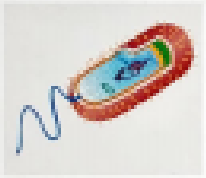
Question 1 (7 marks)

Question 1a (1 mark)

Cells are the basic unit of life: all living things are made of them. New cells come from pre-existing cells, and there are many different types.

Use the key to identify each of the images.

Draggable items:



1. Does the cell have a nucleus?

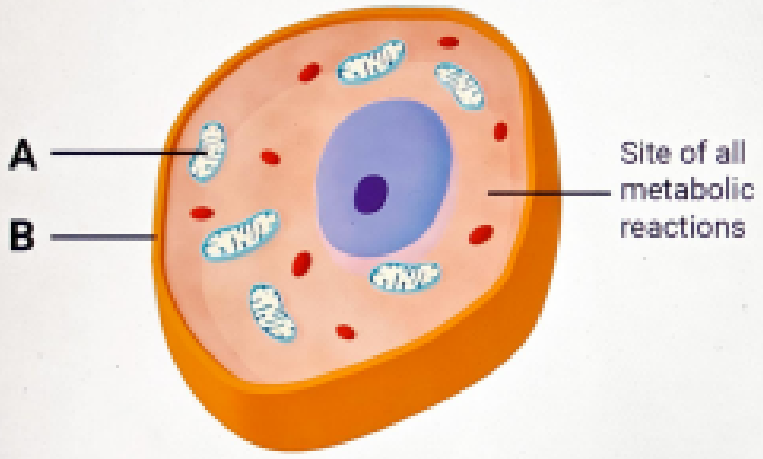
- **YES** → **2. Does the cell have a large central vacuole?**
  - **YES** → **Plant cell** [ ]
  - **NO** → **Animal cell** [ ]
- **NO** → **Bacterial cell** [ ]

Question 1b (1 mark)

Using the key in part (a), **suggest** an alternative question to tell the difference between a plant cell and an animal cell.

Question 1c (1 mark)

State the name of the organelle labelled A in the diagram below.



Question 1d (1 mark)

State the function of the organelle labelled B in the diagram in part (c).

Question 1e (3 marks)

Human bodies are organized from the smallest level of cells to the organism level.

cell → tissue → organ → body system → organism

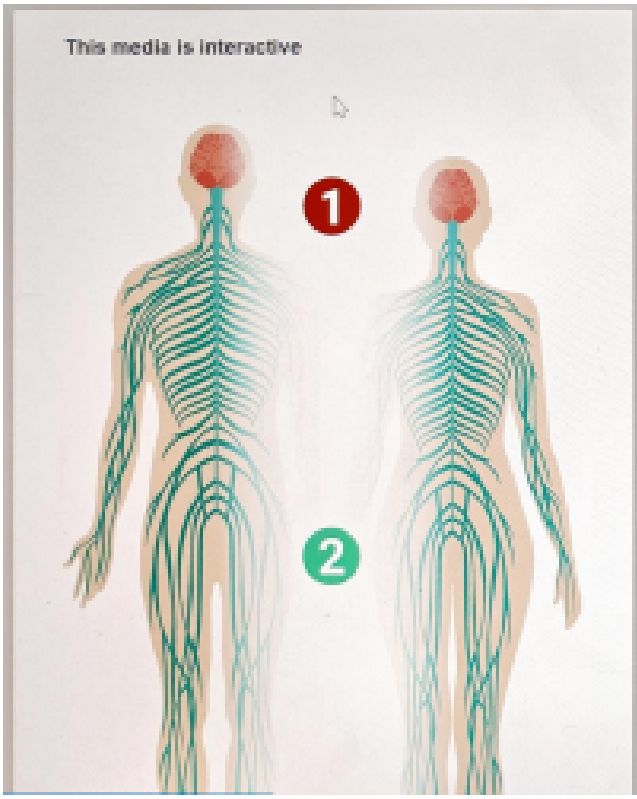
Outline the relationship between cells and tissues.

Question 2 (11 marks)

Question 2a (2 marks)

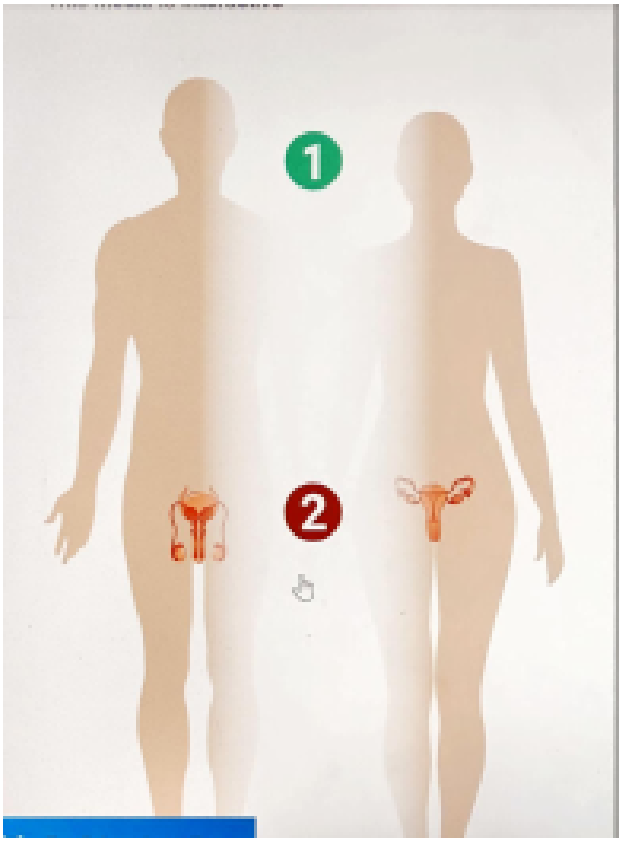
State the name of each body system as you click on the numbers in the diagram below.

This media is interactive



System 1

System 2



System 1

System 2

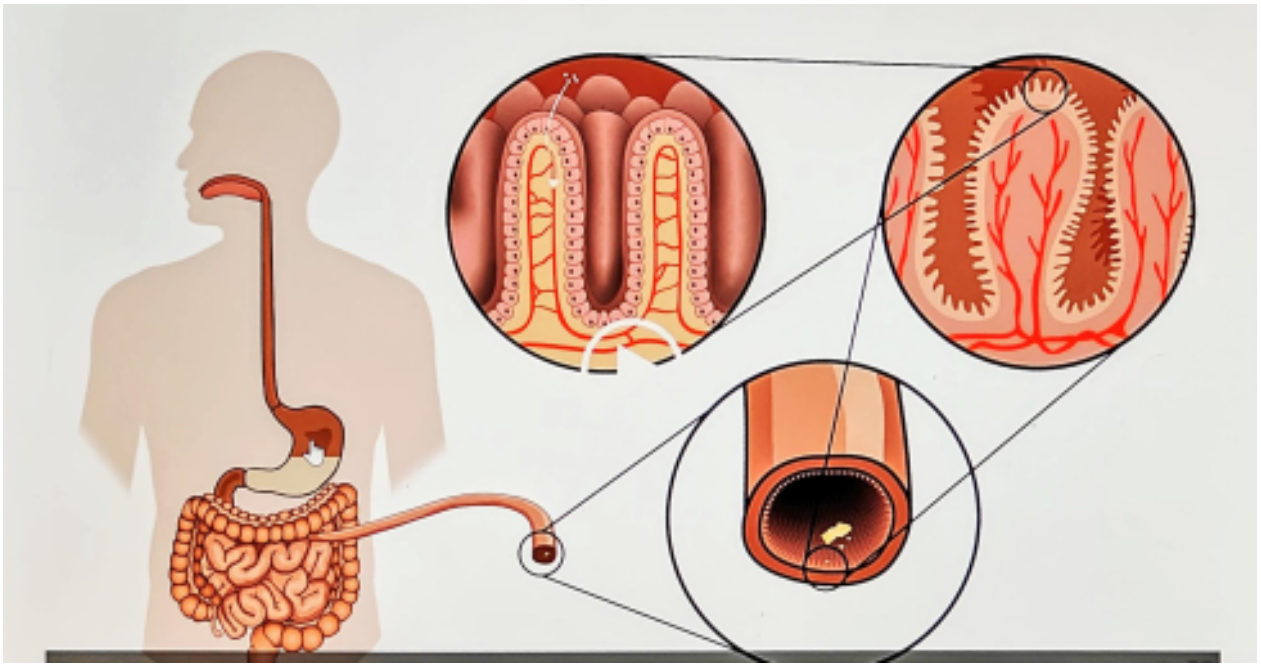
Question 2b (1 mark)

Select the term for all the chemical processes occurring in cells.

- ○ Circulation
- ○ Digestion
- ○ Enzymes
- ○ Metabolism

Question 2c (3 marks)

The animation below shows the passage of food through the digestive system.



Question 2d (1 mark)

Chemical digestion uses enzymes. It starts in the mouth and continues through the digestive system. **State** what is produced when carbohydrates are chemically digested.

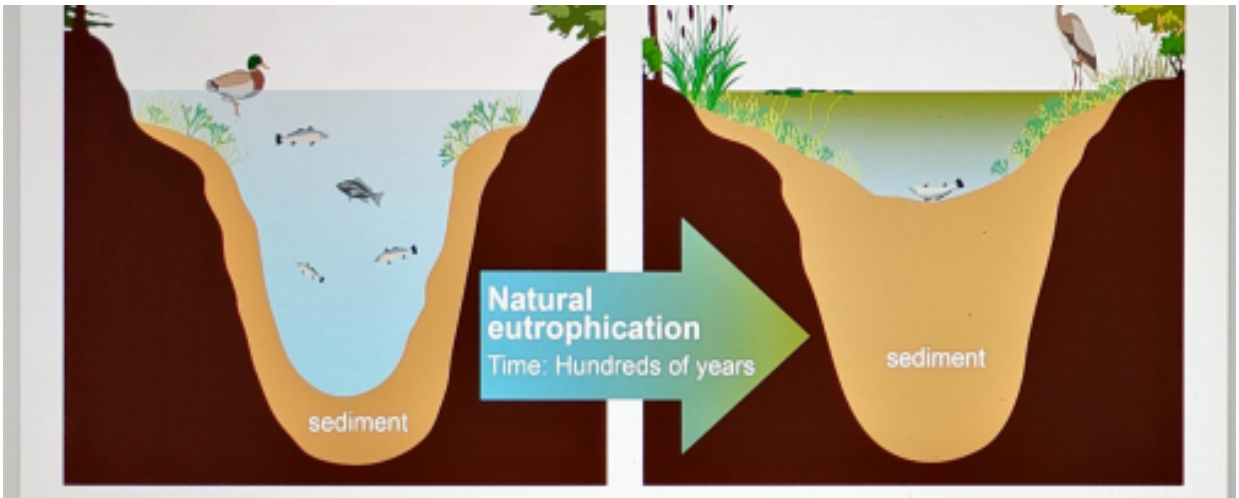
B I U x_2 x^2 Ω Σ Styles

The image below shows the lining of the small intestine, where nutrients are absorbed.

Nutrients from digested food need to move from the small intestine into the blood stream, where they can be transported around the body. **Explain** how the structure of the small intestine is adapted for this purpose. You should use scientific language in your answer.

Question 3 (10 marks)

Eutrophication is a natural process that occurs in bodies of water over hundreds of years. Excess nutrients such as nitrogen, phosphorus and potassium slowly wash from the soil into bodies of water, causing increased growth of algae and aquatic plants. Eutrophication causes lakes to become shallower as sediment builds up.

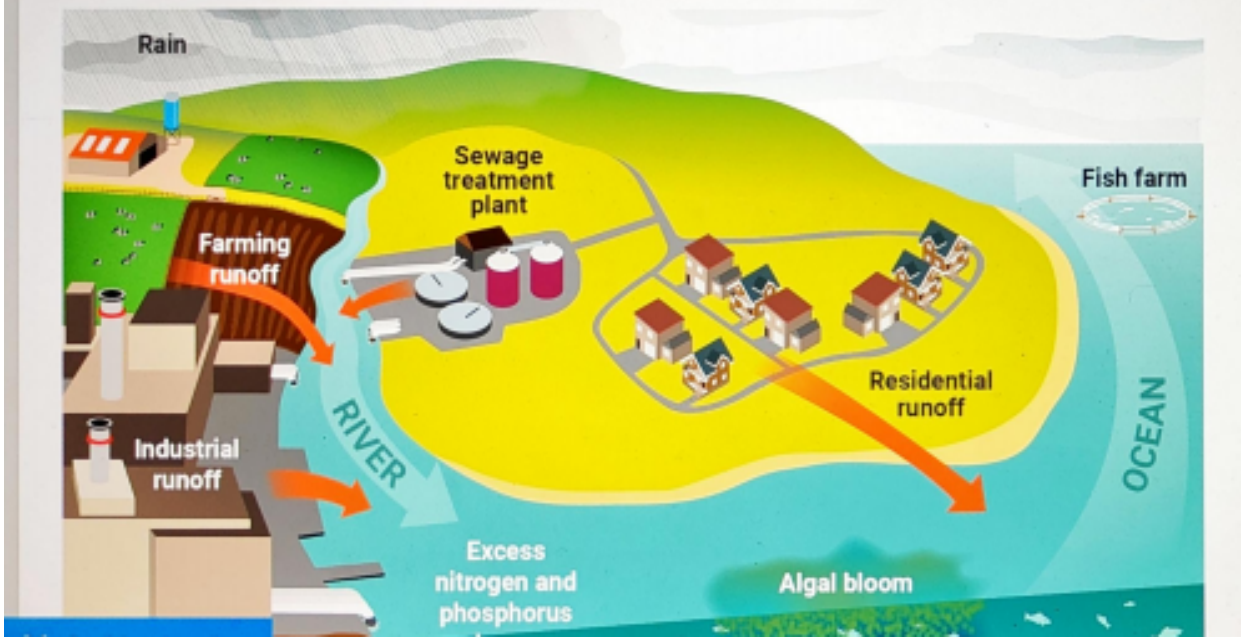


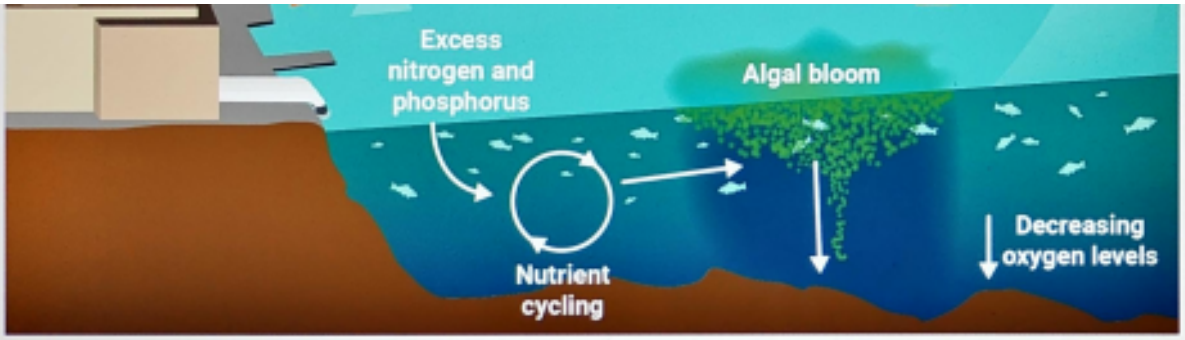
Question 3a (1 mark)

Suggest one source of nutrients that causes natural eutrophication.

Question 3b (2 marks)

The image below shows how human actions have increased both the speed and effects of eutrophication.





Suggest one direct source and one indirect source of nutrients that contribute to eutrophication caused by human actions.

Suggest one direct source and one indirect source of nutrients that contribute to eutrophication caused by human actions.

Direct source of nutrients

Indirect source of nutrients

Question 3c (3 marks)

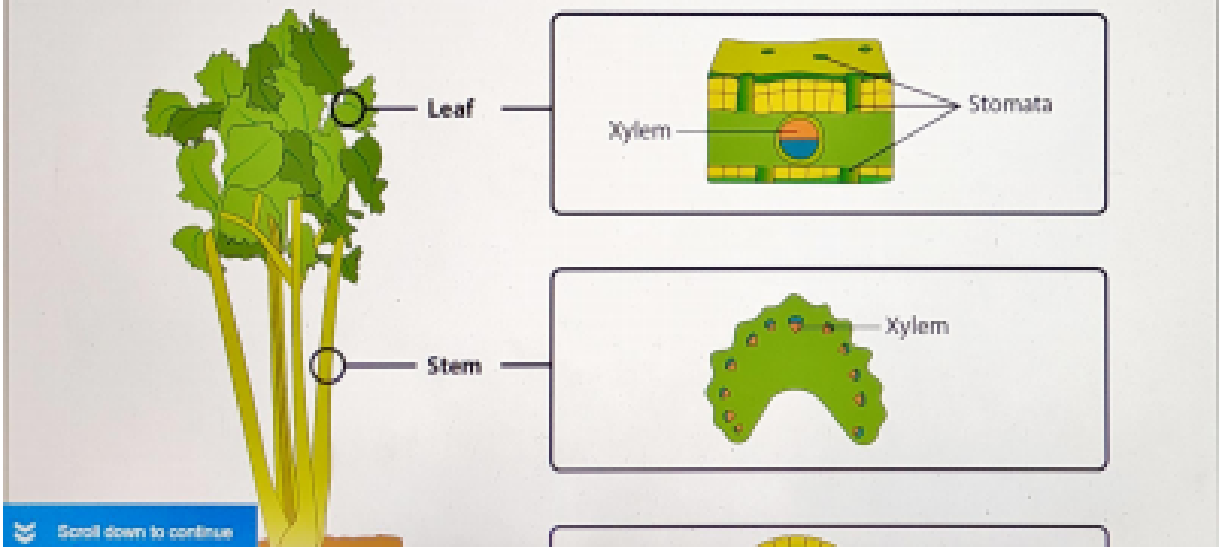
An algal bloom is caused by a rapid increase in the population of algae. Using the image in part (b), **describe** how eutrophication caused by human actions can lead to an algal bloom.

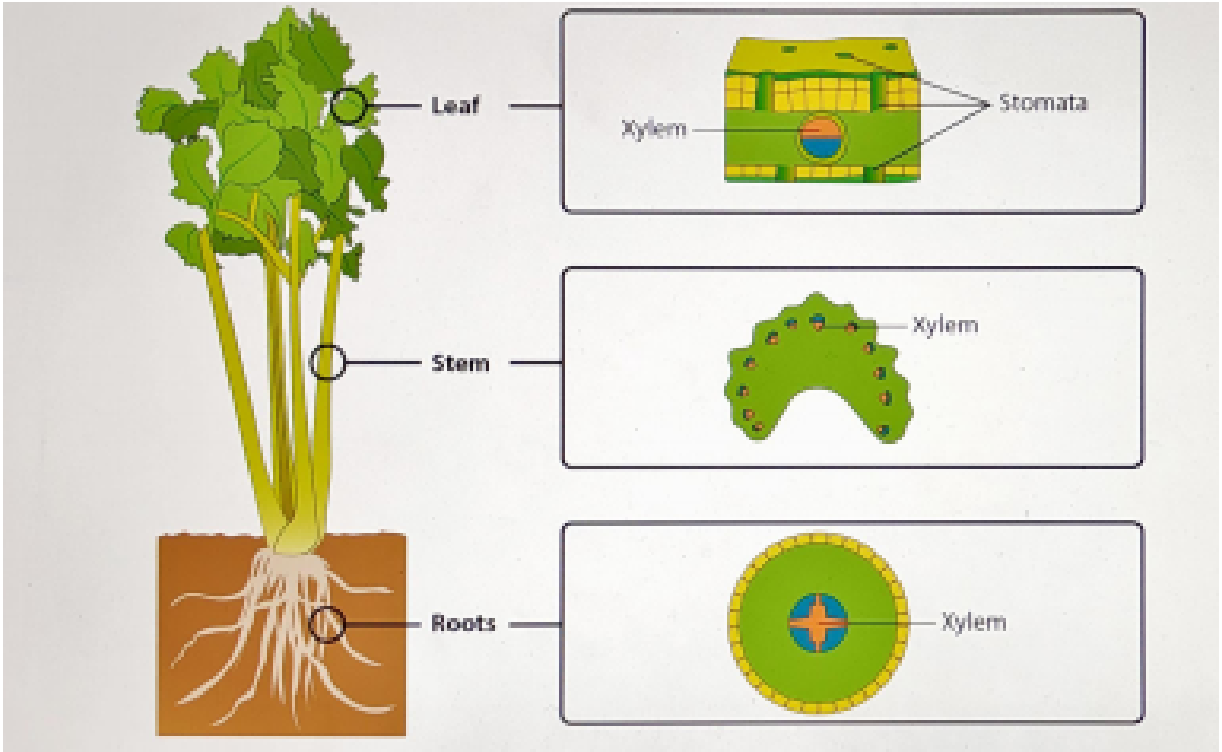
Question 3d (4 marks)

Explain how a large algal bloom could cause a decrease in biomass in the ecosystem.

Question 4 (17 marks)

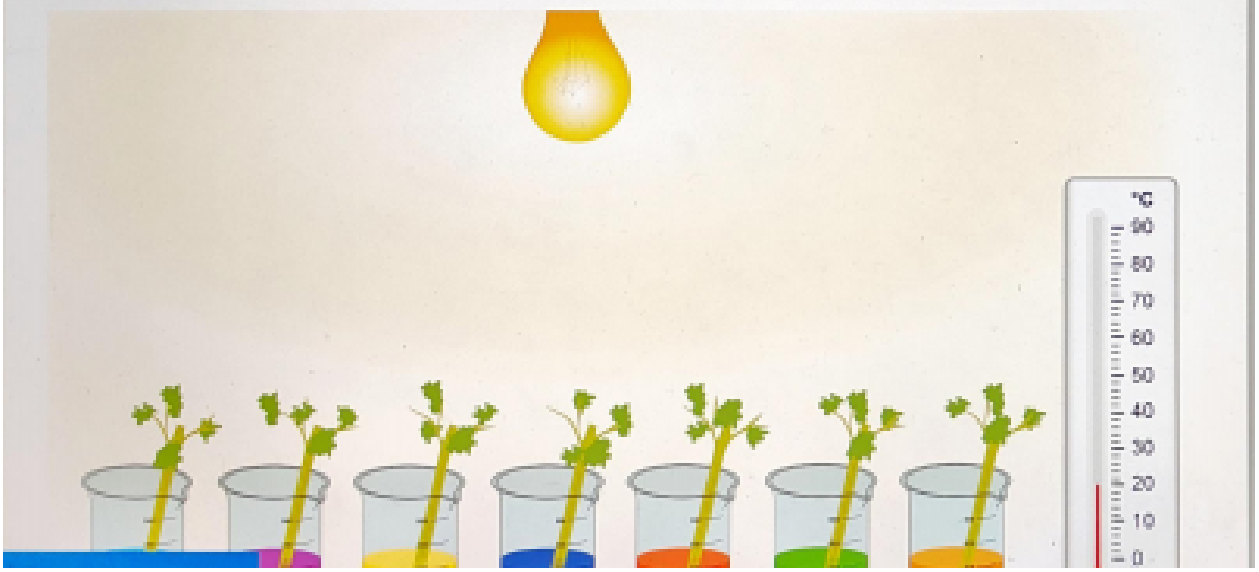
Transpiration is the evaporation and diffusion of water from plants. Water is transported from the roots to the leaves through the xylem. The water exits the plant through the stomata in the leaves. Oxygen and carbon dioxide also diffuse in and out of the plant through the stomata. The image below shows the location of xylem and stomata in a plant.

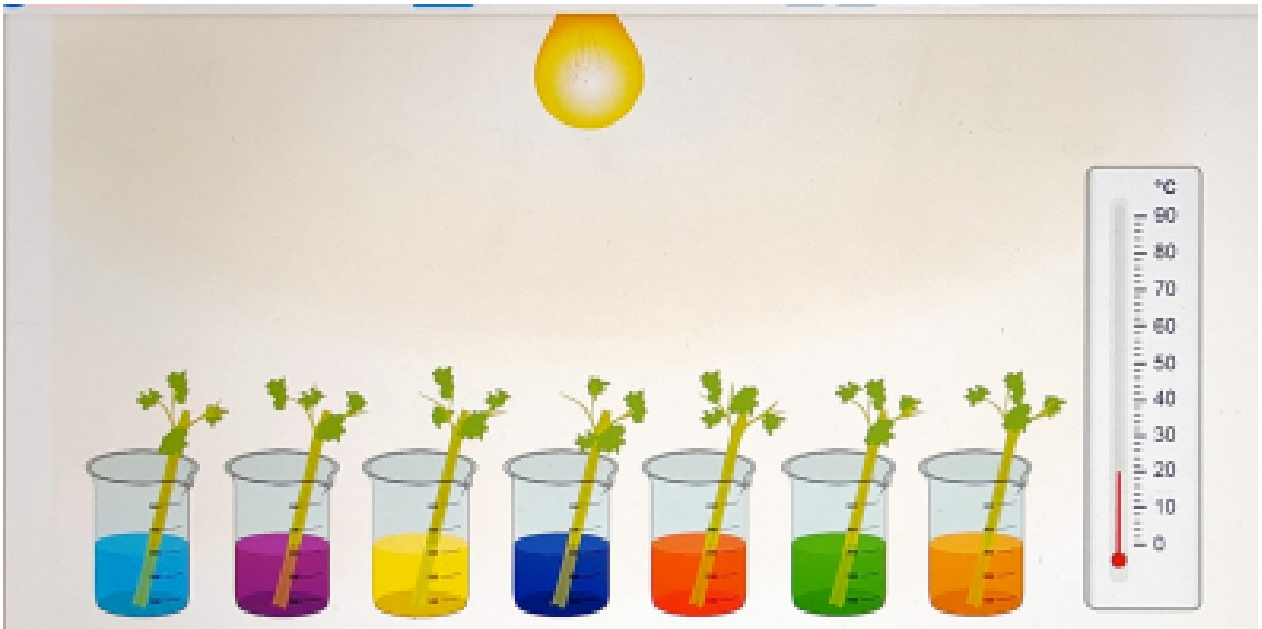




Question 4a (1 mark)

A class of MYP students wanted to investigate the transport of water in plants. One group of students set up the simple experiment below. They placed plant stems, water and seven different colours of food colouring in seven identical beakers.





Identify the independent variable in this investigation.

Question 4b (3 marks)

The rate of transpiration cannot be measured directly; it must be calculated from the dependent variable. **Outline** the measurements needed to calculate the rate of transpiration in cubic centimetres per hour ($cm^3\ h^{-1}$).

Question 4c (2 marks)

State two control variables for this investigation.

Control variable 1

Question 4d (4 marks)

A second group of students also investigated the transport of water in plants. The research questions of both groups are shown below.

	Group 1	Group 2
Research question	The relationship between coloured solutions and the rate of transpiration.	How does changing the colour of water by adding 7 different food colourings affect the rate of transpiration in plant stems?

State two improvements that group 2 made to the research question. **Justify** how each would improve the investigation.

Question 4e (4 marks)

Both groups of students calculated the rate of transpiration from their raw data. Their results are shown below.

Results

Group 1

Colour of water	Rate of transpiration /cm^3 h^{-1}
Red	7
Orange	6
Yellow	6
Green	7
Blue	7
Indigo	6
Violet	6

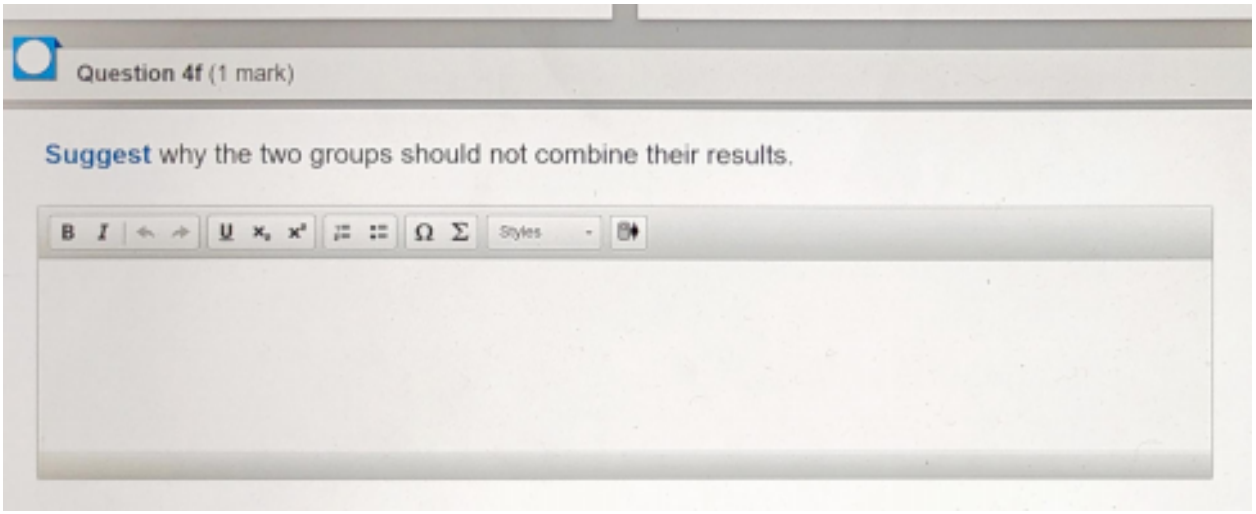
Group 2

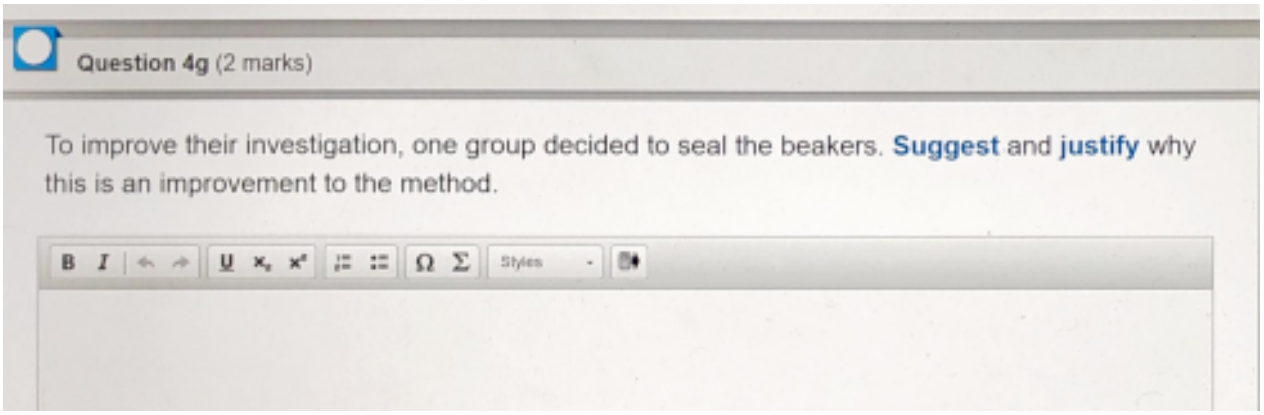
Colour of water	Rate of transpiration /cm^3 h^{-1}
No dye	6.0
Red	5.8
Orange	6.0
Yellow	5.9
Green	6.3
Blue	6.0
Indigo	6.0
Violet	6.1

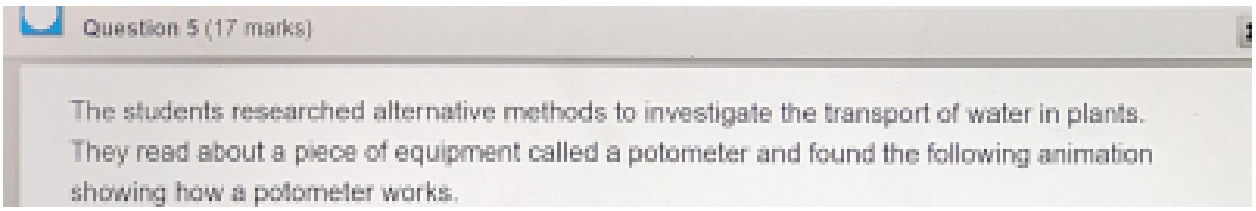
State and **justify** two reasons why the results from group 2 are more valid than the results from group 1.

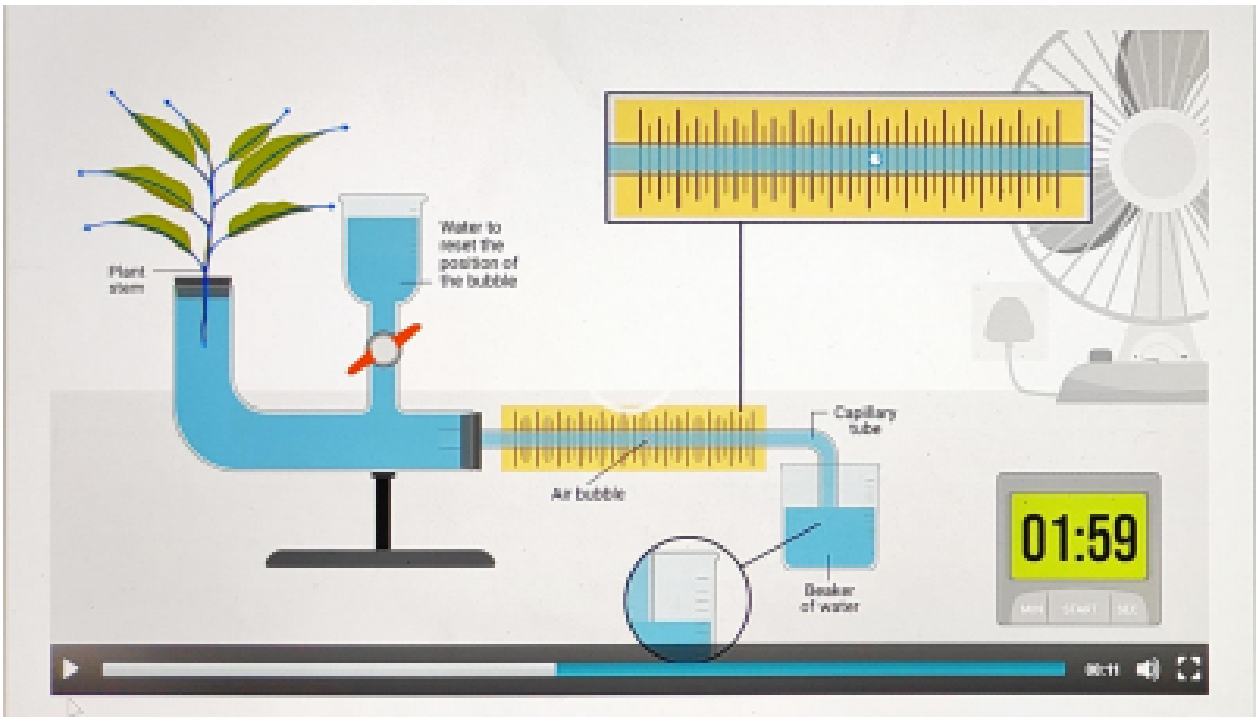
Reason 1

Reason 2


Question 4f (1 mark)
Suggest why the two groups should not combine their results.
Styles


Question 4g (2 marks)
To improve their investigation, one group decided to seal the beakers. Suggest and justify why this is an improvement to the method.
Styles


Question 5 (17 marks)
The students researched alternative methods to investigate the transport of water in plants. They read about a piece of equipment called a potometer and found the following animation showing how a potometer works.



You are provided with a potometer, a multi-speed fan and standard laboratory equipment. **Design** an investigation into the effect of air movement on the rate of transpiration. In your design, you should:

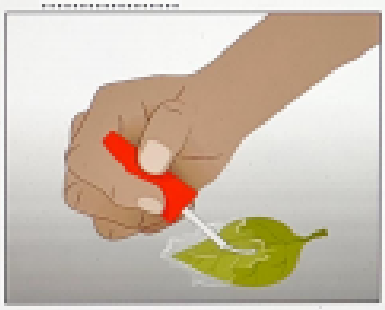
- identify the independent, dependent and two control variables
- formulate a testable hypothesis with a scientific explanation
- describe how to manipulate, measure or monitor all of the variables
- describe a method to collect sufficient data
- justify one calculation needed to transform the data collected
- state how you will make your method safe.

Question 6 (14 marks)

Having learned that stomata are important in both transpiration and gas exchange, the students decided to examine the surfaces of leaves. To compare the leaves, the students decided to estimate the number of stomata per square millimetre of the leaf. This is called the stomatal density. The students used the following method:

1. Randomly select 10 leaves from each plant.

2. Paint the surfaces of each leaf with a layer of clear nail varnish.



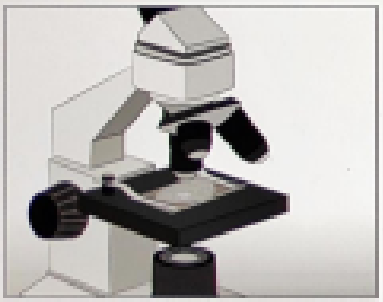
3. Carefully peel off the dried layer of nail varnish.

4. Place the dried layer of nail varnish on a microscope slide.

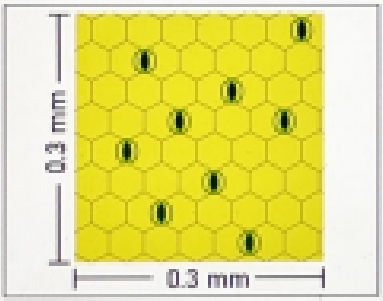
5. Count the number of stomata.

6. Calculate the stomatal density using the following equation:

4. Place the dried layer of nail varnish on a microscope slide.

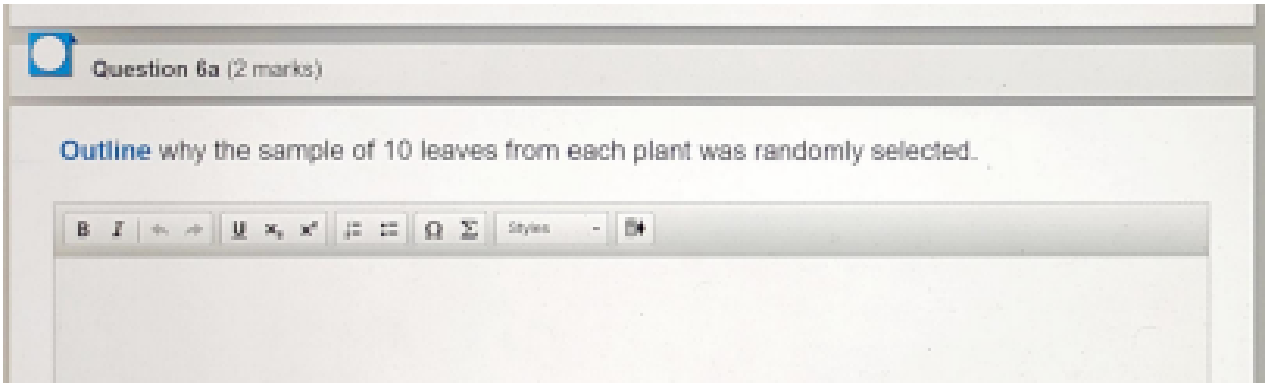


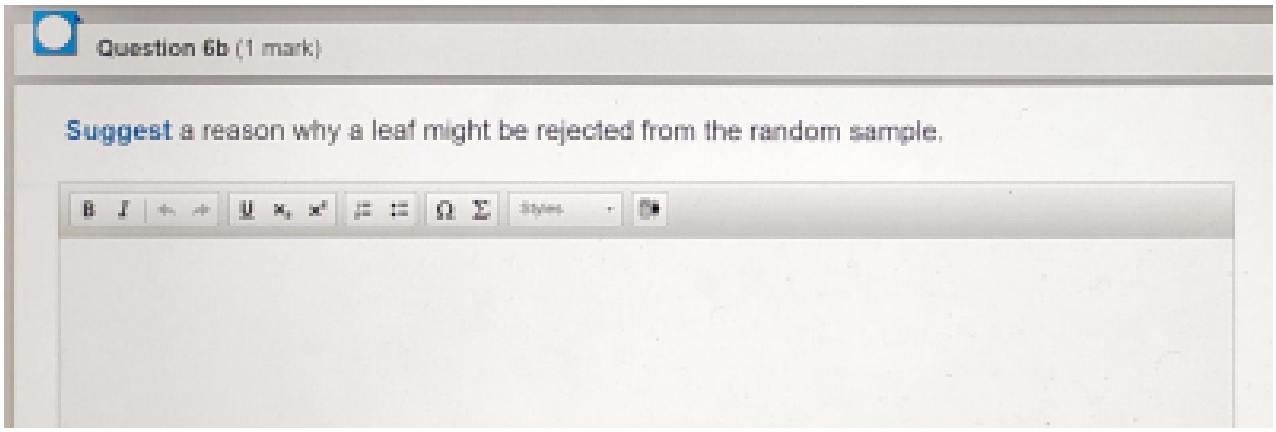
5. Count the number of stomata.



6. Calculate the stomatal density using the following equation:

$$\text{Stomatal density} = \frac{\text{Number of stomata}}{\text{Area}}$$

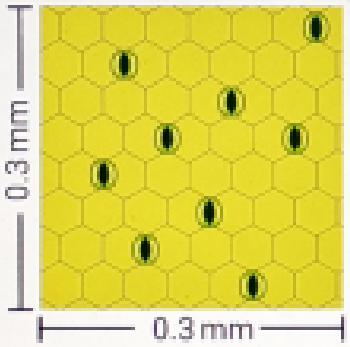

Question 6a (2 marks)
Outline why the sample of 10 leaves from each plant was randomly selected.


Question 6b (1 mark)
Suggest a reason why a leaf might be rejected from the random sample.

Question 6c (1 mark)

The table below shows the results for the lower surface of maize leaves.

Maize leaf sample 10



Maize leaf sample	Number of stomata visible on the lower surface
1	7
2	9
3	8
4	8
5	10
6	5
7	10
8	9

Reset

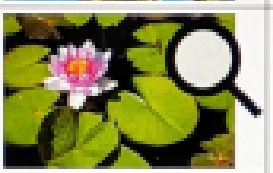
Determine the number of stomata present in maize leaf sample 10 and add your value to the table.

Question 6d (3 marks)

Calculate the average stomatal density of the lower surface of maize leaves. Give your answer to an appropriate degree of accuracy.

Question 6e (1 mark)

The students presented stomatal density data for three other plant species. They included pictures of the plants and information about the habitats in which the plants are normally found.

Plant	Number of stomata per mm^2		Picture of plant	Habitat
	Upper surface	Lower surface		
Sunflower	120	175		Grows in temperate climates.
Water lily	460	0		Grows on the surface of ponds and slow streams.
Pondweed	0	0		Grows underwater.

Select the name given to the type of data shown by the pictures and habitat descriptions.

- Continuous
- Graphical
- Qualitative
- Quantitative

Question 6f (1 mark)

Suggest why pondweed does not have stomata.

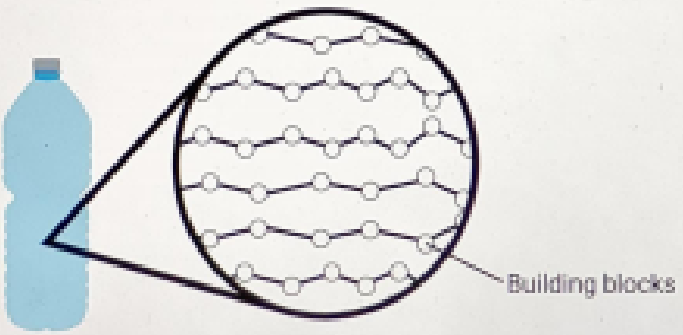
Question 6g (5 marks)

Explain the similarities and differences in distribution of stomata in sunflowers and water lilies. You should use scientific reasoning in your answer.

Question 7 (7 marks)

Humans use resources to create products that simplify our lives without always considering the long-term impacts. Creative methods to recycle plastics are required to protect and maintain the environment for future generations.

Plastics are large molecules made of repeated building blocks joined together in a long chain. They can be made from oil, natural gas or cellulose from plants. Plastics take a long time to break down or degrade, so plastics that are not recycled or burned build up in ecosystems. They can then enter food webs and kill organisms.



Question 7a (1 mark)

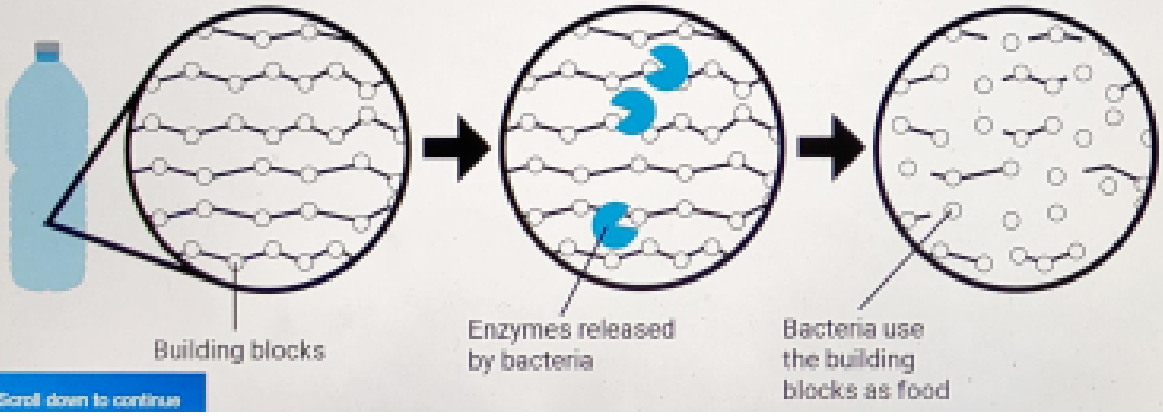
Select the correct meaning of the term *food web*.

- ○ The interconnected food chains in an ecosystem.
- ○ A single chain showing what order organisms are eaten in.
- ○ The total weight of all organisms in an area.
- ○ The part of the planet containing living organisms.

Question 7b (4 marks)

One way of reducing the effect of plastic waste on ecosystems is to improve recycling methods. In 2016, bacteria capable of digesting plastics were discovered in a bottle recycling centre. The bacteria use plastics as a source of food by releasing an enzyme that breaks down the plastics into their building blocks. Scientists are working with enzymes like these to develop a new method of reusing plastics.

The image below shows how enzymes break down plastics.



Scroll down to continue

Describe how enzymes can break down plastics. You should use scientific language in your answer.

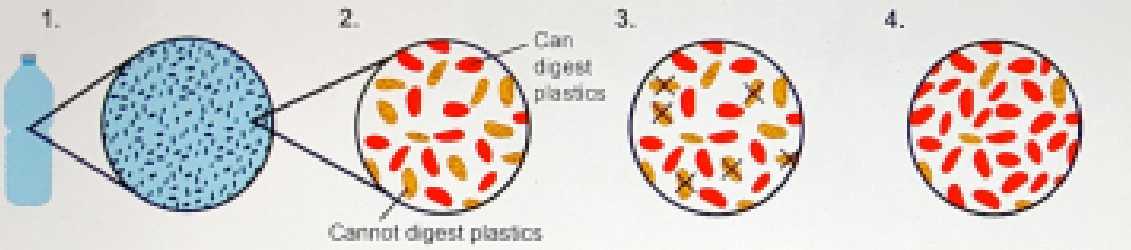
Question 7c (2 marks)

The bacteria discovered in the bottle recycling centre had evolved the ability to digest plastics through natural selection.

Organize the statements to complete the diagram.

Draggable items:

- Characteristics of individuals who reproduce become more common in the population.
- Individuals in a population have different characteristics from one another.
- Individuals with characteristics adapted to the environment survive longer.

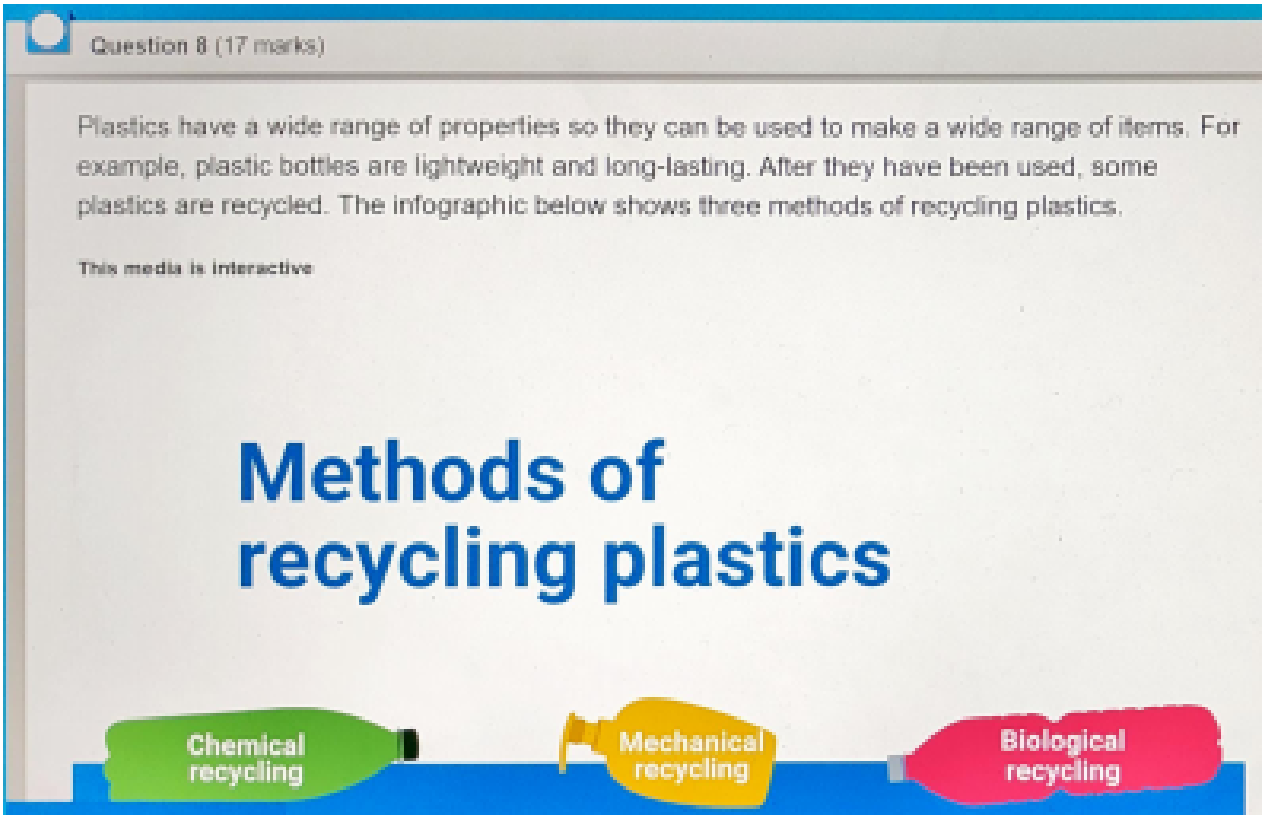


- Populations produce more offspring than the environment can support, so there is competition.

Question 8 (17 marks)

Plastics have a wide range of properties so they can be used to make a wide range of items. For example, plastic bottles are lightweight and long-lasting. After they have been used, some plastics are recycled. The infographic below shows three methods of recycling plastics.

This media is interactive



Question 8a (13 marks)

Using information from the infographic above and your wider MYP studies, **discuss** and **evaluate** the methods of recycling plastics. In your answer, you should include:

- reasons why the properties of plastics make them useful and widely used
- the environmental consequences of two methods of recycling
- the economic impacts of two methods of recycling
- a concluding appraisal justifying your opinion of how plastics should be recycled.

Question 8b (4 marks)

Suggest and **justify** two additional ways in which pollution from plastics can be reduced.

Suggestion 1

Suggestion 2