OCR
Oxford Cambridge and RSA

Tuesday 16 May 2023 – Morning

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

J260/01 Biology (Foundation Tier)

Time allowed: 1 hour 45 minutes

F

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 | | | | | | Candidate number | | | | |

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 **32** pages.

ADVICE
- Read each question carefully before you start your answer.

1 Some bacteria are pathogens that cause diseases.

(a) Our blood contains white blood cells. They help protect us against pathogens.

(i) Write down the name of the organ that pumps the blood around our body.

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

(ii) Which system are white blood cells a part of?

Tick (✓) **one** box.

Gas exchange system ☐

Immune system ☐

Nervous system ☐

[1]

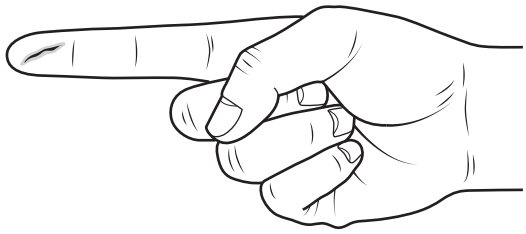
(b) The human body has different types of defences against pathogens.

Draw lines to connect each **type of defence** with the correct **example**.

Type of defence	Example
Chemical	Bacteria in the gut compete against pathogens
Microbial	Skin stops pathogens entering the body
Physical	Stomach acid destroys pathogens

[2]

(c) Beth has a cut on her finger.



Platelets in Beth's blood help to seal the cut so bacteria can't get into it.

Which **two** statements explain how her platelets do this?

Tick (✓) **two** boxes.

They carry oxygen. ☐

They make antibodies. ☐

They make her blood clot. ☐

They stick to the edges of the cut. ☐

[2]

2 Medicines can be used to treat diseases.

(a) Complete the sentences to explain the use of medicines in the treatment of disease.

Use words from the list.

All	**No**	**Some**

..... medicines kill pathogens.

..... medicines treat the symptoms of disease.

[2]

(b) Four groups of students recorded how many times they had to take medicine in a year. There were eight students in each group.

Table 2.1 shows the results for **Group 1**.

Table 2.1

Student	**Number of times medicine had to be taken**
1	4
2	4
3	4
4	7
5	7
6	12
7	18
8	24

(i) What is the median number of times medicine had to be taken in **Group 1**?

Put a (ring) around the correct answer.

4 **7** **8** **10**

[1]

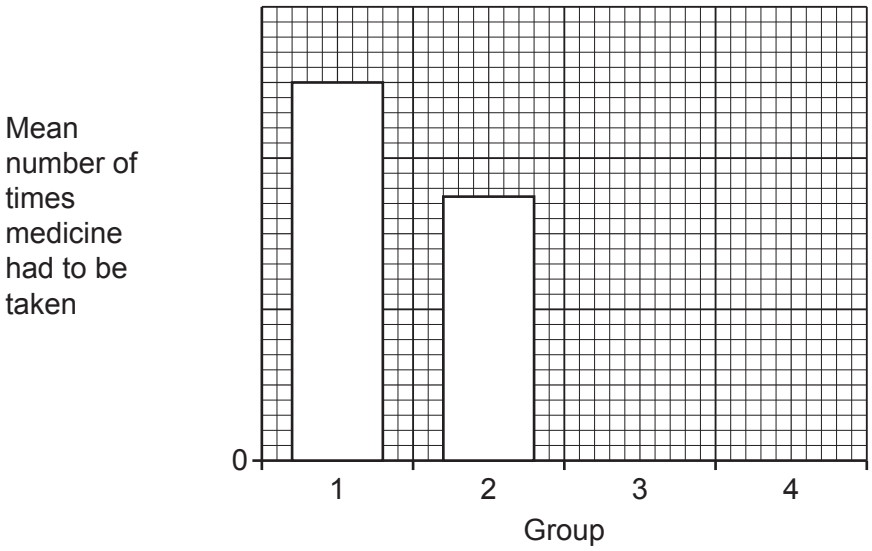
Table 2.2 shows the mean for each group.

Table 2.2

Group	Mean number of times medicine had to be taken
1	10
2	7
3	4
4	5

(ii) Complete the bar chart of the data in **Table 2.2**.

Make sure you:
- complete the scale on the y-axis
- plot the two missing means.



[3]

(iii) What is a correct conclusion from the data?

Tick (✓) **one** box.

Mean of group 1 < Mean of group 2 ☐

Mean of group 2 = Mean of group 3 ☐

Mean of group 3 > Mean of group 4 ☐

Mean of group 4 > Mean of group 3 ☐

[1]

(iv) All the students in these groups are 16 years old. They are all girls.
They are a small sample of all of the 16-year-olds in the UK.

Describe **two** ways you could get a better estimate of the mean value for 16-year-olds in the UK **without** asking all of them.

1 .....

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2 .....

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[2]

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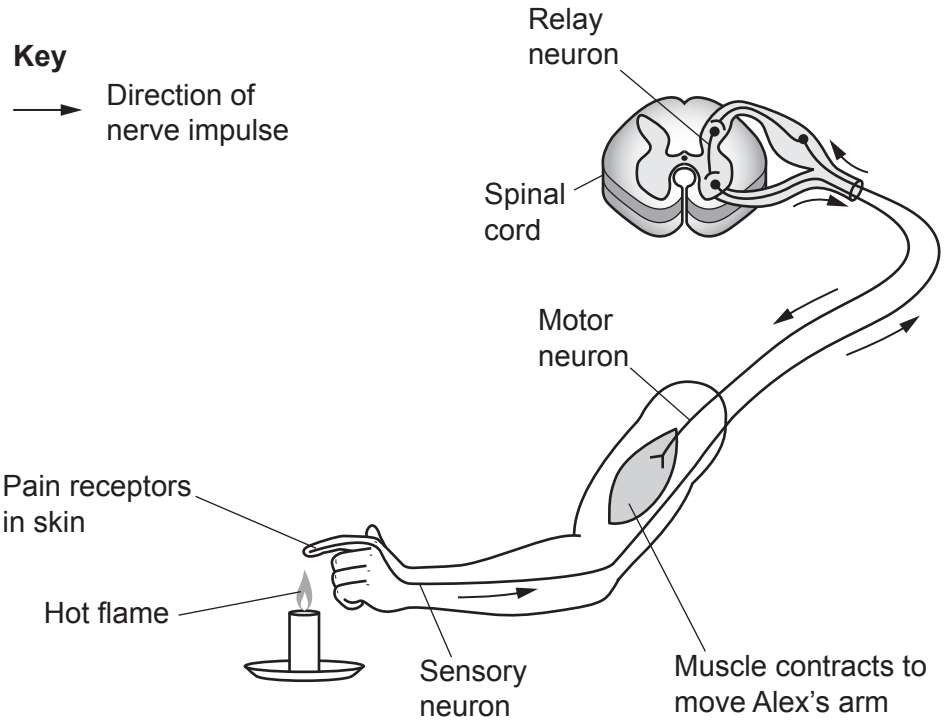
3 Alex touches a hot flame.

Alex's arm moves quickly away from the hot flame. This is a reflex response.

The diagram shows the reflex arc.



Statements **A** to **E** explain how the structures of the reflex arc work to move Alex's arm.

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

A Heat detected by pain receptors in Alex's skin.

B Nerve impulse travels along motor neuron.

C Muscle contracts and moves Alex's arm away from the flame.

D Nerve impulse travels along relay neuron.

E Nerve impulse travels along sensory neuron.

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

One has been done for you.

A				

[3]

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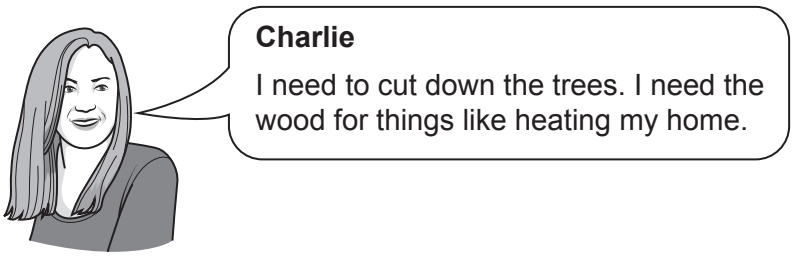
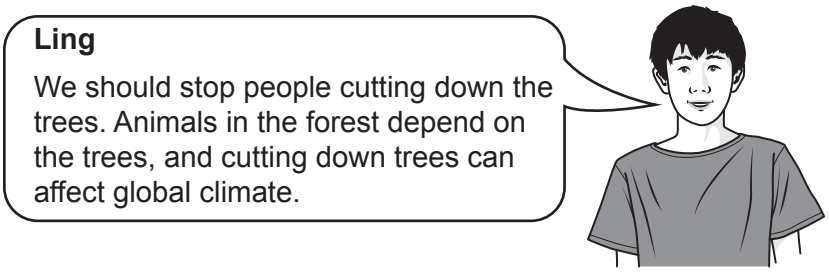
4 There are many species of plants and animals on Earth.

(a)* Charlie lives next to a forest.



Ling is a science student.



Explain advantages **and** disadvantages of stopping people from cutting down trees in the forest.

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..... **[6]**

(b) There are differences between the individuals within a population of a species.

This variation can be caused by the environment.

State **one other** cause of variation between individuals.

.....

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

(c) Darwin and Wallace suggested that new species could evolve from earlier species.

Which **two** statements describe how **fossils** provide evidence for this idea?

Tick (✓) **two** boxes.

Fossils only form under certain conditions. ☐

Fossils show that features of a species can change over time. ☐

Some fossils have features of newer species and features of earlier species. ☐

There are gaps in the fossil record. ☐

Very few organisms end up as fossils. ☐

[2]

(d) Some bacteria have evolved to become resistant to antibiotics.

Which statements about antibiotic resistance are **true**, and which are **false**?

Tick (✓) **one** box for each statement.

	True	**False**
Antibiotics kill resistant bacteria.	☐	☐
Bacteria that are resistant reproduce and have resistant offspring.	☐	☐
Genetic mutations caused the antibiotics to become resistant to the bacteria.	☐	☐
More and more bacteria become resistant until the whole population is resistant.	☐	☐

[2]

(e) Scientists can classify organisms into species based on similarities in their physical features.

Describe how DNA analysis can also be used to classify organisms into species.

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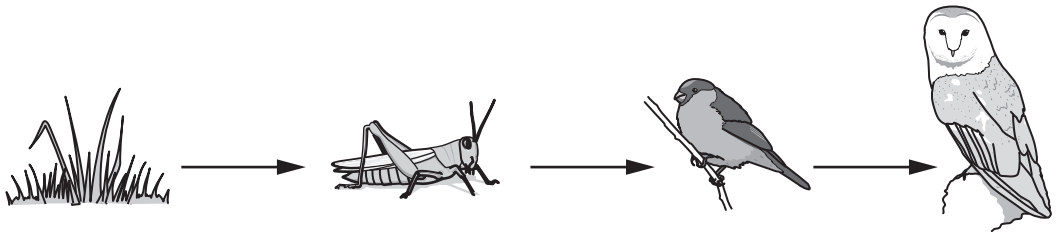
..... **[2]**

5 The diagram shows a complete food chain.



(a) Biomass is passed through this food chain when the organisms eat each other.

Where was all of this biomass originally produced?

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

(b) The amount of biomass in the grass is 810 kg / m^3.

The amount of this biomass passed on to the grasshoppers is 37 kg / m^3.

Calculate the percentage of the grass's biomass passed on to the grasshoppers.

Give your answer to **3** significant figures.

Percentage = ... % **[3]**

(c) Photosynthesis in the grass makes glucose. The grass uses some of this glucose to make amino acids, fatty acids, glycerol, and other sugars.

Which statements about these substances are **true**, and which are **false**?

Tick (✓) **one** box for each statement.

	True	False
The sugars are joined together to make carbohydrates.	☐	☐
Lipids are made from the amino acids and glycerol.	☐	☐
The fatty acids are joined together to make proteins.	☐	☐
Making proteins also requires nitrate ions from the soil.	☐	☐

[2]

6 Water and other substances are transported into and out of plants.

(a) Complete the table to describe how each substance is related to photosynthesis.

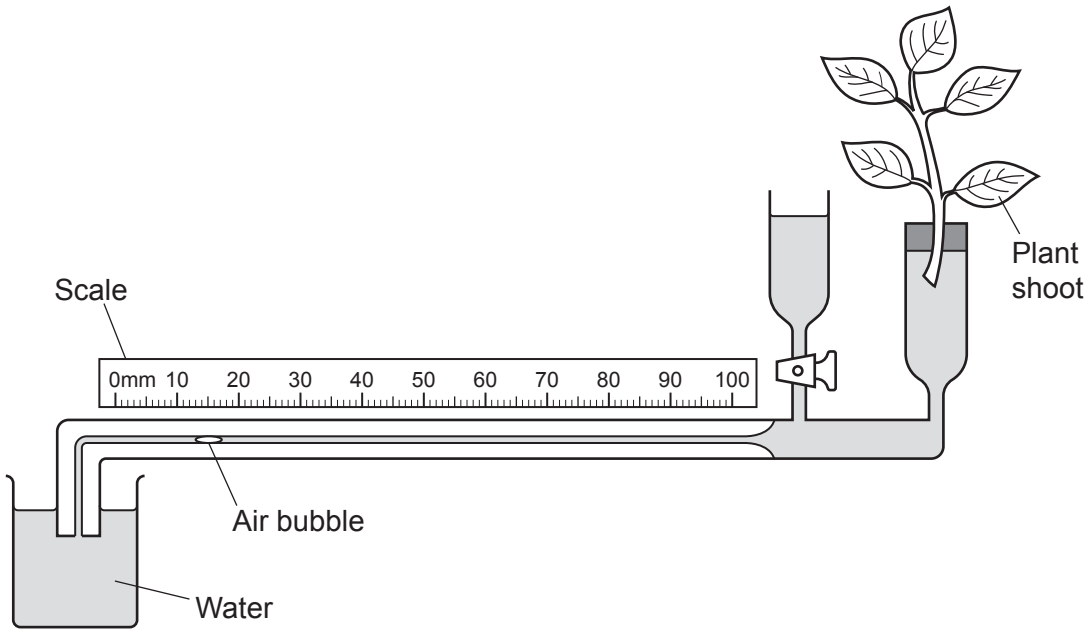
Tick (✓) the correct boxes.

	Carbon dioxide	**Oxygen**	**Water**
Used for photosynthesis			
Made by photosynthesis			

[2]

Jack investigates the effect of temperature on the amount of water taken up by a plant shoot.

He uses this apparatus to measure the amount of water taken up by the shoot.



Water is taken up into the shoot to replace water that evaporates from its leaves.

When water is taken up into the shoot, the air bubble moves along the scale.

(b) Jack does a practice attempt with the apparatus. His results are shown in the table.

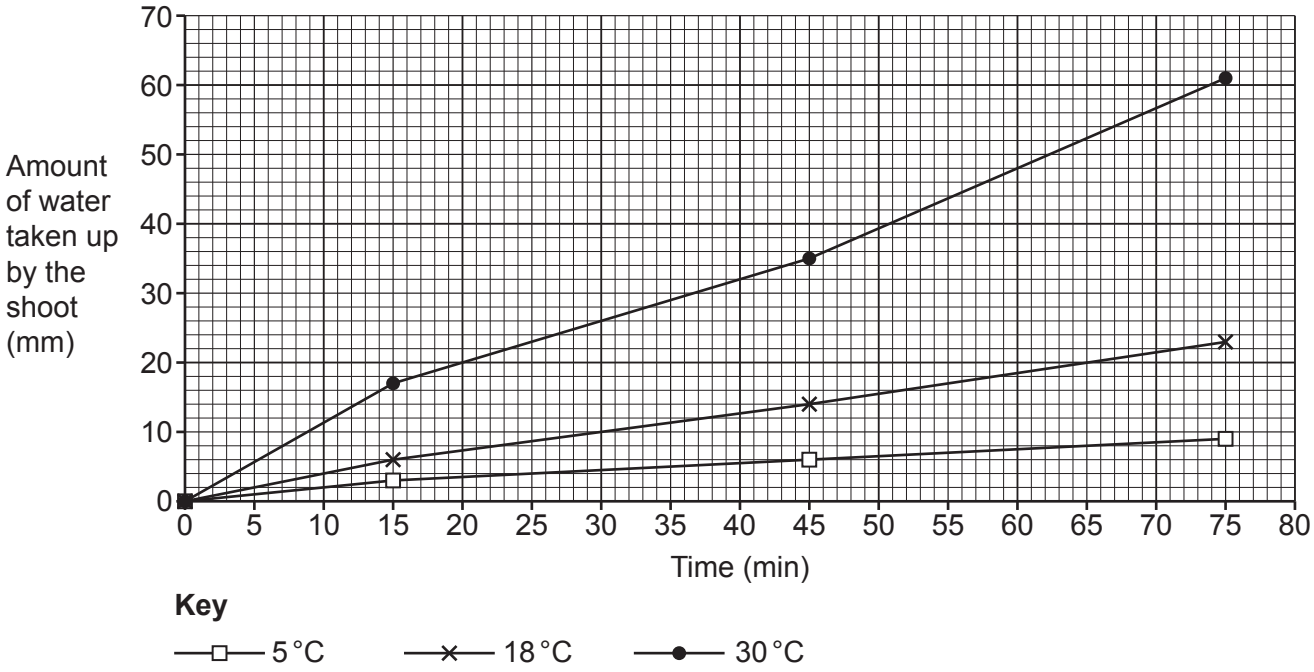
Time since start of practice attempt (min)	**Position of air bubble on scale (mm)**
0	15
60	50

Calculate how many mm of water were taken up into the shoot in this practice attempt.

Water taken up = ... mm **[1]**

Jack does the experiment three times, each time at a different temperature.

His results are shown in the graph.



(c) In **one** of the experiments, the shoot had taken up 20 mm of water after 20 minutes.

(i) At which temperature was this experiment done?

Use the graph.

Temperature = ... °C **[1]**

(ii) Calculate the average rate at which the 20 mm of water was taken up over the 20 minutes in this experiment.

Rate = ... mm / min **[2]**

(d) Explain why water was taken up more quickly by the shoot at higher temperatures.

.....

.....

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.....

.....

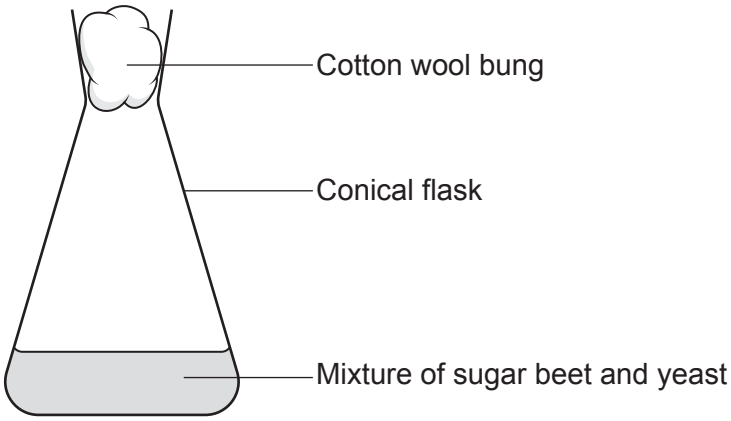
..... **[3]**

7 Bioethanol can be used as a fuel in cars.

This type of ethanol is made when anaerobic respiration happens in yeast.

(a) A teacher uses the equipment in the diagram to make this type of ethanol.

The yeast use glucose from a plant called 'sugar beet' for anaerobic respiration.



After 30 minutes the mixture is bubbling and feels warmer than it did at the start.

(i) Why does the mixture feel warmer?

Put a (ring) around the correct option.

The mixture feels warmer because the process of respiration is

endothermic / exothermic / photosynthetic.

[1]

(ii) Why does the mixture bubble after 30 minutes?

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

(b) Another type of respiration is aerobic respiration.

Complete the table to compare the processes of aerobic and anaerobic respiration.

Tick (✓) **one** box in each row.

Statement	Both types of respiration	Only aerobic respiration	Only anaerobic respiration
Happens **without** oxygen			
Produces the most ATP			
Requires glucose			

[2]

(c) The teacher uses a light microscope to count the yeast cells in one drop of the mixture.

From this the teacher estimates there are 2 million yeast cells in the mixture in the flask.

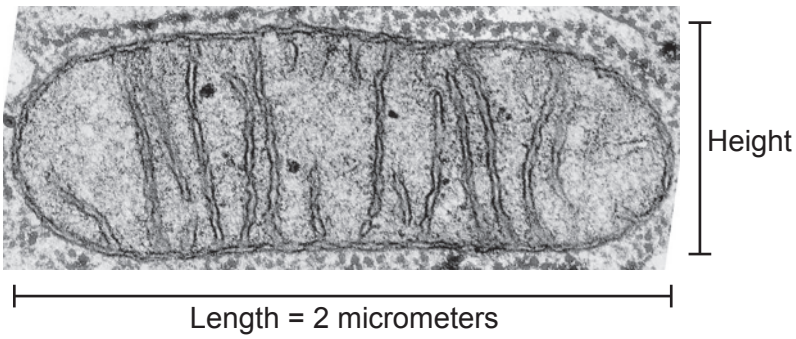
Explain why this is only an **estimate** of the number of yeast cells in the flask.

.....

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

(d) Aerobic respiration happens in the mitochondria in yeast cells.

An electron microscope was used to make this image of a mitochondrion.



(i) The length of the mitochondrion in the image is 2 micrometers.

Use this information to **estimate** the height of the mitochondrion.

Height of mitochondrion = ... micrometers **[2]**

(ii) Complete the sentences to explain how electron microscopes have increased our understanding of sub-cellular structures such as mitochondria.

Put a (ring) around each correct option.

An electron microscope has high magnification, which allows us to see structures that

are very **dark / large / light / small**.

An electron microscope has high resolution, which allows us to tell the difference

between structures that are very **close together / dark / far apart / light**.

[2]

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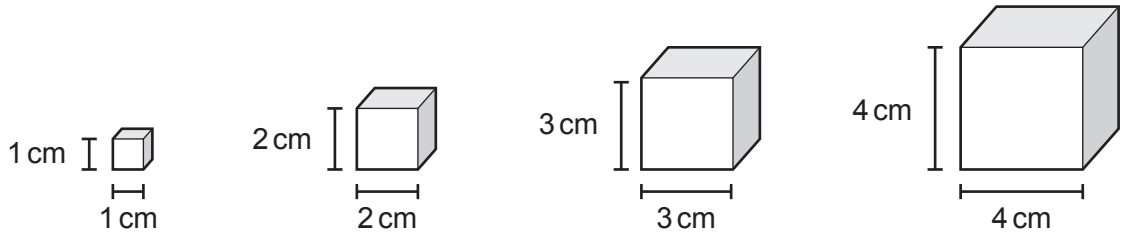
8 Sam is learning about surface area : volume ratio.

(a) Sam has four jelly cubes of different sizes, as shown in **Fig. 8.1**.
Each cube has six square faces.

The cubes are a model of the surface area : volume ratio of animals of different sizes.

Fig. 8.1



Cube A **Cube B** **Cube C** **Cube D**

The measurements of the cubes are recorded in the table.

Cube	Length of each side (cm)	Surface area of cube (cm^2)	Volume of cube (cm^3)	Surface area : volume ratio of cube
A	1	6	1	6 : 1
B	2	24		3 : 1
C	3	54	27	
D	4	96	64	1.5 : 1

(i) Calculate the volume of cube **B**.

Volume = ... cm^3 **[2]**

(ii) Calculate the surface area : volume ratio of cube **C**.

Surface area : volume ratio = ... : ..... **[2]**

(iii) Describe the relationship between cube size and surface area : volume ratio.

.....

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

(iv) Sam places jelly cubes **A**, **B**, **C** and **D** into a solution of coloured stain.
The stain diffuses into the jelly cubes.

Predict which cube will take the longest time for the stain to diffuse to the centre of the cube.

Explain your answer.

Prediction .....

Explanation .....

.....

.....

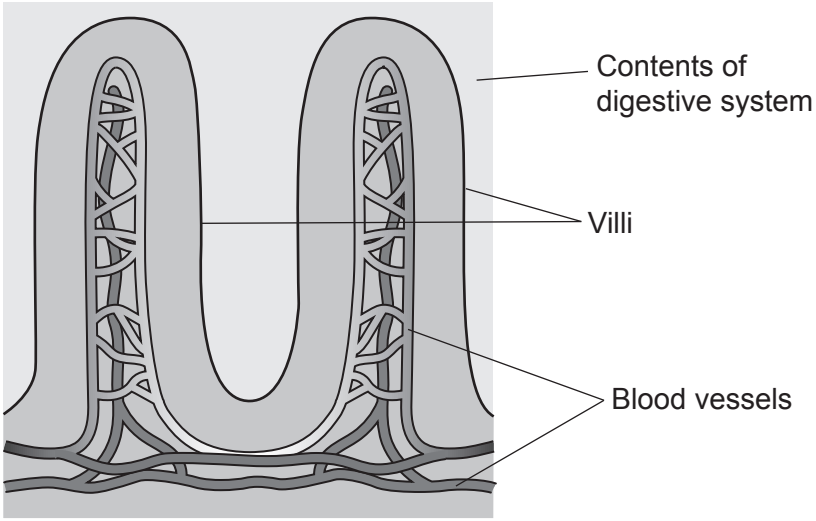
[2]

(b) Humans are large animals. The human body is made of millions of cells.

To stay alive, every cell in the body needs a constant supply of water and other substances that are absorbed into the body by the digestive system.

Parts of the wall of the digestive system are covered with structures called villi, as shown in **Fig. 8.2**.

Fig. 8.2



(i) The surface area of the digestive system wall has villi rather than being flat.

Explain why this is an advantage.

.....

.....

.....

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

(ii) The villi contain blood vessels.

Explain why this is an advantage.

.....

.....

.....

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

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9 Our features are affected by our genome and our environment.

(a) Which statement is correct?

Tick (✓) **one** box.

Every feature is controlled by a single gene. ☐

Every feature is controlled by multiple genes. ☐

Most features are controlled by a single gene. ☐

Most features are controlled by multiple genes. ☐

[1]

(b) Scientists have different terms for different parts of the genome.

Draw lines to connect each **term** with its correct **explanation**.

Term	Explanation
	A dominant or recessive version of a gene.
Allele	A section of a chromosome.
Chromosome	A sex cell used for sexual reproduction.
Gene	A very long molecule of DNA. Humans have 23 pairs of these.
Genome	All the genetic material of an organism.
	The part of a cell where the genome is stored.

[4]

(c) A scientist says:

Explain the terms **phenotype** and **genotype**.

Phenotype .....

.....

Genotype .....

.....

[2]

(d) Describe how our genes affect our features.

.....

.....

.....

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

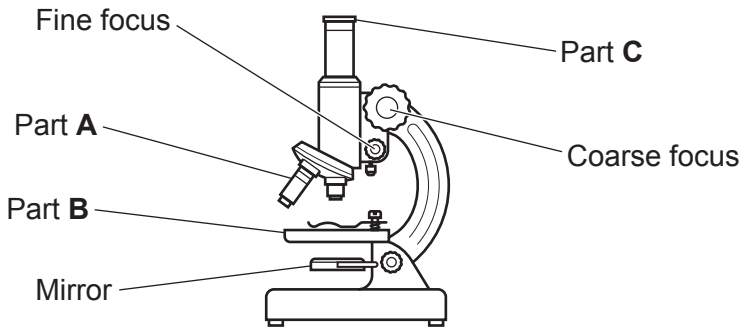
(e) Describe **one** example of how our features can be affected by our environment.

.....

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

10 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			

[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	Y
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.

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

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11 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 ..... .

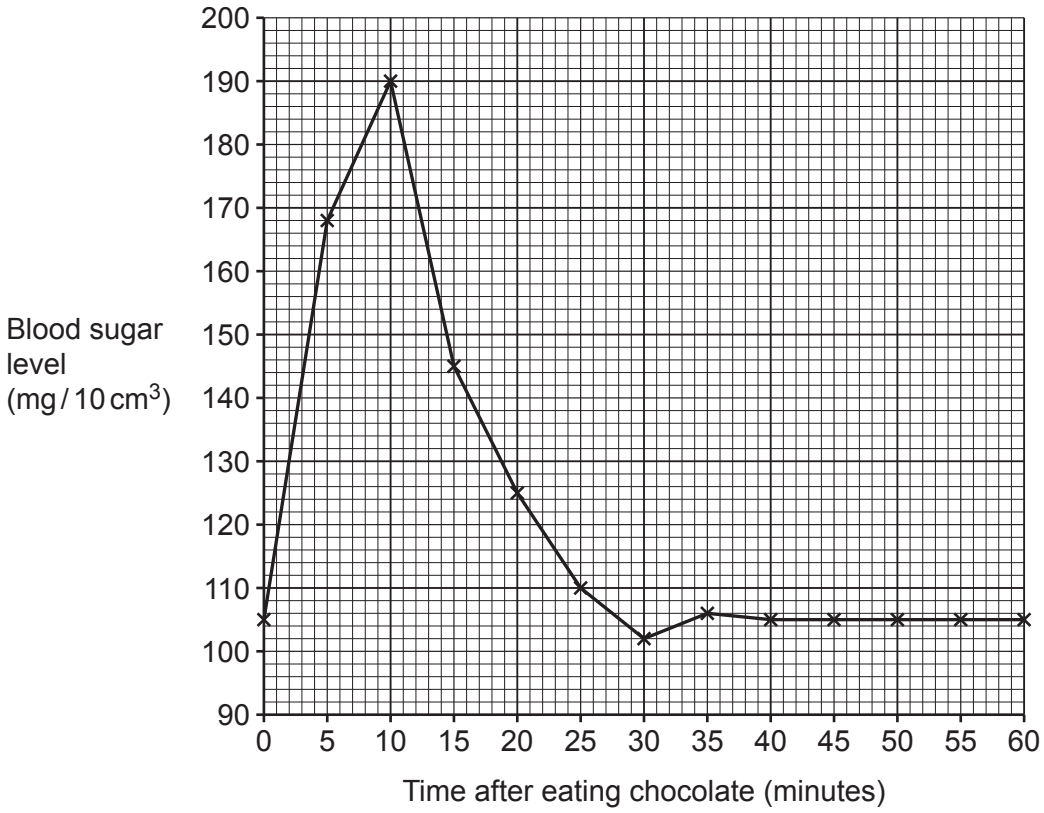
Compared to nervous system responses, hormone responses are usually

..... 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 cm^3 **[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 cm^3.

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]

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).