Oxford Cambridge and RSA

Tuesday 13 May 2025 – Afternoon

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

J260/05 Biology (Higher Tier)

Time allowed: 1 hour 45 minutes

H

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 **28** pages.

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

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1 There are two types of cell division, meiosis and mitosis.

(a) Complete the table to show which type of cell division is described by each statement.

Tick (✓) **one** box in each row.

Statement	**Both types of cell division**	**Meiosis only**	**Mitosis only**	**Neither type of cell division**
It involves two divisions to produce four new cells.				
It makes new cells for growth and repair of tissues in adults.				
It produces cells with half the number of chromosomes.				
It produces gametes.				

[4]

(b) Cancer is the result of changes in cells.

(i) In which part of a cell do these changes occur?

Tick (✓) **one** box.

Cell membrane ☐

Cell wall ☐

Cytoplasm ☐

DNA ☐

[1]

(ii) Describe how the changes lead to a single cell forming a tumour.

.....

.....

.....

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

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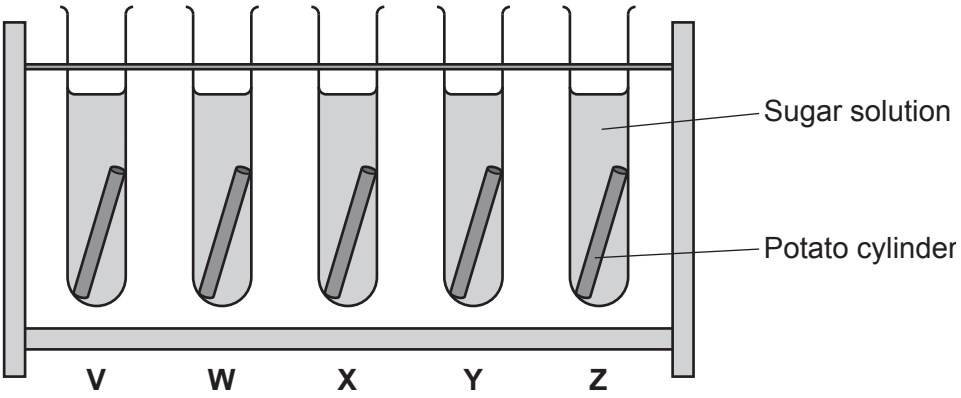
2 A student investigates the effect of sugar concentration on osmosis.
They use potato cylinders placed in sugar solutions of different concentrations.



(a) Statements **A** to **E** describe how the student does the investigation.

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

A Cut five potato cylinders.

B Calculate the change in mass.

C Measure the starting mass of the potato cylinders.

D Place the potato cylinders into each of the different sugar solutions for 24 hours.

E Remove and dry the potato cylinders, and measure their mass.

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

One has been done for you.

A				

[3]

(b)
(i) State **one** variable that the student should control in this investigation.

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

(ii) Suggest why the student dries the potato cylinders before measuring their final mass.

.....

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

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Turn over for the next question

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(c) The table shows the student's results.

Sugar solution	Mass of the potato cylinder at the start (g)	Mass of the potato cylinder after drying (g)	Change in mass (g)
V	1.10	1.21	+ 0.11
W	1.36	1.48	.....
X	1.42	1.42	0.00
Y	1.28	1.18	.....
Z	1.35	1.12	–0.23

(i) Calculate the change in mass for potato cylinders **W** and **Y**. **[1]**

(ii) The student uses the change in mass to conclude which sugar solution had the largest effect on the potato cylinders.

Suggest why the student **cannot** make a valid comparison between the potato cylinders using the change in mass.

Use the data in the table.

.....

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

(iii) Suggest **two** ways in which the student could improve their method so they can make a valid comparison between potato cylinders.

1 .....

.....

2 .....

.....

[2]

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(d)

(i) Explain why some of the potato cylinders decreased in mass.

Use ideas about osmosis.

.....

.....

.....

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

(ii) The potato cylinder placed in sugar solution **X** did **not** change in mass.

Suggest **one** reason why this might have happened.

.....

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

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3 We can become unwell if we are infected with a pathogen.

(a)
(i) Complete the sentences to explain how immune system cells in the blood are adapted to fight infections.

Use words from the list.

antibodies	**antigens**	**red blood cells**	**white blood cells**

White blood cells have receptors that recognise a pathogen's ..... .

Some white blood cells release ..... against pathogens.

Pathogens can be ingested and digested by some ..... .

[3]

(ii) Antibodies are proteins.

Which molecules are joined together to make a protein?

Tick (✓) **one** box.

Amino acids ☐

Fatty acids and glycerol ☐

Glucose ☐

Starch ☐

[1]

(iii) What is the reagent used to test for proteins?

Tick (✓) **one** box.

Benedict's solution ☐

Biuret solution ☐

Ethanol ☐

Iodine solution ☐

[1]

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(b) Explain how a vaccination provides protection against an infection.

.....

.....

.....

.....

.....

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

(c) AIDS is a condition caused by a pathogen that destroys white blood cells.

(i) State the type of pathogen that causes AIDS.

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

(ii) Explain why a common communicable disease such as influenza can be much more dangerous for a person who is living with AIDS.

.....

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

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4 The botanist Carl Linnaeus classified many organisms in the 1700s.

(a)
(i) Describe how scientists such as Linnaeus classified organisms into groups.

.....

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

(ii) Describe **one** additional piece of evidence from cells that modern scientists use to classify organisms.

.....

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

(b) Tigers live in forests around Asia, China and Russia.

(i) Tigers are an endangered species.

Describe **two** human activities that could have caused tigers to become endangered.

1 .....

2 .....
[1]

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(ii) It is estimated that:

- in 1900, there were 100 000 tigers in India
- by 1972, there were only 1827 tigers in India.

Calculate the percentage decrease in the number of tigers in India from 1900 to 1972.

Percentage decrease = ... % **[2]**

(iii) Scientists estimate the tiger population size in India each year.

Suggest **one** reason why scientists can only **estimate** the tiger population size.

.....

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

(c) Scientists are trying to conserve tigers in India. This has the benefit of protecting them from extinction.

Explain **one other** benefit and **one** challenge of conserving tigers in India.

Benefit .....

.....

.....

.....

Challenge .....

.....

.....

.....

[4]

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5

(a) Tay-Sachs disease is inherited.

It is caused by a recessive allele of a single gene.

(i) Explain the term recessive.

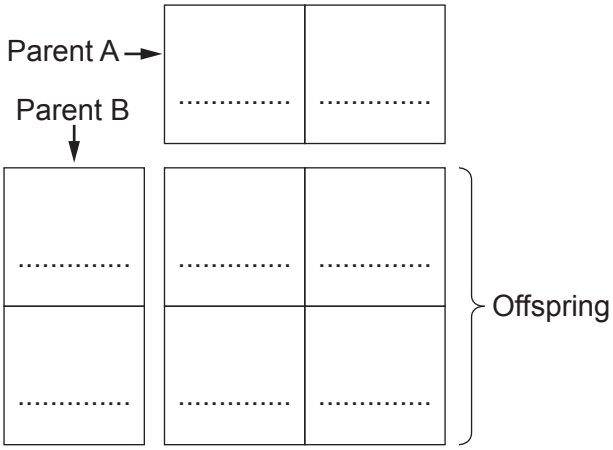
.....

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

(ii) Complete the Punnett square to show how Tay-Sachs disease may be inherited when both parents are heterozygous.

Use:

- **T** to represent a normal allele
- **t** to represent a Tay-Sachs disease allele.



[2]

(iii) Which offspring would have Tay-Sachs disease?

Put a ring around the correct option in the Punnett square. **[1]**

(iv) Write down the expected **ratio** of children without Tay-Sachs disease to children with the disease for these parents.

Ratio = ... : ..... **[1]**

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(b) Tay-Sachs disease damages nerve cells in the nervous system.

The Tay-Sachs allele codes for a functional protein that has an active site.

What type of protein does the Tay-Sachs allele code for?

Tick (✓) **one** box.

Carbohydrate ☐

DNA ☐

Enzyme ☐

Fat ☐

[1]

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(c) Stem cells could be a potential treatment for Tay-Sachs disease.

(i) There are adult and embryonic stem cells.

Describe the different functions of these stem cells.

Adult .....

.....

Embryonic .....

.....

[2]

(ii) Which statement is an ethical implication of using stem cells?

Tick (✓) **one** box.

It is possible for viruses to be transferred with the stem cells leading to infection. ☐

Stem cells are taken from an embryo which is a potential future life. ☐

Stem cells could potentially become cancerous. ☐

The treatment may be rejected by the immune system. ☐

[1]

(iii) Explain your answer to **(c)(ii)**.

.....

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

(iv) All new treatments must be tested before they are made widely available.

Clinical drug trials can be classed as blind or double blind.

Describe what is meant by a **blind** and a **double-blind** trial.

Blind .....

.....

Double-blind .....

.....

[2]

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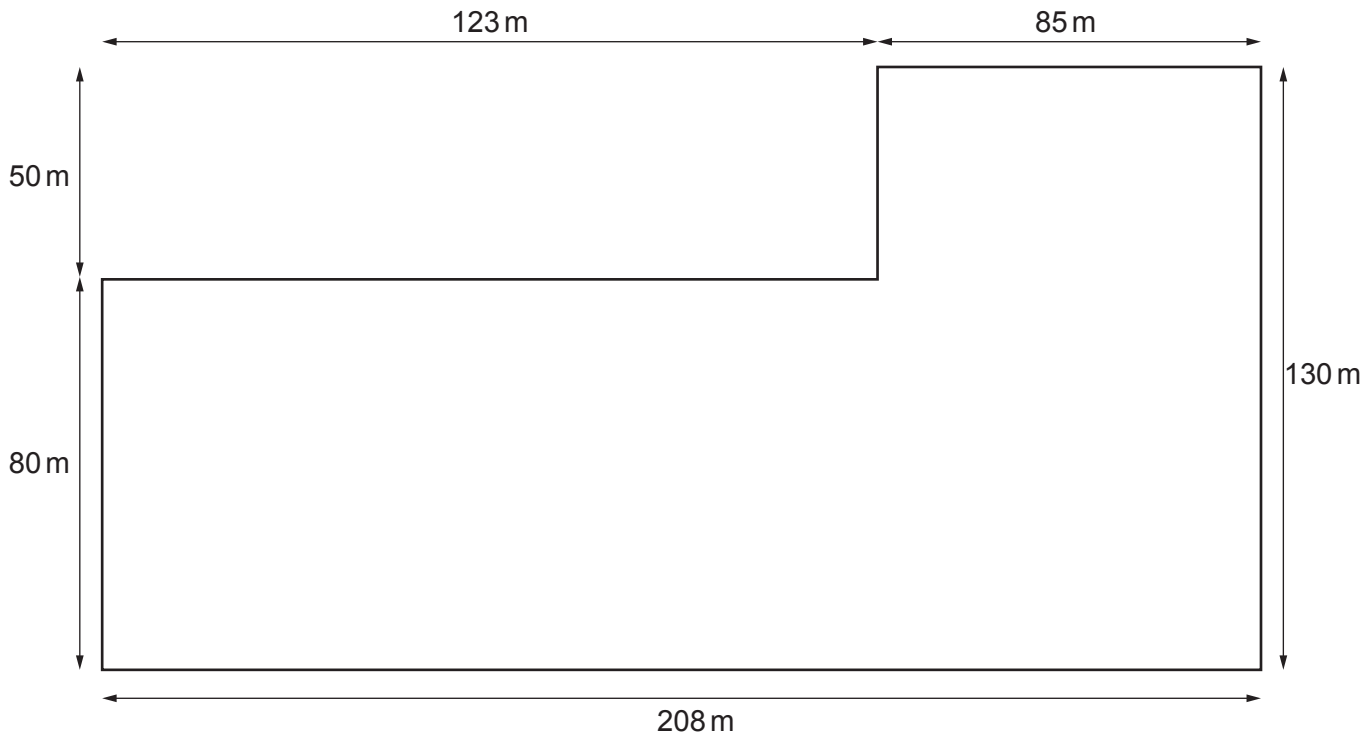
6 A student estimates the number of daisies growing in a park.

- The student places a quadrat at different positions in the park.
- The quadrat measures 0.5 m × 0.5 m.
- The student counts the number of daisies in each quadrat.

The diagram shows the shape and dimensions of the park.



(a) The mean number of daisies in each quadrat is 8.

Calculate the estimated population of daisies in the park.

Give your answer in **standard form** and to **two significant figures**.

Use the equation: estimated population = $\dfrac{\text{area of park}}{\text{area of quadrat}}$ × mean number of daisies per quadrat

Estimated population = ... **[5]**

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(b) Suggest **two** ways in which the student could improve the investigation so that the estimate is **not** biased.

1 .....

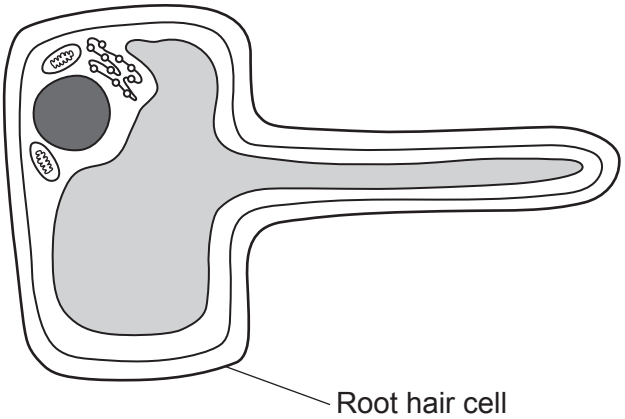
.....

2 .....

.....

[2]

(c) Daisies take up water and minerals from the soil through their root hair cells.



(i) State the names of the processes that move water and mineral ions into root hair cells.

Water .....

Mineral ions .....

[2]

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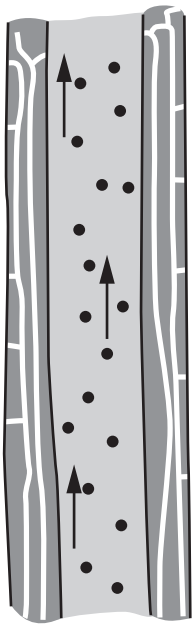
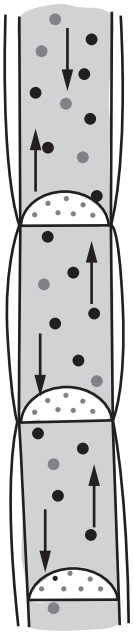
(ii) Plants have transport vessels called xylem and phloem.

Xylem vessels are involved in transpiration. Phloem vessels are used for the translocation of sugars.



Xylem vessel



Phloem vessel

Explain **one** way in which xylem and **one** way in which phloem are adapted to carry out their functions.

Xylem .....

.....

Phloem .....

.....

[2]

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7 The heart is an organ in the circulatory system.

(a) Describe how the human circulatory system works together with the gaseous exchange and digestive systems.

Gaseous exchange system .....

.....

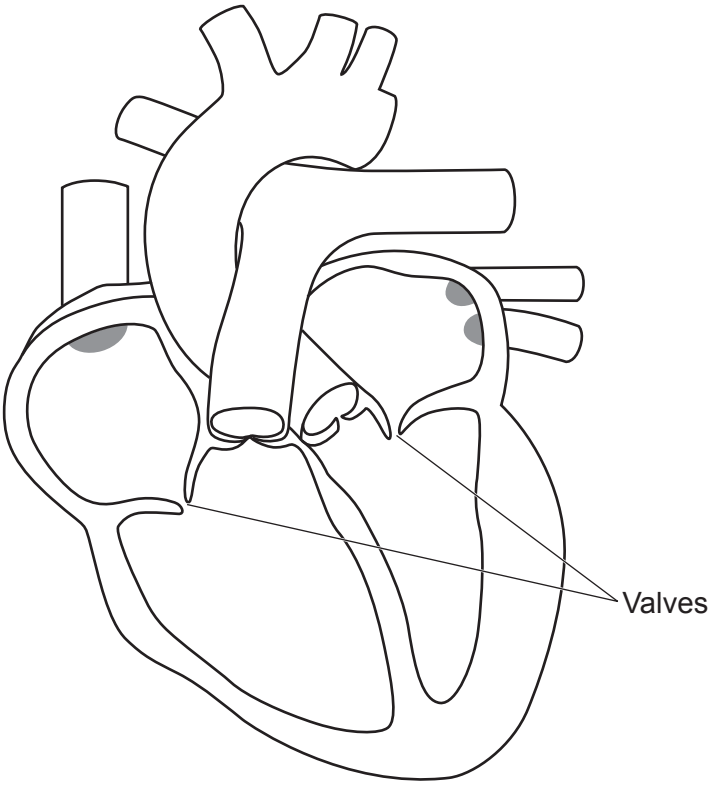
Digestive system .....

.....

[2]

(b) **Fig. 7.1** shows the inside of the human heart.

Fig. 7.1



The heart is adapted to pump blood around the body.

Describe the function of the valves in the heart.

.....

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

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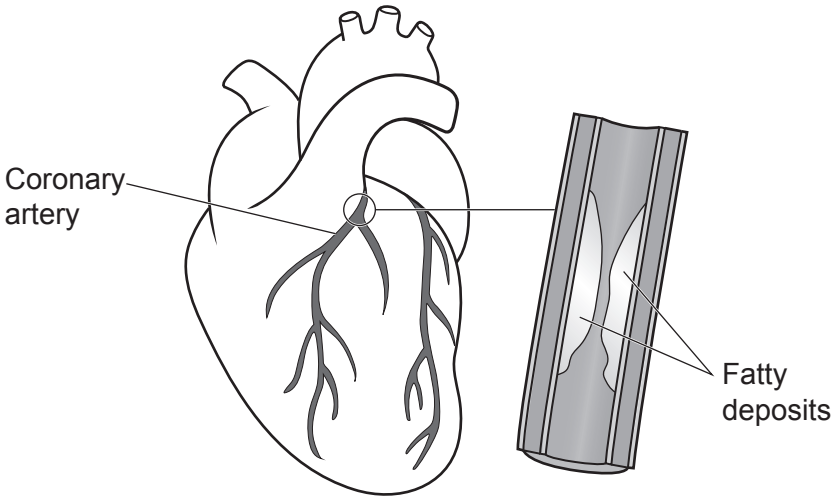
(c)* **Fig. 7.2** shows the coronary artery on the outside of a patient's heart.

Fig. 7.2



The patient has also been diagnosed with high blood pressure.

Explain why this patient is at high risk of cardiovascular disease (CVD) **and** evaluate ways in which they could reduce their risk.

.....

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.....

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

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8

(a) Humans have reflexes to prevent our body from damage.

(i) We blink to protect our eyes. The blink reflex happens when a stimulus is detected.

Complete the boxes to explain how the blink reflex happens.

Stimulus detected by ..... in the eye.

↓

Impulse travels along a sensory neuron.

↓

Impulse travels along a ..... neuron.

↓

Impulse travels along a motor neuron.

↓

Impulse arrives at ..... in the eyelid.

[3]

(ii) Reflexes are involuntary responses.

An example of a voluntary response is deciding to pick up a book.

State the **additional** structure that is involved in a **voluntary** response.

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

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(b) The nervous system and endocrine system respond to internal and external change.

Explain the importance of homeostasis.

.....

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

(c) Hormones control many processes in the human body.

Complete the table to explain the role of the hormone **adrenaline** in the human body.

Adrenaline	
Secreted by	Adrenal gland
Stimulus	....
Effect on liver	....
Effect on muscles	....

[3]

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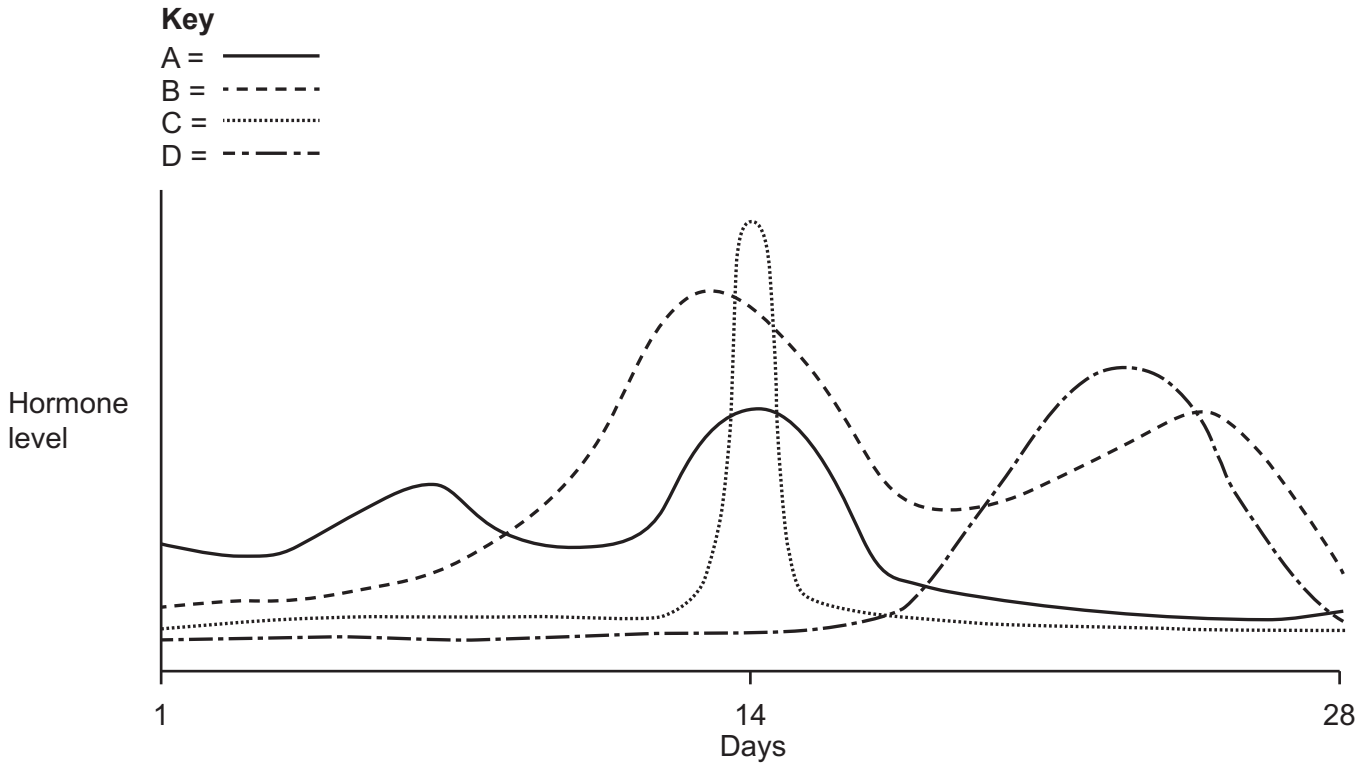
(d) The graph shows changes in the levels of four hormones that control the menstrual cycle during one complete cycle.



Draw lines to connect each **hormone** to its correct **name** and **action** to explain how they interact to control the menstrual cycle.

Hormone	Name	Action
A	FSH	Causes a follicle containing an egg to develop and produce oestrogen.
B	LH	Causes ovulation (the release of a mature egg).
C	Oestrogen	Causes uterus wall to thicken.
D	Progesterone	Prepares the lining of the uterus for implantation.

[5]

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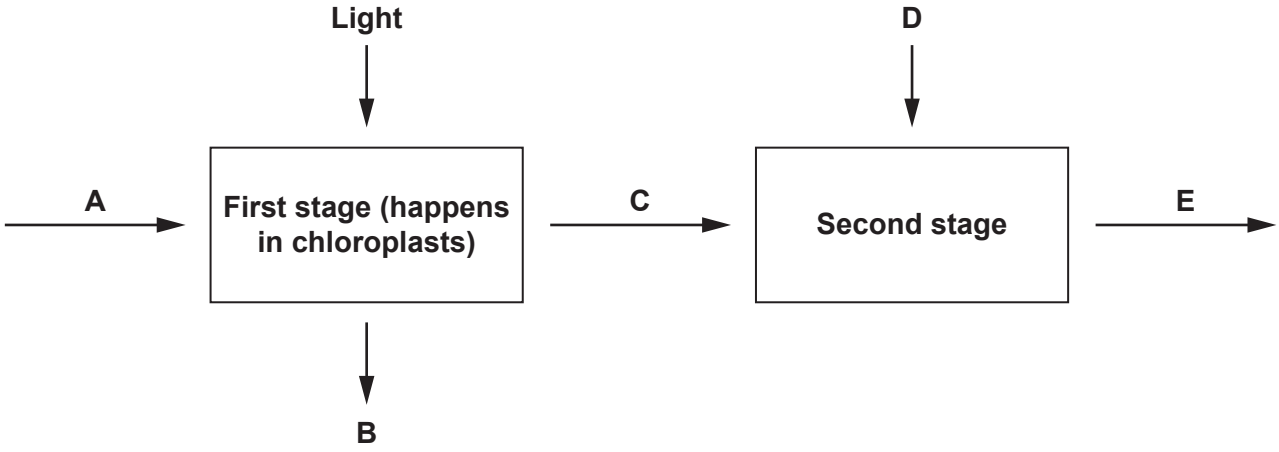
9 Photosynthesis involves many chemical reactions but can be summarised into two main stages:



(a) Complete the table to describe the process of photosynthesis, including the inputs and outputs of the two stages.

Use words from the list.

carbon dioxide	**glucose**	**hydrogen**	**oxygen**	**water**

Input or output	Name of reactant or product
A	.....
B	.....
C	.....
D	.....
E	.....

[3]

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(b) A student investigates the effect of light on the rate of photosynthesis in pondweed.

The table shows the student's results.

Light intensity (arbitrary units)	Distance from the light source (cm)	Number of bubbles given off in 1 minute
0.0064		105
0.0016	25.0	105
0.0004	50.0	28
0.0001	100.0	8

(i) Calculate the distance from the light source at which the light intensity is 0.0064.

Use the equation: light intensity = $\frac{1}{d^2}$

Distance = ... cm **[3]**

(ii) Use the table and the equation to explain why the rate of photosynthesis changes with distance from the light source.

.....

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

(iii) There are different methods that can be used to collect the gas produced by the pondweed.

Describe a different method that the student could use **and** explain why it is better than counting the number of bubbles in 1 minute.

.....

.....

.....

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

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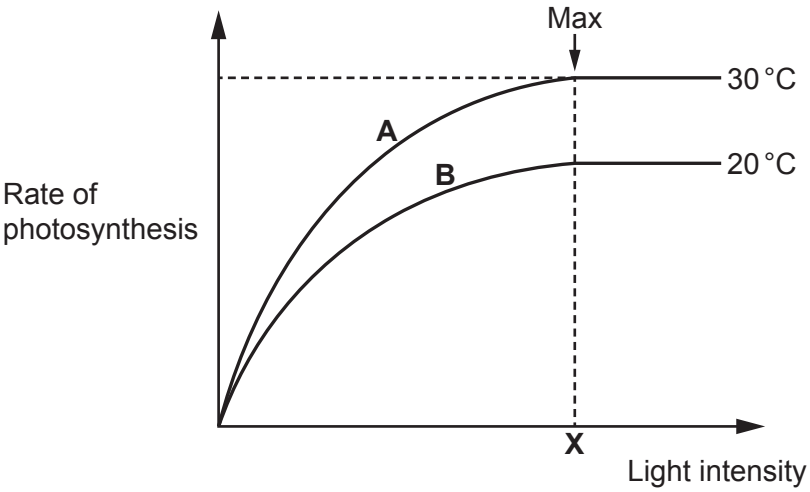
(c) The graph shows the effects of light intensity and temperature on the rate of photosynthesis.



Explain the effect **and** interaction of light intensity and temperature in **limiting** the rate of photosynthesis.

Use evidence from the graph in your answer.

.....

.....

.....

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

END OF QUESTION PAPER

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EXTRA ANSWER SPACE

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