Question 1 (11 marks)

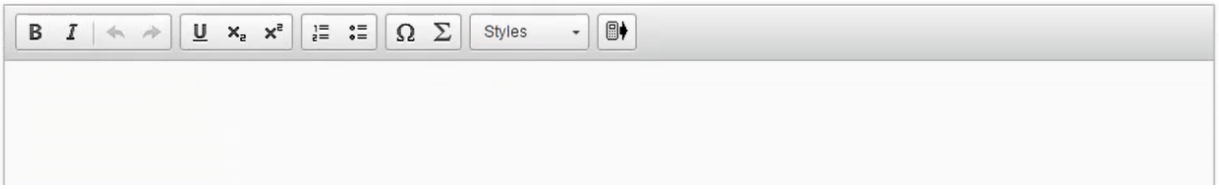
Question 1a (1 mark)

Select the best description of the term *population*.

- All of the living organisms and non-living materials in the same area
- A combination of living organisms that live in the same area
- The area in which an organism lives
- Organisms of the same species that live in the same area

Question 1b (3 marks)

Outline the meaning of the term *natural selection*.



Question 1c (4 marks)

The peppered moth can be found in two different colours: grey and black. The grey moths use a light-coloured lichen on trees to camouflage themselves from predators, such as birds. During the industrial revolution, a great deal of soot from burning coal stained the lichens black.


BEFORE THE INDUSTRIAL REVOLUTION


AFTER THE INDUSTRIAL REVOLUTION

Describe how this change in the environment selected for the black-coloured moths and affected their frequency in the population.

Question 1d (3 marks)

Before the industrial revolution, most peppered moths were grey in colour. The black colour trait in moths is recessive. **Explain** how the black colour trait remained in the population even though it was an undesirable trait.

Question 2 (6 marks)

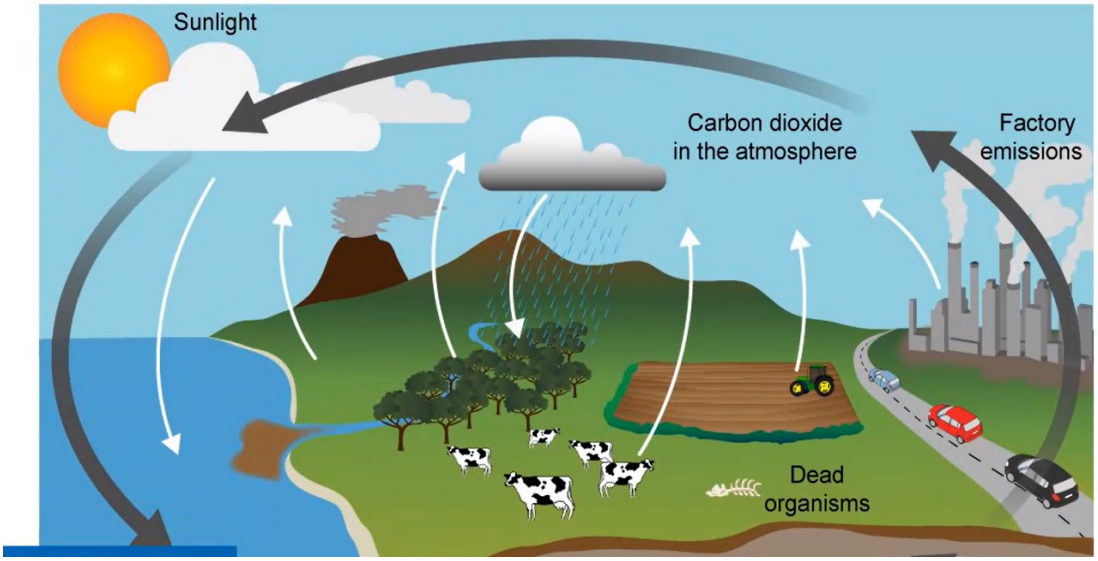
Question 2a (3 marks)

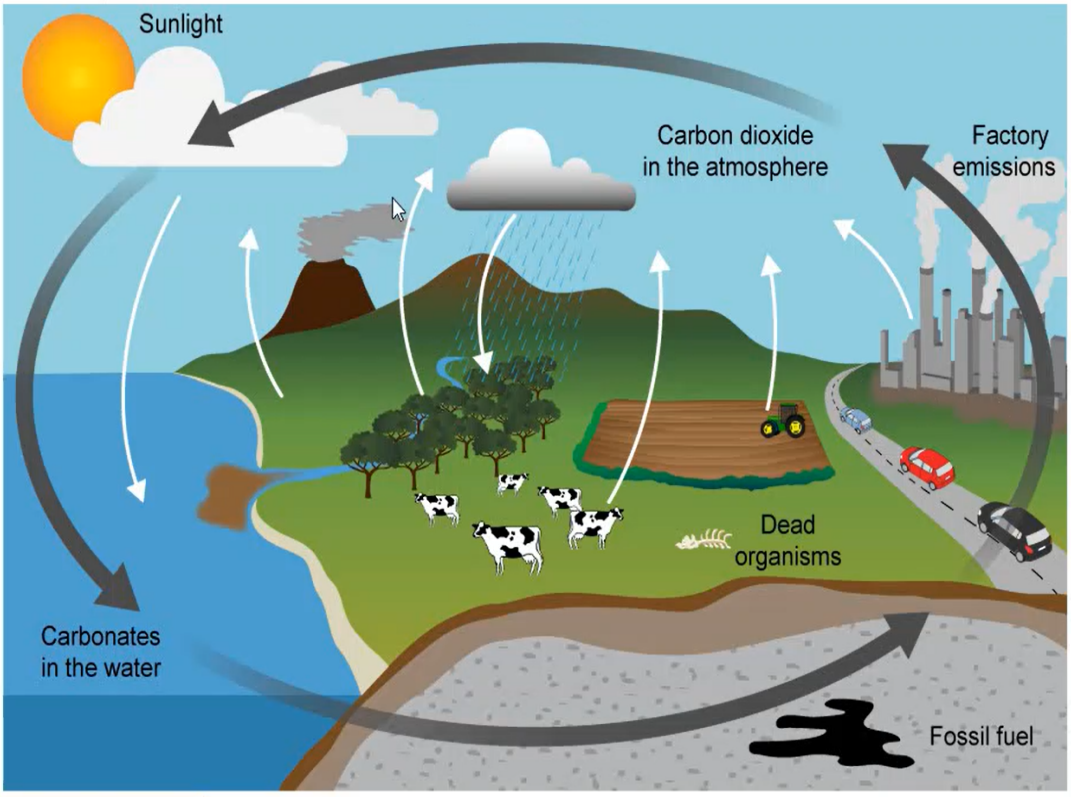
Outline how plants and animals are connected in the carbon cycle.

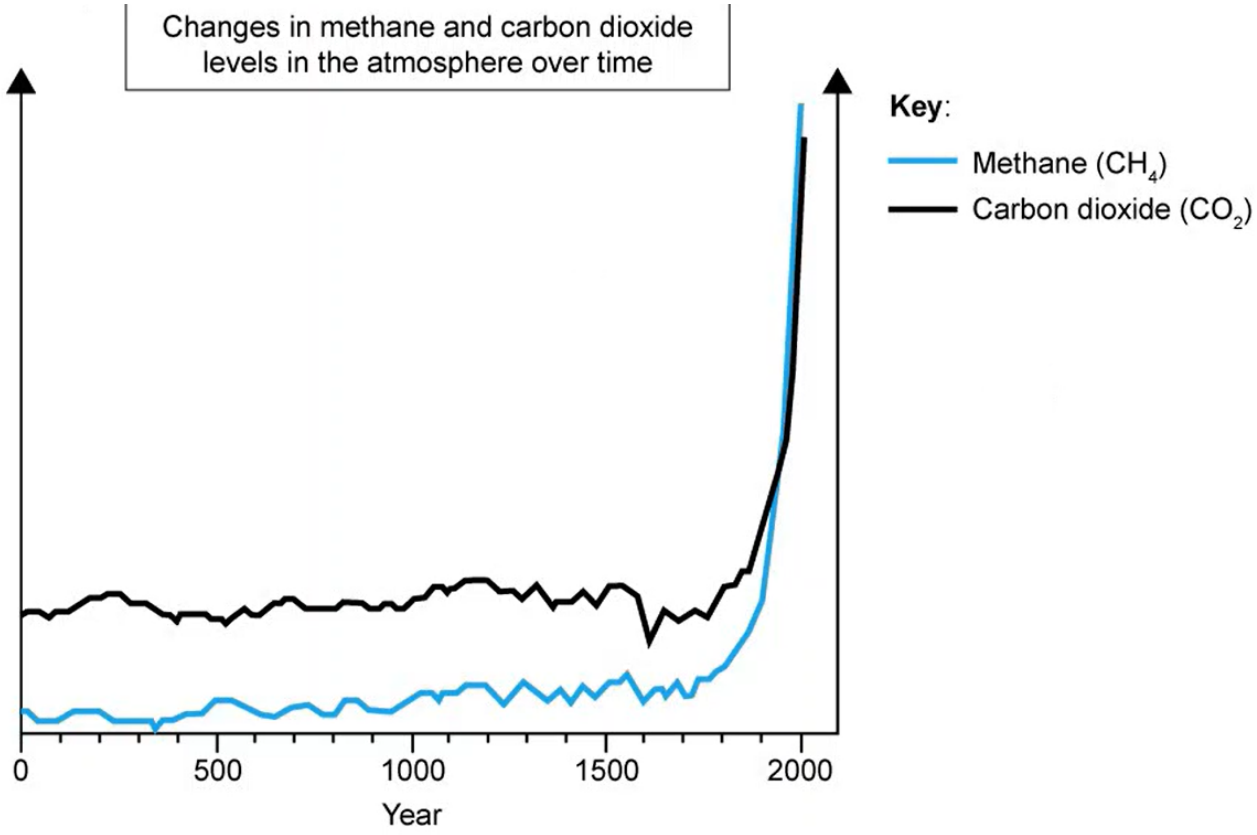
Question 2b (3 marks)

The diagram and graph below show some information about the carbon cycle.

Diagram | Graph







Use information from the diagram and graph above to **describe** how human activity has led to a change in the carbon cycle.

Question 3 (8 marks)

Question 3a (1 mark)

Select the name of the process that produces sperm and egg cells in organisms.

- Mitosis
- Homeostasis
- Meiosis
- Photosynthesis

Question 3b (3 marks)

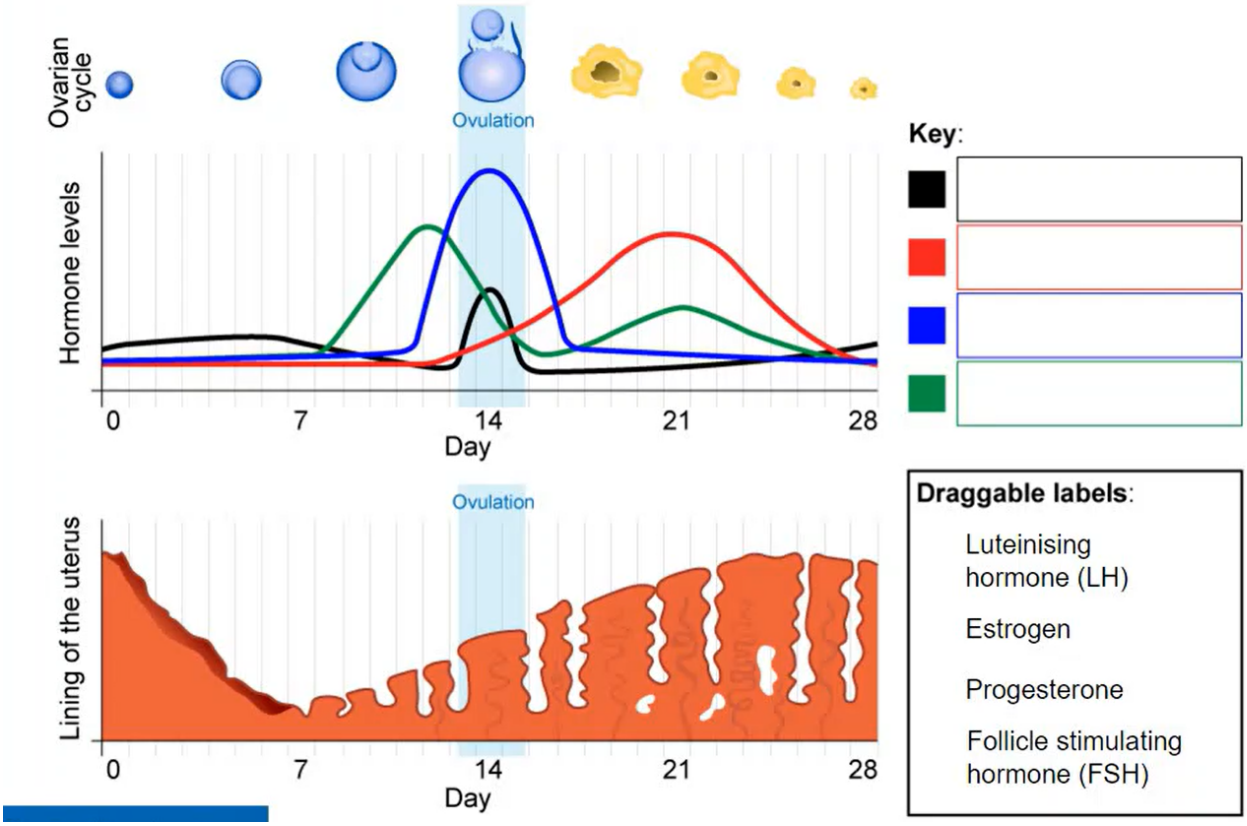
Outline how fertilization leads to variation in a population.

Question 3c (3 marks)

The table below gives some information about the role of hormones involved in the menstrual cycle.

Hormone	Role
Estrogen	• Stops FSH being produced so that only one egg matures in a cycle • Repairs and thickens the uterus lining • Stimulates the pituitary gland to release LH
FSH (follicle stimulating hormone)	• Causes an egg to mature in an ovary • Stimulates the ovaries to release estrogen
LH (luteinising hormone)	• Triggers ovulation (the release of a mature egg)
Progesterone	• Maintains the lining of the uterus during the middle part of the menstrual cycle and during pregnancy

Analyse the information in the table to label the key of the following graph.



Question 3d (1 mark)

The graph above shows changing hormone levels during the menstrual cycle.

Use information in the table above to **suggest** **one** possible result if estrogen does not stop the production of FSH.

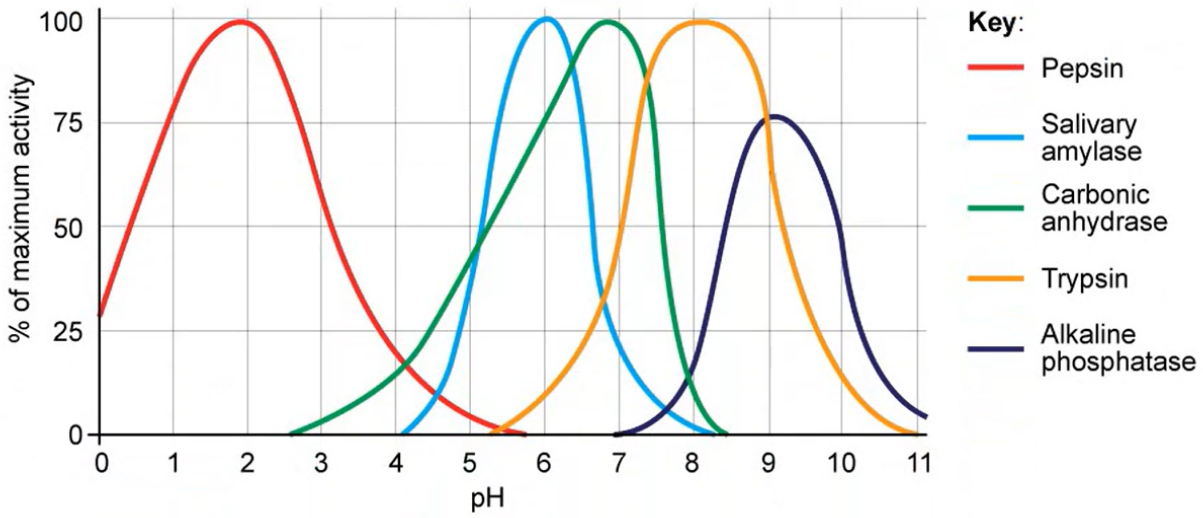
B I U x_2 x^2 Ω Σ Styles

Question 4 (12 marks)

Question 4a (4 marks)

Enzymes are biological compounds that speed up biochemical reactions in organisms. Enzymes are a type of catalyst.

The graph below shows data about five enzymes found in the human digestive system. **Interpret** the data in the graph and use your scientific knowledge about the pH in different parts of the digestive system to drag and drop the correct enzyme to the correct location in the human body.



Draggable items:

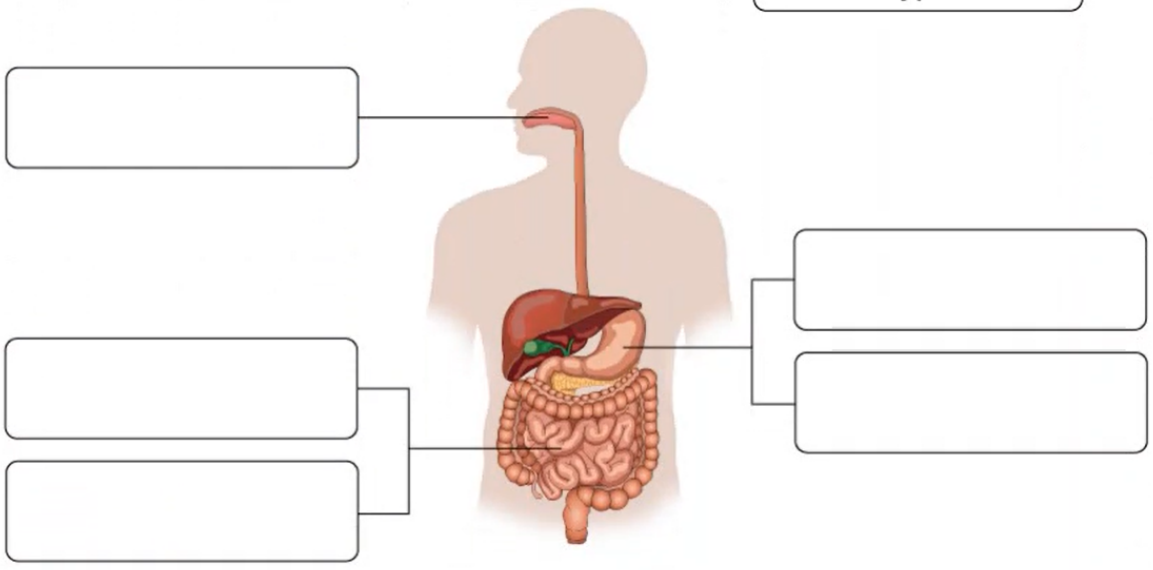
Alkaline phosphatase

Carbonic anhydrase

Pepsin

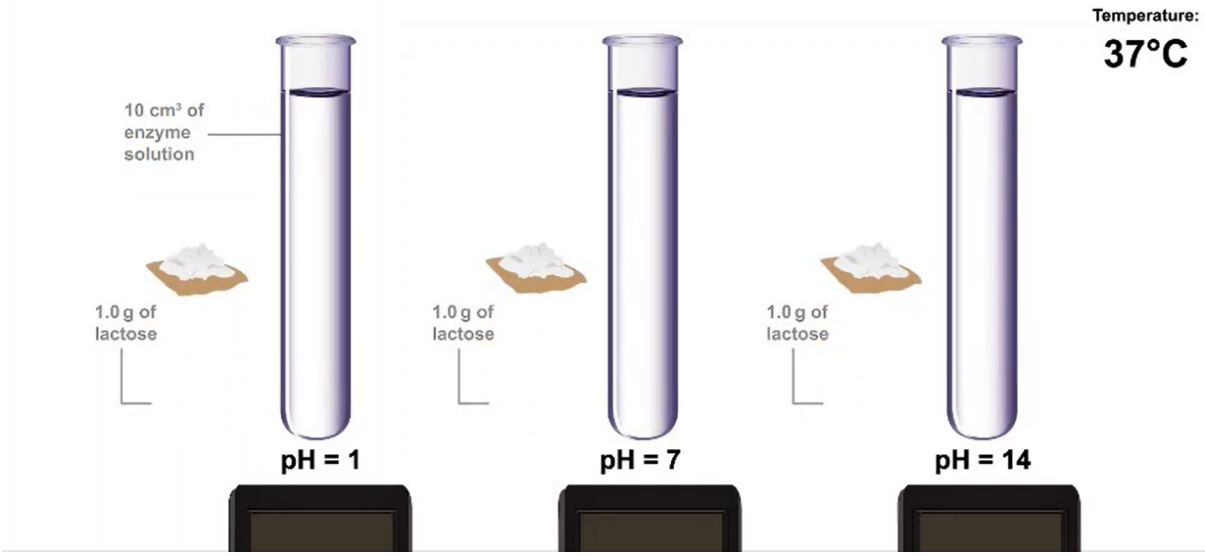
Salivary amylase

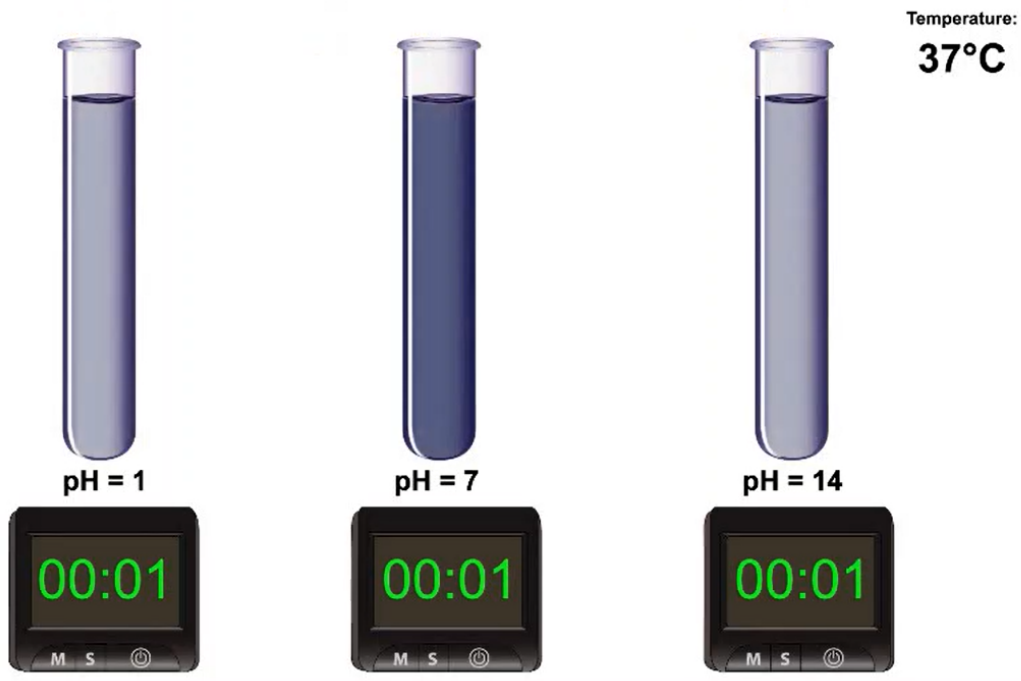
Trypsin



Question 4b (1 mark)

A group of students wanted to investigate the effect of pH on enzyme based reactions.





Formulate a research question for this investigation.

Question 4c (4 marks)

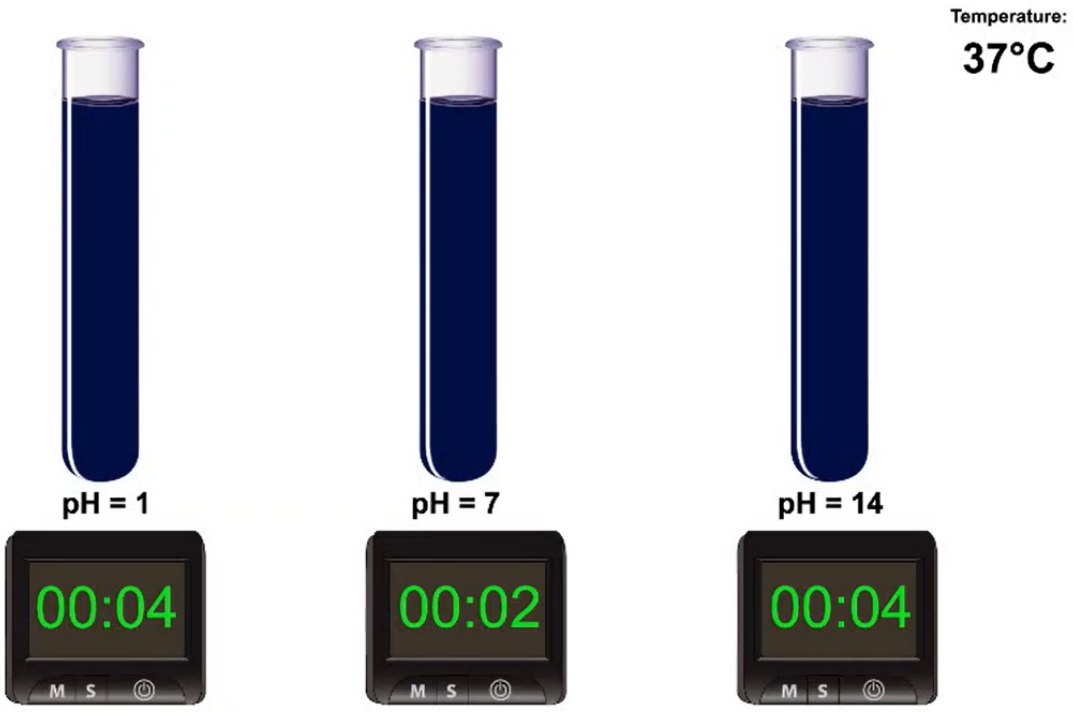
Identify the variables in this investigation.

Independent variable

Control variable 1

Question 4d (3 marks)

Lactase is an enzyme present in the human digestive system. **Explain** why the values of pH chosen in the animation above will not give sufficient relevant data.



The students knew that each enzyme molecule could be used multiple times but wondered if the concentration of lactose would affect the time of reaction. The students conducted an investigation changing the concentration of lactose. The students hypothesized that if the concentration of lactose increases, then the time to change colour would be shorter because more lactose would be interacting with the enzyme.

Question 5a (1 mark)

State the name of the enzyme that breaks down lactose.

B I U x_2 x^2 Ω Σ Styles

Question 5b (5 marks)

The table below shows the data collected by the students.

Concentration of lactose / gdm^{-3}	Time for colour change / s
2	78
4	63
6	54
8	46
10	43
12	42
14	41

Plot the data from this table on the axes below, add values to both axes and label the *y* axis.

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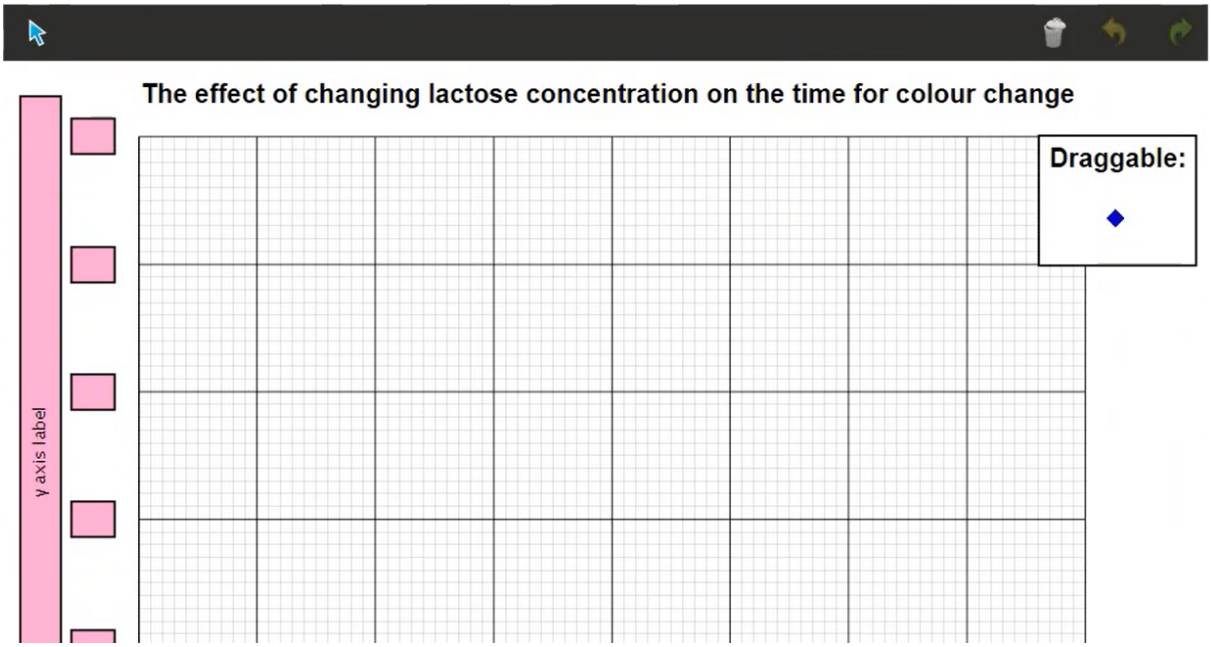


Question 5c (1 mark)

State the unit that is missing from the *x* axis.

Question 5d (6 marks)

Use scientific reasoning to **explain** the trend shown by the data in the graph above.

Question 5e (5 marks)

The students hypothesized that if the concentration of lactose increases, then the time to change colour would be shorter because more lactose would be interacting with the enzyme.

Using the graph, **evaluate** the validity of the students' hypothesis.

Question 5f (2 marks)

State one improvement to the investigation. **Justify** your answer.

Question 5g (1 mark)

The action of enzymes is temperature dependent. **State one** extension to the enzyme investigation other than changing the temperature or pH.

In a third enzyme investigation using lactose, the students wanted to study the effects of temperature. **Design** an investigation into the effect of temperature on enzyme activity. 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 the independent variable
- describe the method
- state how you will make sure your method is safe.

Question 7 (4 marks)

Question 7a (2 marks)

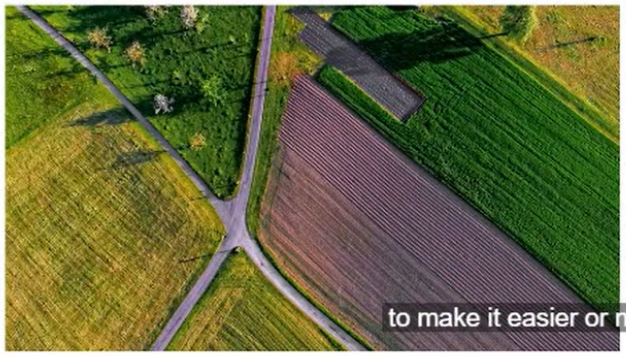
Select all the factors needed for plant growth.

- ☐ Glucose
- ☐ Light
- ☐ Oxygen
- ☐ Water
- ☐ Nutrients
- ☐ Carbon dioxide

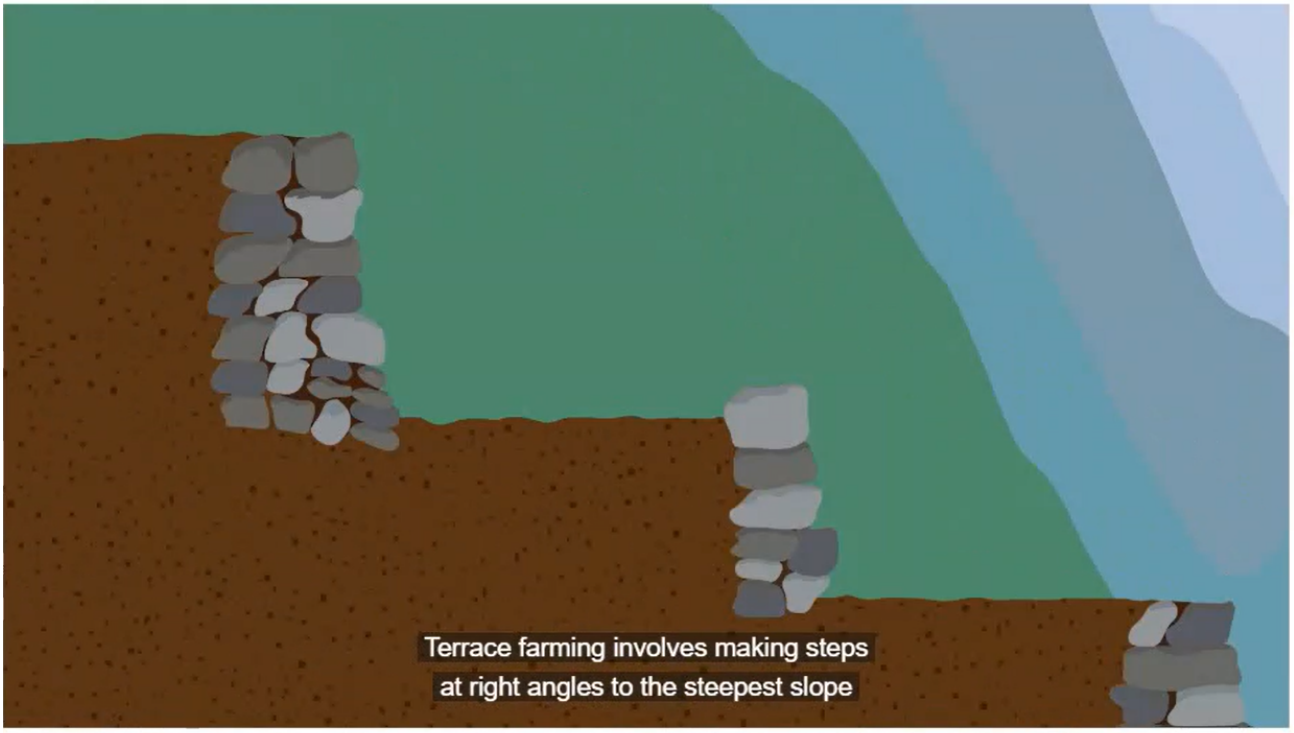
Question 7b (2 marks)

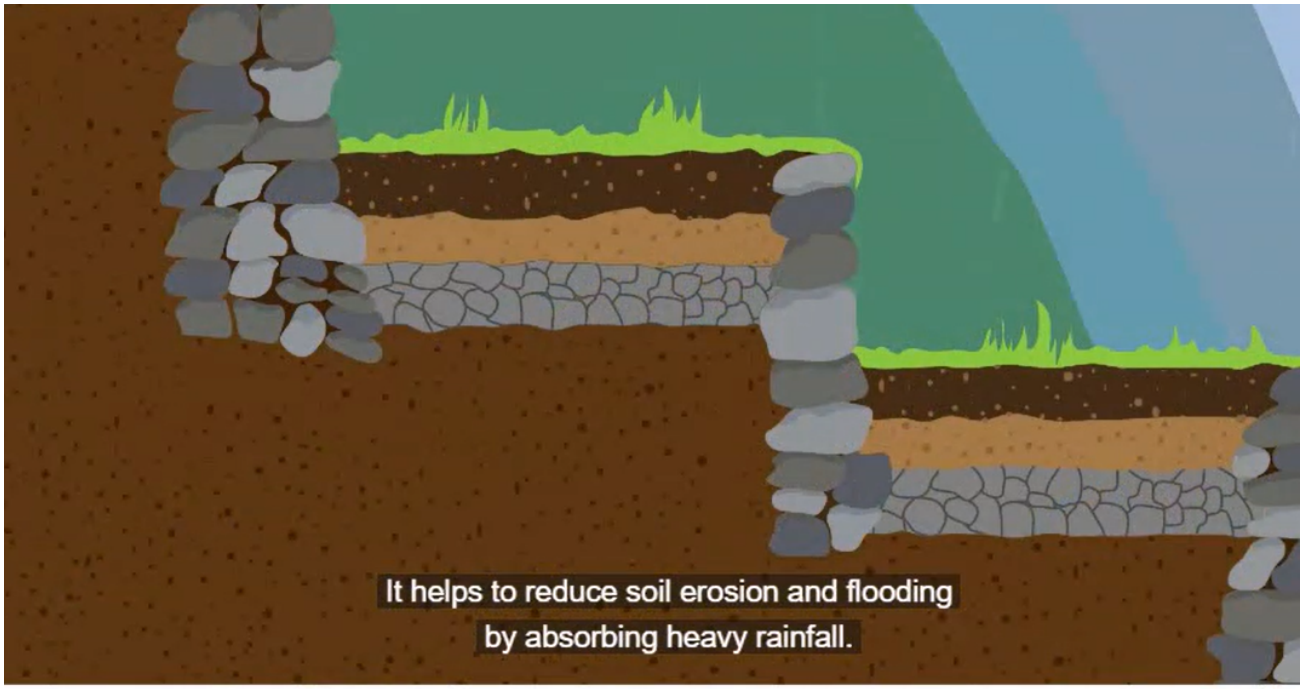
For **one** of the factors you selected in part (a), **outline** the role of this factor in plant growth.

B I U x_2 x^2 Ω Σ Styles

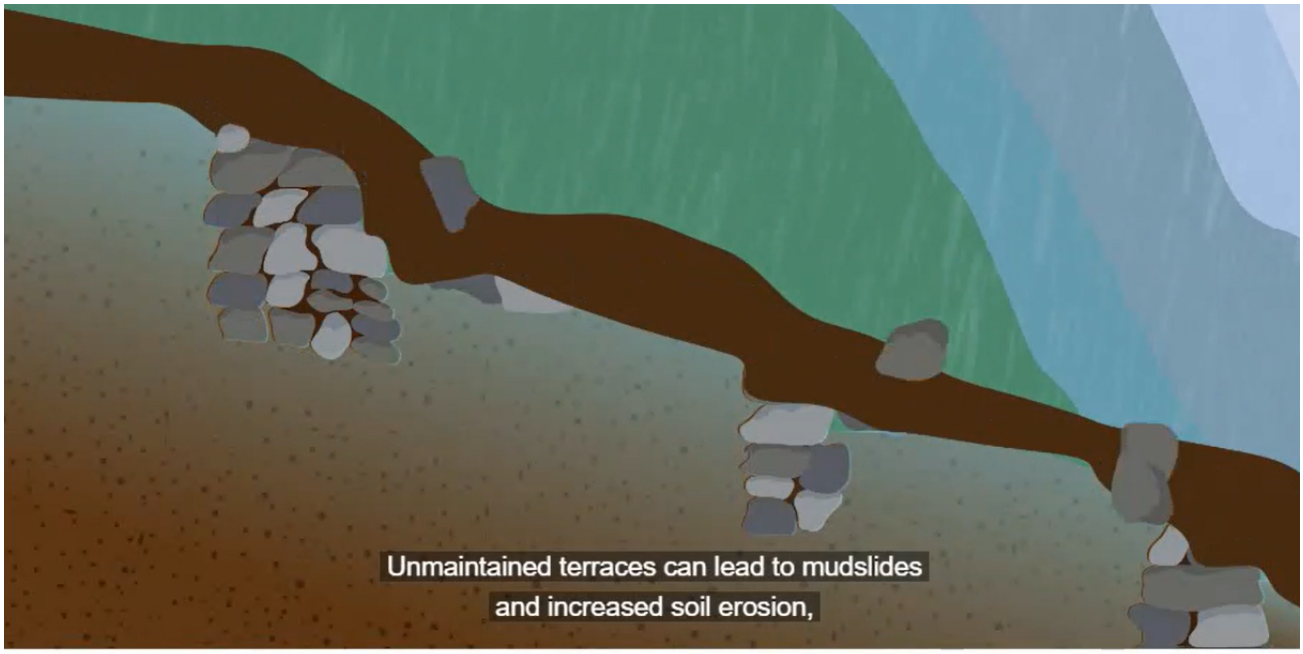


to make it easier or more efficient to farm.

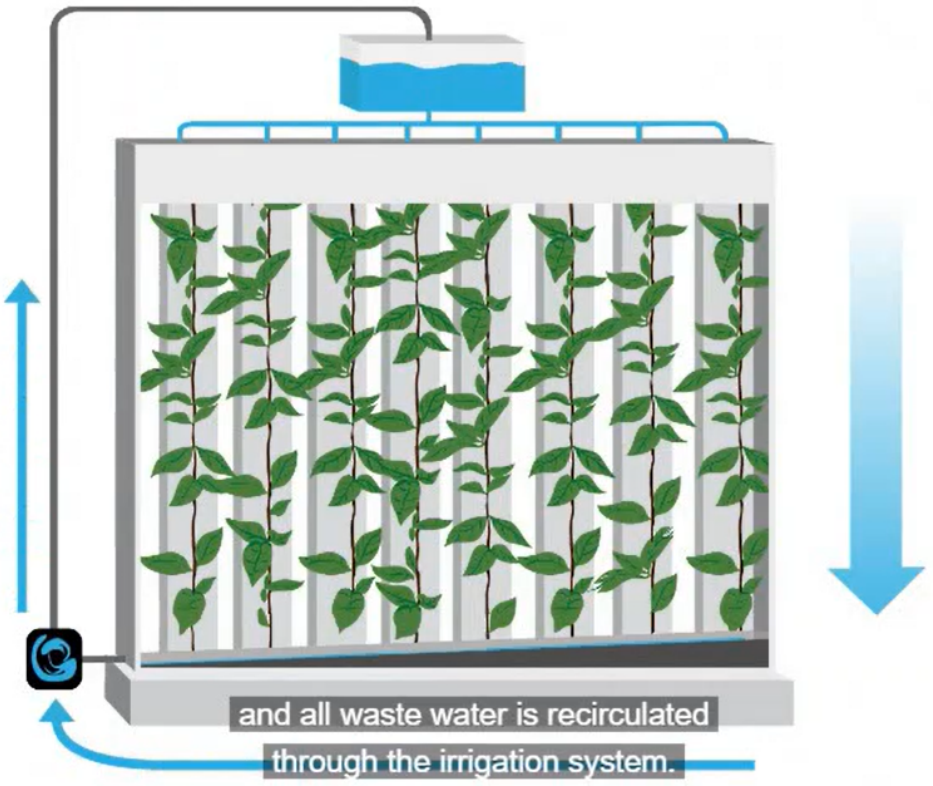



It helps to reduce soil erosion and flooding
by absorbing heavy rainfall.


the ground can absorb too much rainwater
leading to saturation.


Unmaintained terraces can lead to mudslides
and increased soil erosion,


By growing crops on several floors
or using the outside walls of buildings,


and all waste water is recirculated
through the irrigation system.

For many thousands of years, humans have been changing their natural environment to make it easier or more efficient to farm.

Ancient civilizations in Peru, for example, built complex terracing systems to ensure a good supply of water.

Terraces are still used today and are often seen in the rice-growing areas of South-East Asia, such as Indonesia, the Philippines and Vietnam. The Indonesian island of Bali is particularly well-known for large areas of rice terraces.

Terrace farming involves making steps at right angles to the steepest slope consisting of a channel dug out on the uphill side. The waste soil is used to form a bank on the downhill side.

Terrace farming allows the use of land that is too hilly or steep for conventional farming methods. It helps to reduce soil erosion and flooding by absorbing heavy rainfall. In some situations, the soil quality is reduced because nutrients are leached from the soil.

If terracing is not maintained properly, the ground can absorb too much rainwater leading to saturation. The problem with ground saturation is that it can lead to water overflow. In periods of heavy rains the effects can be catastrophic. Unmaintained terraces can lead to mudslides and increased soil erosion, particularly in sandy soils or on extremely steep terrains.

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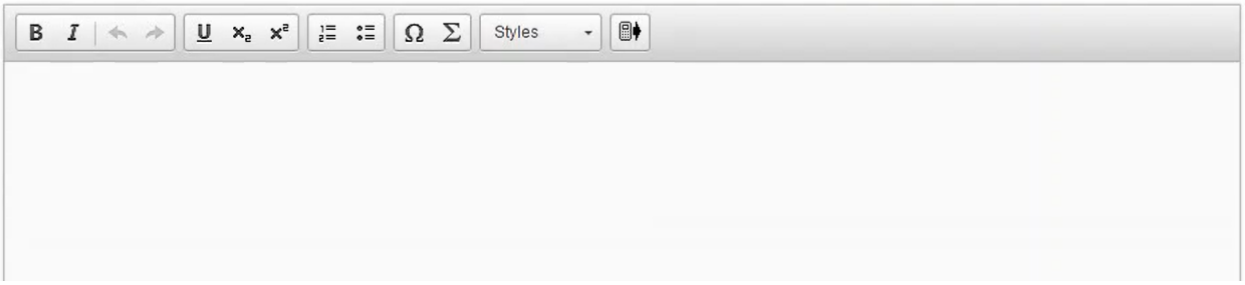
Many mathematical models predict a rapid growth in global population. It will become increasingly difficult to find enough land to feed everyone. Scientists are developing vertical farms to maximize the growing space for food production.

By growing crops on several floors or using the outside walls of buildings, farmers are able to maximize the area for growth in locations with limited space.

The nutrient level can be controlled and all waste water is recirculated through the irrigation system. This means that vertical farming is very efficient.

Compare and contrast how the needs of the crops have been met in landscape terracing and vertical farming. **Justify** your answers.



Using information from the video, **discuss** and **evaluate** how humans have changed their natural landscape to optimize their local environment for farming. In your answer, you should include:

- a discussion of how the landscape has been changed
- scientific justification of the changes to the landscape
- advantages of changing the landscape
- disadvantages of changing the landscape
- an economic impact or a social impact
- a concluding appraisal.