that time there was a mixture of white, yellow and purple carrot plants. All these plants were the same species.

Which word describes differences between members of the same species?

Tick (✓) **one** box.

- Differentiation
- Heterozygous
- Natural selection
- Variation

[1]

- (b) In the 1300s, farmers started growing yellow carrots in the hot, dry environment in southern Europe.

Around this time, some of the plants began to produce carrots that were pale orange.

What change in the yellow carrot plants could have caused this new pale orange colour?

..... [1]

- (c) Later, farmers started growing yellow and orange carrots in northern Europe.

Plants producing darker orange carrots were better able to survive in the colder, wetter environment in northern Europe.

Explain how the farmers could have made sure they were growing the best carrots to get the highest yield each year.

.....
.....
.....
.....
.....
..... [3]

(d) Explain how modern technology could convince scientists to classify white carrots and orange carrots as separate species.

.....

.....

.....

..... [2]

8 Plants take up water for photosynthesis.

(a) Explain how chloroplasts in leaf cells are related to photosynthesis.

.....

.....

.....

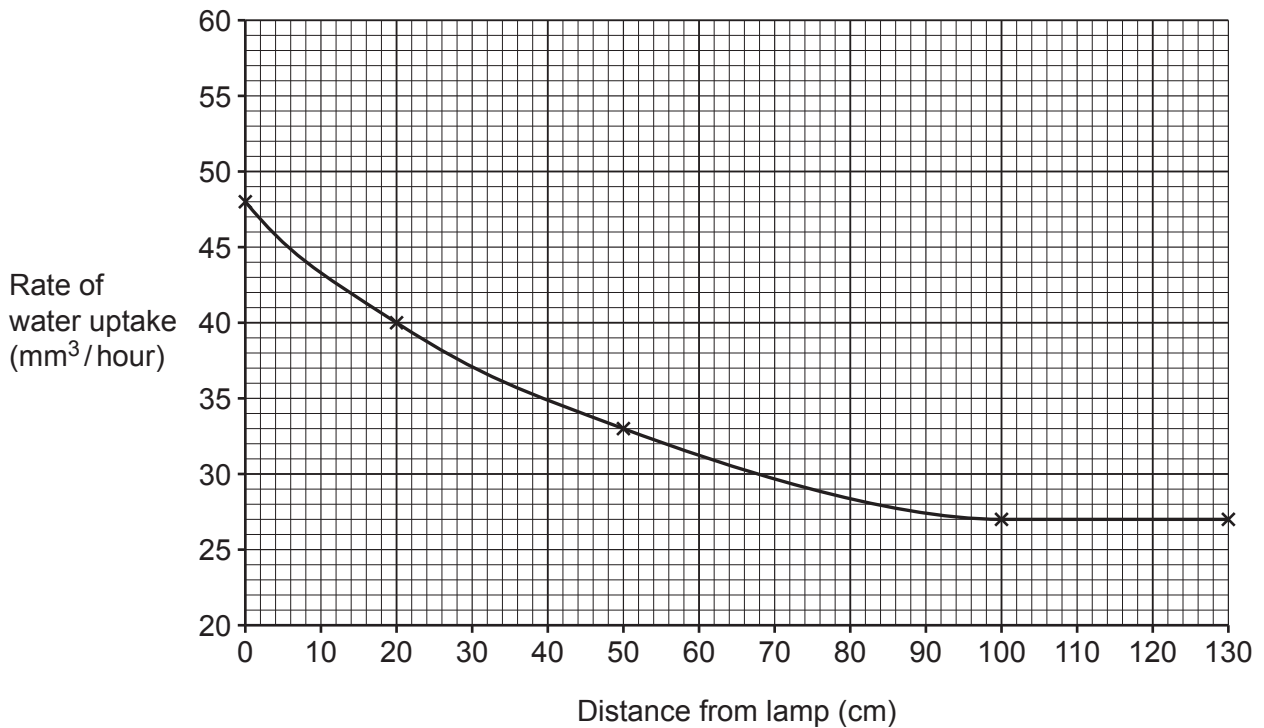
..... [2]

(b) State the name of the process that moves water up through a plant to its leaves.

..... [1]

A student measures the rate of water uptake by a leafy plant shoot at different distances from a lamp.

The results are shown in the graph.



(c) (i) Between which measured distances can the relationship between the distance and the rate of water uptake be represented by the equation $y = mx + c$?

Between and cm [1]

- (ii) Calculate the rate of water uptake in **litres** per hour when the distance from the lamp was 0 cm.

1 mm³ is 0.000001 litres.

Give your answer in **standard form**.

Rate = litres/hour [3]

- (iii) Calculate the change in the rate of water uptake **per cm** when the lamp was moved from 0 cm to 100 cm away.

Change in rate = mm³/hour/cm [2]

- (d) Another student tested a different leafy shoot.

- This leafy shoot had a mass of 10 g at the start of the day.
- This leafy shoot took up 0.4 g of water during the day.

- (i) Calculate the percentage change in mass of the shoot if the water caused its mass to increase by 0.4 g.

Percentage change = % [2]

- (ii) At the end of the day, the student observed that the mass of the shoot had **not** increased by 0.4 g. It had only increased by an amount much smaller than this.

Suggest an explanation for this observation.

.....

.....

.....

..... [2]

9 People can get different types of cancer.

(a) Complete the sentences to describe what all cancers in humans have in common.

Use words from the list.

amino acids	genes	human
lipids	meristem	mitosis
osmosis	pathogen	translocation

The cancer cells are cells.

The disease is caused by changes in the that control the process of

[2]

(b) Risk factors for cancer include:

- a person's age
- exposure to substances that are carcinogens (for example in cigarette smoke).

Give **two other** risk factors that affect a person's risk of developing cancer.

1

2

[2]

(c) All blood cells are made from stem cells in the bone marrow (soft tissue inside bones).

Leukaemia is a type of cancer that disrupts this process. Having leukaemia means the person **cannot** make working white blood cells.

Explain how this will affect the balance between health and disease in the person's body.

.....
.....
.....
.....
.....

[3]

(d) When a person develops leukaemia they **cannot** make new red blood cells.

Explain why the person's **existing** healthy red blood cells cannot divide to make more.

.....

.....

.....

..... [2]

(e) A treatment for leukaemia involves:

Step 1: Destroying the patient's existing affected cells.

Step 2: Giving the patient a transplant of bone marrow stem cells.

Describe one benefit **and** one risk of step 2.

Benefit

.....

Risk

..... [2]

END OF QUESTION PAPER

ADDITIONAL ANSWER SPACE

If additional space is required, you should use the following lined page(s). The question number(s) must be clearly shown in the margin(s).

A large area of lined paper for writing, consisting of 25 horizontal dotted lines. A solid vertical line runs down the left side of the page, creating a margin. The rest of the page is open for writing.

A large area of the page is reserved for writing, featuring a vertical solid line on the left side and horizontal dotted lines extending across the page.

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