



Question 1 (13 marks)




Forest ecosystems contain a wide variety of interacting organisms.



Question 1a (1 mark)

Organize the stages of the butterfly life cycle so they are in order.

Draggable items:

 Caterpillar	 Egg	 Pupa
--	---	---

Butterfly

Scroll down to continue



Question 1b (1 mark)

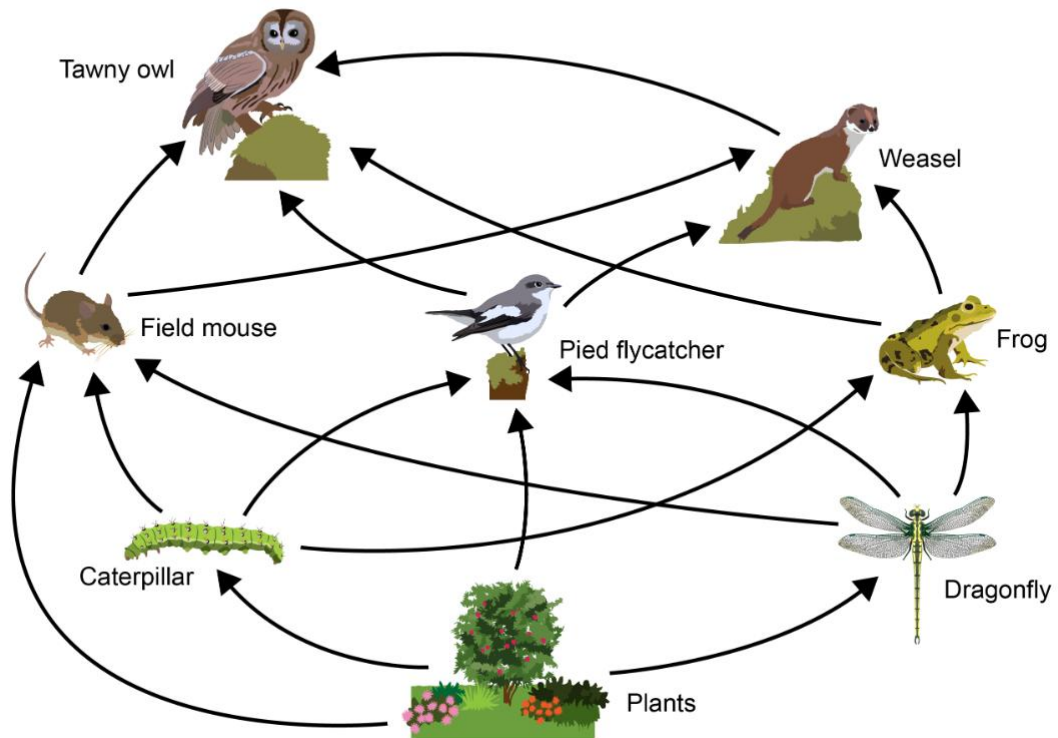
During growth, organisms produce new cells by mitosis. **State** one other function of mitosis.

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Question 1c (2 marks)

Below is a food web from a forest ecosystem.



Identify a food chain including a caterpillar and four other organisms.

Draggable items:

Caterpillar	Dragonfly	Field mouse	Frog
Pied flycatcher	Plants	Tawny owl	Weasel

Food chain structure: [] → [] → [] → [] → []



Question 1d (2 marks)

Pied flycatchers mainly eat insects, including caterpillars and adult butterflies. Their eggs hatch at the time in the year at which most caterpillars are present in the ecosystem.

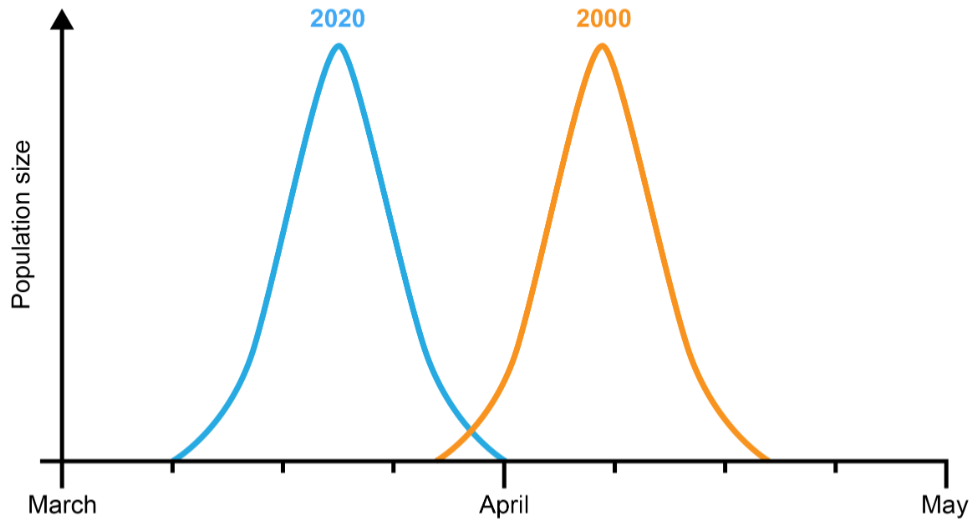
Suggest two reasons why pied flycatchers' eggs hatch at the same time as the peak in caterpillar population.





Question 1e (3 marks)

Over the past 20 years, the timing of the peak in caterpillar population has changed. It is now earlier in the year, as shown in the graph below. Some scientists suggest that the timing of the peak has moved because of climate change.

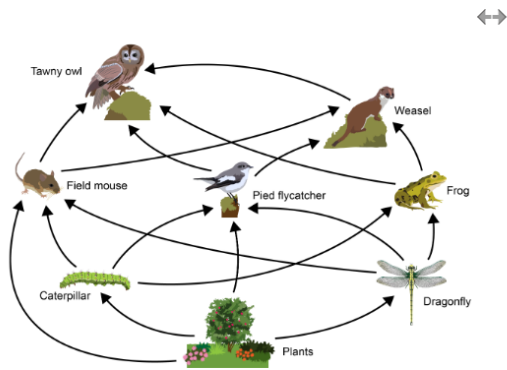


Suggest why climate change may have caused the peak in caterpillar population to move earlier in the year.



Question 1f (4 marks)

Pied flycatchers migrate from Africa to Europe to reproduce every spring. The timing of pied flycatchers' migration has not changed, even though the timing for the peak in caterpillar population has changed. Use the food web to **predict** the consequence of this mismatch in timing on the forest ecosystem.



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Question 2 (14 marks)

Drugs such as amfetamines cause changes in the human body.



Question 2a (1 mark)

One effect of amfetamine is an increase in heart rate. **State** the function of the heart.

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Question 2b (2 marks)

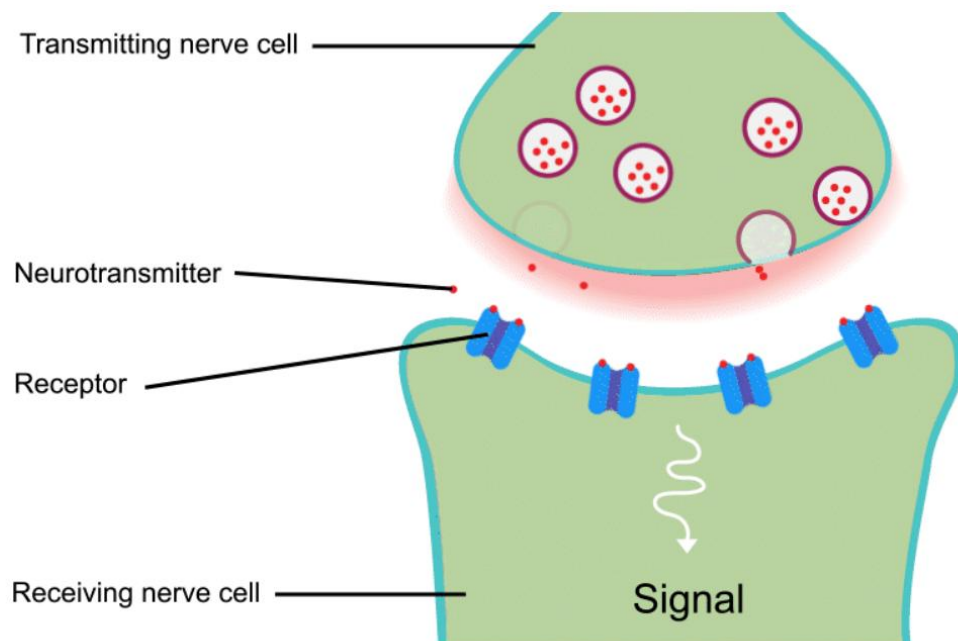
Outline how the function of the circulatory system supports cellular respiration.

B *I* ← → U \times_2 \times^2 $\frac{\square}{\square}$ $\frac{\square}{\square}$ Ω Σ Styles



Question 2c (1 mark)

In the central nervous system, signals are sent from one nerve cell to the next using chemicals called neurotransmitters.



Select the process by which neurotransmitters cross the space between nerve cells.

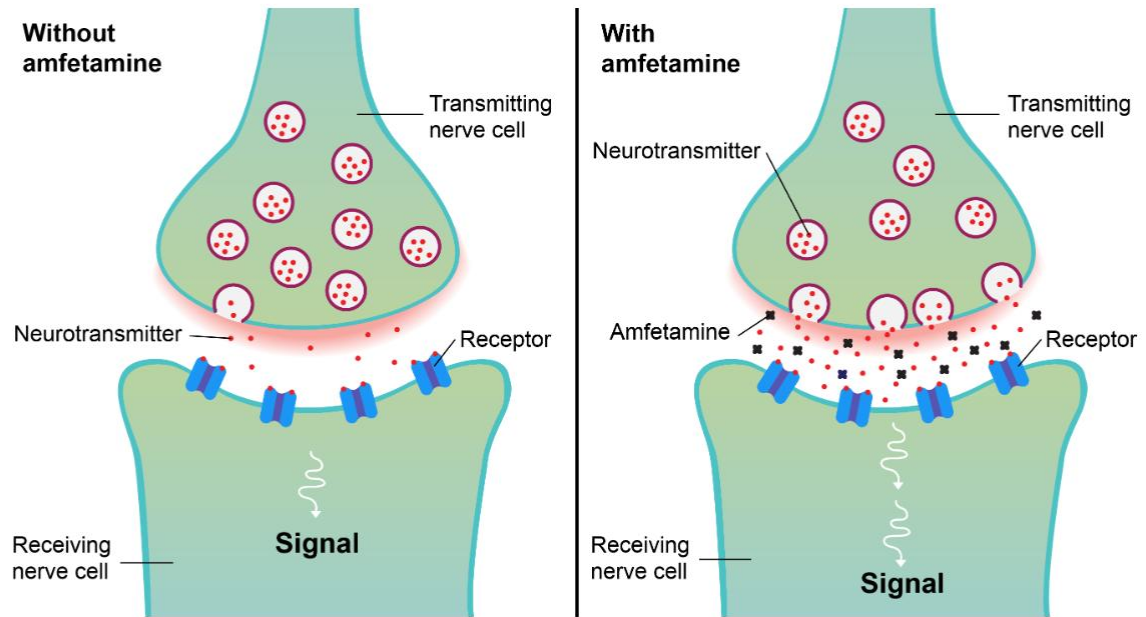
- Select
- Select
- Absorption
- Conduction
- Depression
- Diffusion

(3 marks)



Question 2d (3 marks)

The image below shows how nerve signals can be affected by amphetamine.



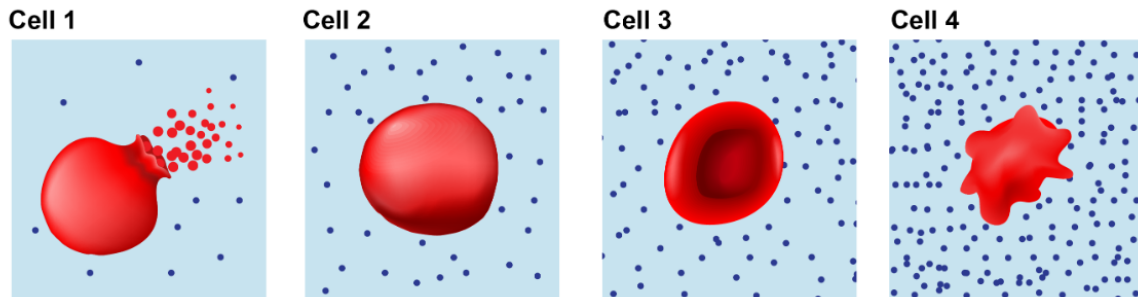
Use the image to **explain** why nerve signals are affected by amfetamines.

B *I* ← → U \times_2 \times^a $\frac{1}{x}$ $\frac{1}{x^a}$ Ω Σ Styles -



Question 2e (4 marks)

One side effect of using amfetamines is dehydration. **Select** the dehydrated cell in the image below. Using scientific knowledge, **justify** your answer.



Key: Water Solute

- Select ▾
- Select
- Cell 1
- Cell 2
- Cell 3
- Cell 4

→ U \times_2 \times^a $\frac{1}{x}$ $\frac{1}{x^a}$ Ω Σ Styles -

Scroll down to continue



Question 2f (1 mark)

High blood pressure is another side effect of amfetamines. **Select** one factor that does **not** affect blood pressure.

- Age
- Blood group
- Diet
- Sex



Question 2g (2 marks)

Studies have shown that if one individual has high blood pressure, it is likely that their brothers and sisters will also have high blood pressure. **Suggest** two reasons why this is the case.

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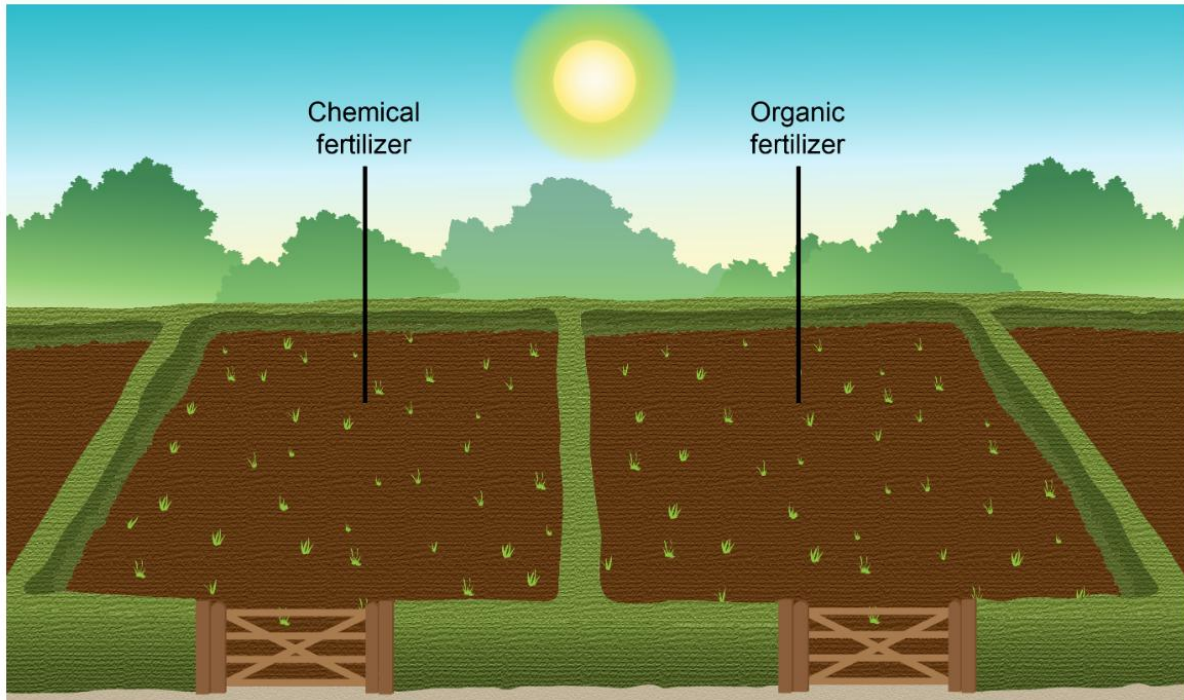
Question 3 (10 marks)

People from different cultures have learned various traditional farming methods over the years. They use what they know from their own culture. These traditional methods support biodiversity, soil health, water conservation and sustainable pest control, without using store-bought fertilizers or pesticides. A pesticide is a substance used to protect plants or crops from animals, plants or fungi that may harm them. Modern farming uses pesticides as well as store-bought fertilizers.



Question 3a (2 marks)

The image below shows a field that has been divided in half. This was done to investigate the effect of using different types of fertilizers on mass of crop harvested.



State a research question for this investigation.

B I ← → x₂ x² ≡ ≡ Ω Σ Styles ↕



Question 3b (1 mark)

Suggest a reason for carrying out the experiment on the same field.

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Question 3c (1 mark)

A farmer conducted an experiment using different fertilizers on plant A in this field. 100 seeds of plant A were grown with each type of fertilizer, and the mass of crop harvested was measured annually over a period of five years. The results are shown in the table below.

Number of years	Mass of crop harvested / kg	
	Chemical fertilizer	Organic fertilizer
1	90	70
2	92	75
3	94	78
4	88	84
5	80	90

Identify the year in which the highest mass of crop was harvested using organic fertilizer.



Question 3d (2 marks)

Identify a similarity and a difference in mass of crop harvested for both types of fertilizer.



Similarity

B I ← → **U** x_2 x^2 $\frac{1}{2}$ $\frac{3}{4}$ Ω Σ
Styles -

Difference

B I ← → **U** x_2 x^2 $\frac{1}{2}$ $\frac{3}{4}$ Ω Σ
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Question 3e (1 mark)

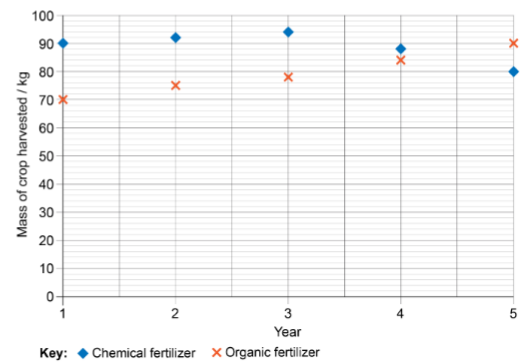
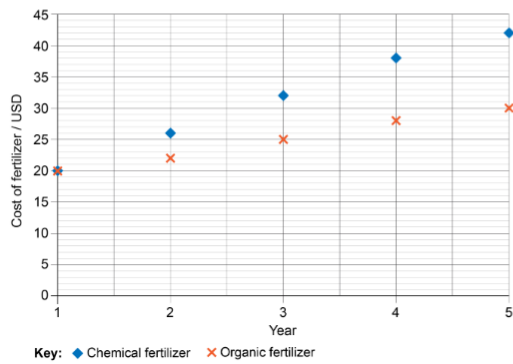
State why the experiment in part (c) was conducted over five years.

B I ← → **U** x_2 x^2 $\frac{1}{2}$ $\frac{3}{4}$ Ω Σ Styles -



Question 3f (3 marks)

During the experiment in part (c), the farmer also collected data on the cost of using chemical fertilizer and organic fertilizer on mass of crop harvested over the same five-year period. This data is shown in the graphs below.



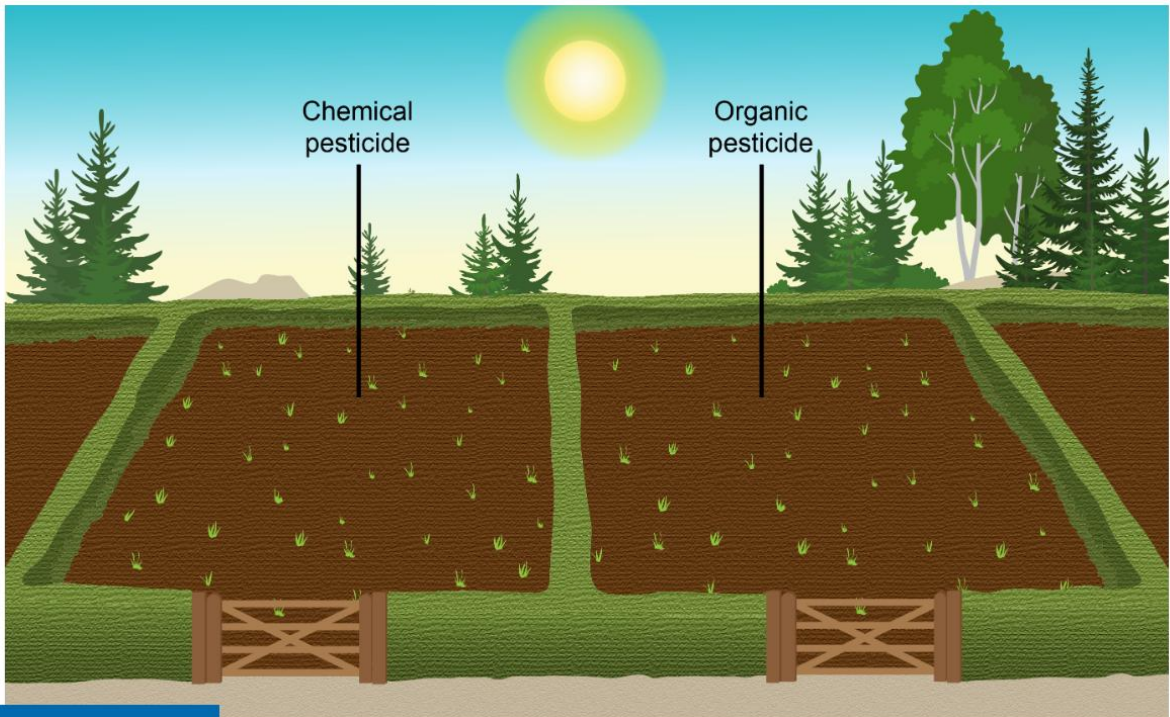
Using these graphs, **discuss** which fertilizer is the most efficient for the farmer to use.

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Question 4 (10 marks)

Another difference between modern and traditional farming is the type of pesticides used. Modern farming uses chemical pesticides, while traditional farming uses organic pesticides.

A student decided to carry out an experiment to measure the effect of different types of pesticides on plant growth by measuring the height of the plants.





Question 4a (4 marks)

Identify the variables in this investigation.



Independent variable

Rich text editor for the independent variable.

Control variable 1

Rich text editor for control variable 1.



Question 4b (3 marks)

The student measured the plants after one year of exposure to organic pesticide. Measure the missing height and calculate the average to complete the table below.

Year 1 Organic pesticide Draggable item:

The diagram shows four green plants of varying heights on a brown soil background. Plant 1 is approximately 3.5 cm tall, Plant 2 is approximately 2.5 cm tall, Plant 3 is approximately 3.0 cm tall, and Plant 4 is approximately 6.5 cm tall. To the right of the plants is a vertical ruler with markings from 0 to 7 centimeters. The ruler has millimeter markings between centimeter markings. The labels 'mm' and 'cm' are at the bottom of the ruler.

Year	Height of plant / cm				
	Plant 1	Plant 2	Plant 3	Plant 4	Average
1	4.6		3.6	5.8	
2	8.9 cm	9.7	6.8	7	8.1
3	12.7 cm	15.6 cm	17.1 cm	14.6 cm	15.0
4	14	15.9	17.5	15.1	15.6
5	18.6	17.8	19.9cm	20.2	19.1

Reset

Working

Rich text editor toolbar with icons for Bold (B), Italic (I), Undo, Redo, Underline (U), Strikethrough (x), Superscript (x^e), Bulleted List, Numbered List, Insert Link (Ω), Insert Table (Σ), Styles dropdown, and a mobile device icon.



Question 4c (1 mark)

State one way to improve the **presentation** of the data in part (b).

Rich text editor toolbar with icons for Bold (B), Italic (I), Undo, Redo, Underline (U), Strikethrough (x), Superscript (x^e), Bulleted List, Numbered List, Insert Link (Ω), Insert Table (Σ), Styles dropdown, and a mobile device icon.



Question 4d (1 mark)

Suggest why the height of the plants in year 4 remained similar to those in year 3.

Rich text editor toolbar with icons for Bold (B), Italic (I), Undo, Redo, Underline (U), Strikethrough (x), Superscript (x^e), Bulleted List, Numbered List, Insert Link (Ω), Insert Table (Σ), Styles dropdown, and a mobile device icon.



Question 4e (1 mark)

Fertilizers can be used to increase plant growth. **Suggest** one other way to increase plant growth in **this** experiment.

Rich text editor toolbar with icons for Bold (B), Italic (I), Undo, Redo, Underline (U), Subscript (x₂), Superscript (x²), Bulleted List, Numbered List, Link (Ω), Unlink (Σ), Styles, and a trash icon.



Question 5 (11 marks)

In addition to reducing pests, pesticides can affect plant growth. The student measured the effect of pesticide concentration on growth of corn plants in a laboratory. The pesticide they used was called pesticide X. They used the method below.

1. Select corn plants of 5 cm height.
2. Place one plant in a container with a heater and a lamp.
3. Spray the plant with 2 % pesticide solution.
4. Measure the increase in plant height after 30 days.
5. Repeat the experiment for each pesticide concentration. The concentrations used are 0 %, 4 %, 6 %, 8 %, 10 %.



Question 6 (16 marks)

Different cultures farm in various ways, based on their background and values. For instance, traditional rice farming in Southeast Asia involves flooding fields. This promotes anaerobic conditions, which affect soil health. Soil health cannot be measured directly but can be shown through different indicators. Nitrogen concentration in soil is one indicator of soil health.

Design an investigation to test how nitrogen concentration in soil affects plant growth. You are provided with standard laboratory equipment and various soil samples with nitrogen concentrations ranging from 1.25 g kg⁻¹ and 2.25 g kg⁻¹. In your answer, you must include:

- the independent variable, the dependent variable and two control variables
- equipment you will use
- details of how to manipulate, measure or monitor the variables
- details of the method you will use to collect sufficient data
- a safety or ethical consideration.

Rich text editor toolbar with icons for Bold (B), Italic (I), Undo, Redo, Underline (U), Subscript (x₂), Superscript (x²), Bulleted List, Numbered List, Link (Ω), Unlink (Σ), Styles, and a trash icon.



Question 7 (11 marks)

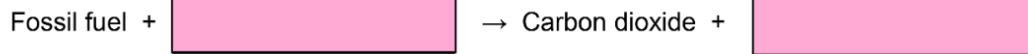


Increases in both global population and economic growth mean more greenhouse gases are being released. Although progress has been made with renewable energy, burning fossil fuels is still a significant contributor to emissions.



Question 7a (1 mark)

Complete the word equation to **show** how carbon dioxide (CO₂) is produced when fossil fuels are burned.



Question 7b (2 marks)

Complete the table below to **classify** the gases found in our atmosphere. Some have already been completed for you.

Gas	Greenhouse gas?
Argon (Ar)	<input type="text" value="Select"/>
Carbon dioxide (CO ₂)	<input type="text" value="Yes"/>
Methane (CH ₄)	<input type="text" value="Select"/>
Nitrous oxides (NO _x)	<input type="text" value="Yes"/>
Oxygen (O ₂)	<input type="text" value="Select"/>
Sulfur dioxide (SO ₂)	<input type="text" value="No"/>
Water vapour (H ₂ O)	<input type="text" value="Select"/>



Question 7c (2 marks)

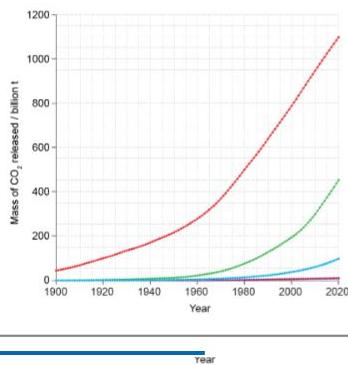
The graphs below show information about the relationship between income and annual mass of CO₂ released since 1900. The countries have been grouped into four income categories: low, lower-middle, upper-middle and high.

This media is interactive

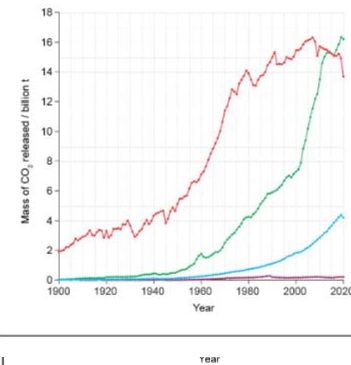
Click on a graph to expand it.

All graphs

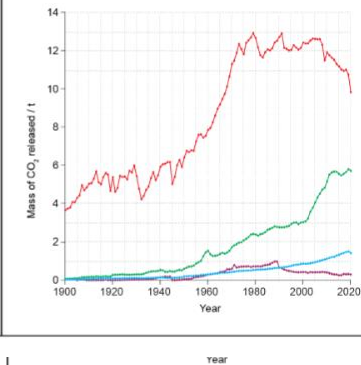
Graph 1:
Historical total mass of CO₂ released



Graph 2:
Annual mass of CO₂ released per income category



Graph 3:
Annual mass of CO₂ released per person



Key:

- High-income countries
- Lower-middle-income countries
- Upper-middle-income countries
- Low-income countries



Use graph 1 to **calculate** the combined historical total mass of CO₂ released for low-, lower-middle- and upper-middle-income countries in 2020. Give your answer to three significant figures.

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Question 7d (2 marks)

Use graph 2 to **identify** a similarity and a difference in the trends of annual mass of CO₂ released for lower-middle- and upper-middle-income countries.

B *I* ← → U x_2 x^2 $\frac{1}{x}$ $\frac{1}{x^2}$ Ω Σ Styles -



Question 7e (1 mark)

Use graph 2 to **identify** the year when upper-middle-income countries started to release more CO₂ than high-income countries.

B *I* ← → U x_2 x^2 $\frac{1}{x}$ $\frac{1}{x^2}$ Ω Σ Styles -



Question 7f (1 mark)

Graph 3 shows the annual mass of CO₂ released per person. **Suggest** why this mass has decreased for high-income countries over the last 10 years.

B *I* ← → U x_2 x^2 $\frac{1}{x}$ $\frac{1}{x^2}$ Ω Σ Styles -



Not Started
Question 7g (2 marks)

Scientists have predicted that over the next 100 years, the annual CO₂ released from low-income countries will start to increase rapidly. **Suggest** two ways that high-income countries could collaborate with low-income countries to prevent this outcome.

B *I* ← → U \times_e \times^e $\frac{\square}{\square}$ Ω Σ Styles -



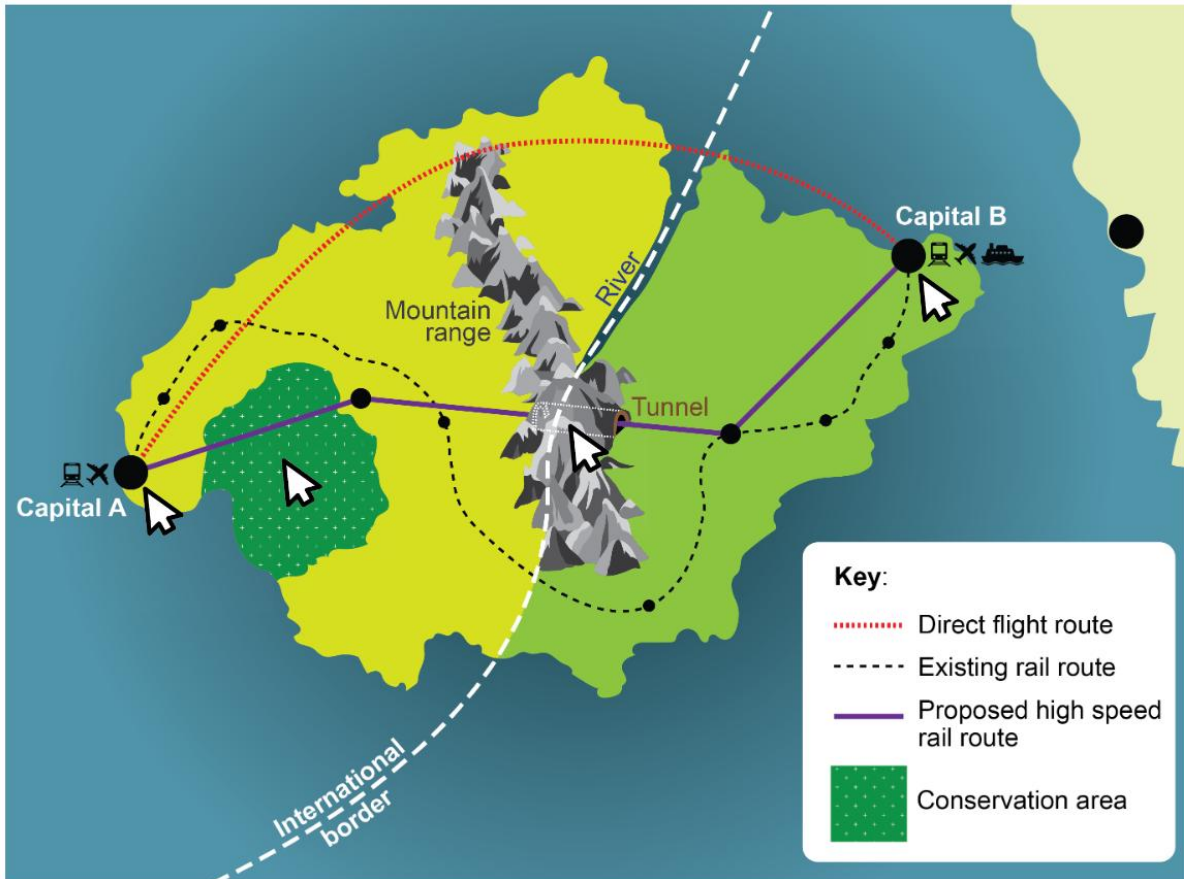
Question 8 (15 marks)



Transport is responsible for about 25 % of the carbon dioxide (CO₂) released globally each year. In wealthier countries, where people travel frequently, transport can have a big impact on an individual's carbon footprint. In these countries, people often use planes or trains to travel between cities for work or leisure. An individual's decision on how to travel depends on factors like time, cost, convenience and personal preferences.

The interactive infographic below shows a review of current and future transport options within a region.

Click on the arrows for more information.



Transport option between Capital A and Capital B		Mass of CO ₂ released / g km ⁻¹	Total journey time / hours	Cost / EUR
Direct flight route	246	3	75
Existing rail route	-----	35	6	60
Proposed high speed rail route	————	4	4	95



