**Question 1** (7 marks)

Water is needed to sustain plant life. Water supports many different functions within a plant. Plants have evolved many different adaptations to collect and conserve water depending upon their environment.

**Question 1a** (1 mark)

**elect** the correct diagram showing the movement of water through a plant. This movement of ater through a plant is called transpiration.

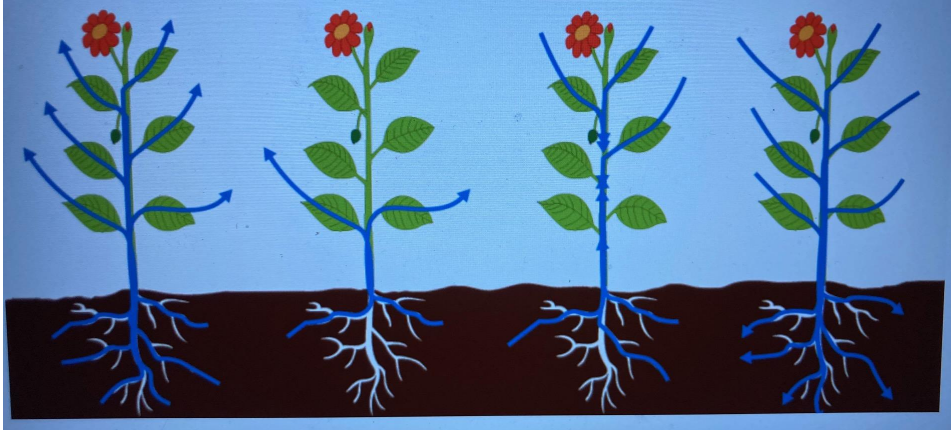
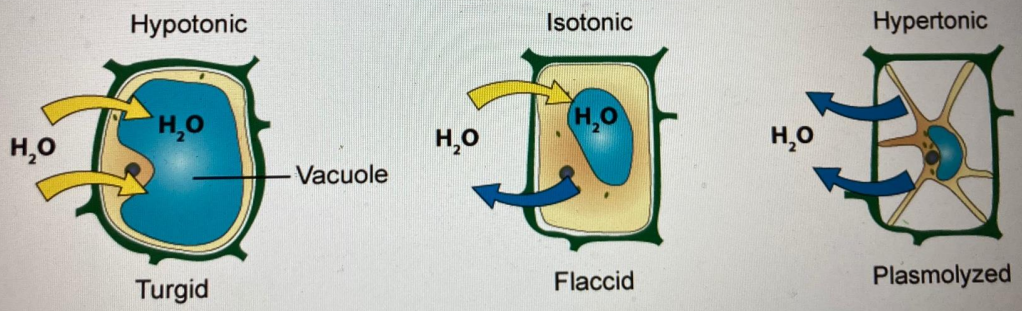


Diagram A ○ Diagram B ○ Diagram C ○ Diagram D ○

**Question 1b** (1 mark)

Plants can experience water stress either when there is not enough water in the soil or when the transpiration rate is too high.

Plants must control water loss. Water maintains pressure in plant cells. A cell filled with enough water is said to be turgid. On the other hand, if a cell has lost too much water, it may become flaccid. In extreme cases, the cell might become plasmolyzed.




©

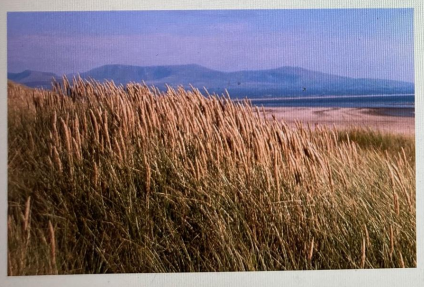
**State** the name of the structure in the cell that prevents it from bursting when it is turgid.

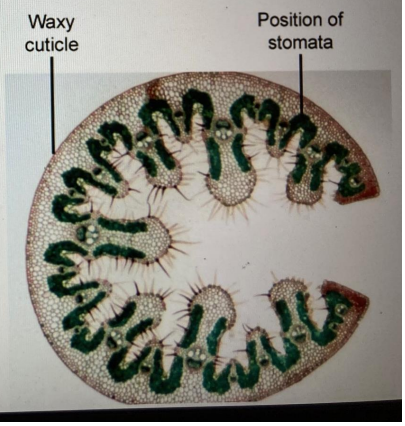
**Question 1c** (1 mark)

**Suggest** and **justify** a possible effect of plasmolyzed cells on the plant's structure.

**Question 1d** (4 marks)

Many environmental factors impact on the transpiration rate of plants. Marram grass is a plant that has had to adapt to dry and windy conditions.







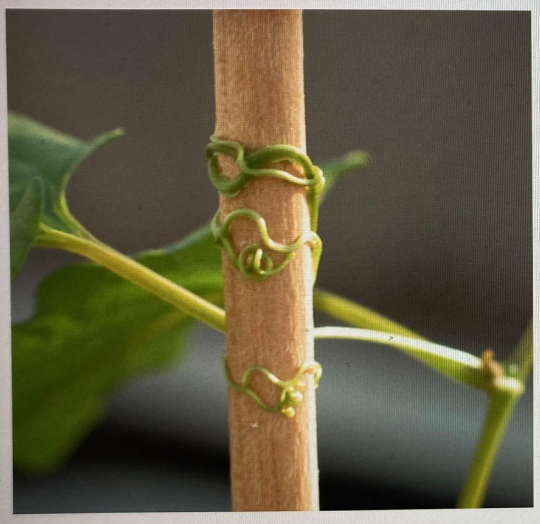

Scroll down to continue

The image above shows that the leaves of marram grass are curled inwards. The outer surface of the leaf is quite thick and the inner surface is folded so that stomata are sunken. The stomata are also surrounded by hairs.

**Explain** how one adaptation of the marram leaf reduces water loss by transpiration. You should include scientific knowledge and understanding in your answer.

B I U $x_2$ $x^2$ Ω Σ Styles

**Question 2** (16 marks)



©

Living organisms have the ability to respond to a stimulus. When a plant responds to a stimulus, it is called a tropism.

There are many examples of tropisms in plants. For example, gravity or touch may act as a stimulus and cause a response in plants.

If the tropism is positive, the stimulus causes growth of the plant toward the stimulus. If the tropism is negative, the stimulus causes growth of the plant away from the stimulus. In this example, the growth of a plant is responding to touch.

**Question 2a** (2 marks)

**State two** stimuli, other than gravity or touch, that cause tropism in plants.

**Question 2b** (4 marks)

A plant shows both positive and negative tropism.

**Suggest** how the growth of a plant shows both positive and negative tropism towards gravity.

**Question 2c** (3 marks)

*Mimosa pudica* is a low-growing plant that responds to touch in the following way:

This media contains no audio

©

**Suggest** how this type of tropism might improve chances of survival for this plan

**Question 2c** (3 marks)

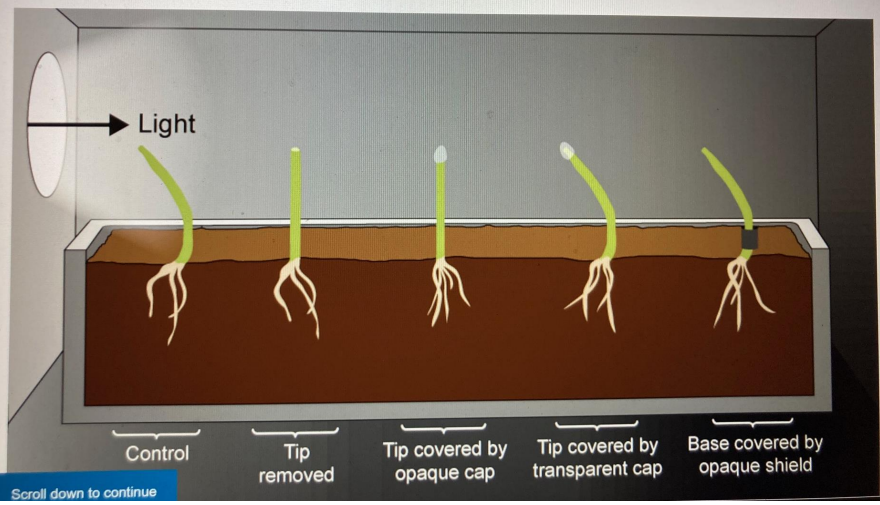
*Mimosa pudica* is a low-growing plant that responds to touch in the following way:

This media contains no audio

Assistance

**Question 2d** (3 marks)

In 1880, Charles Darwin and his son Francis Darwin carried out a famous experiment on plant tropism. The experimental set up looked like this:



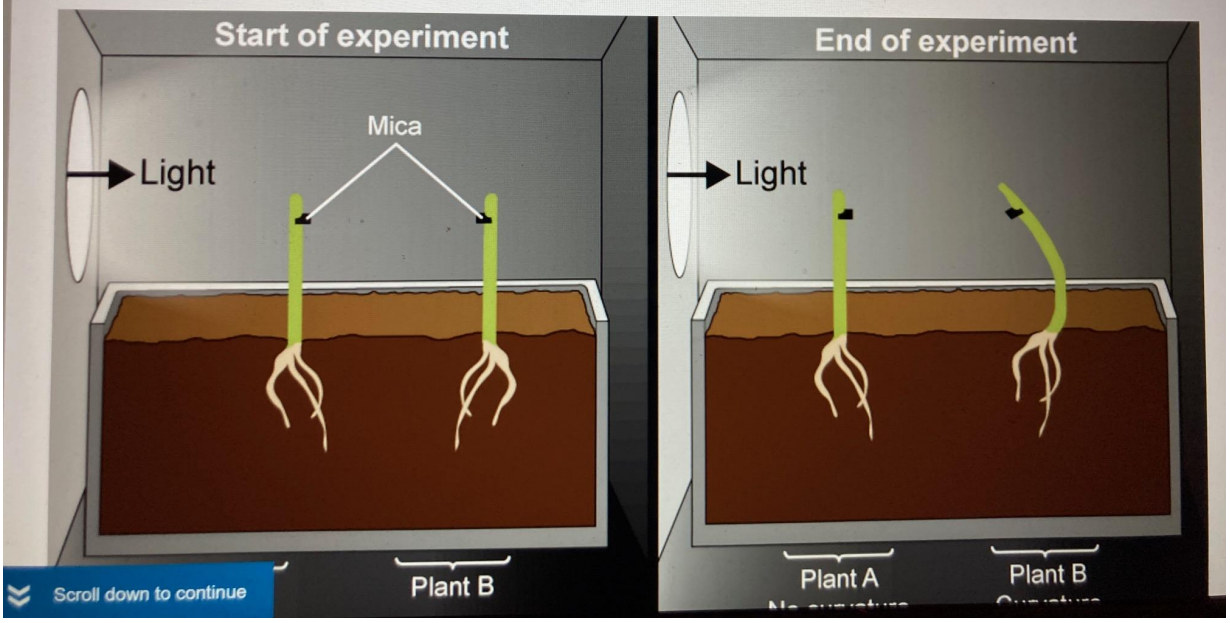

Scroll down to continue

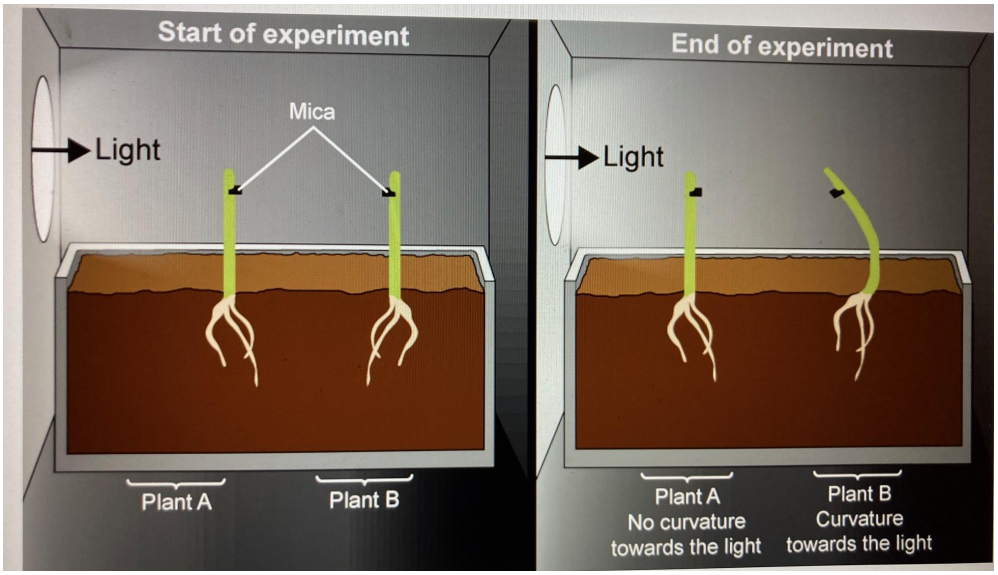
**Describe** what the results in the picture above indicate about the response of plants to light.

Assistance

**Question 2e** (4 marks)

Other researchers studied this behaviour further. The tips of two plants were separated from their bases on one side with a thin sheet of mica. The mica on one plant was placed on the same side as the light source. The mica on the other plant was placed on the opposite side of the light source. Mica is a non-permeable material. The result of the experiment is shown below.



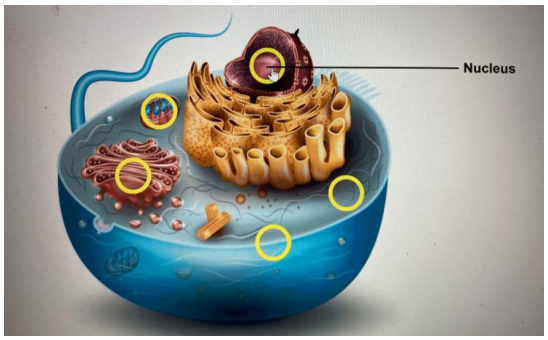
Based on these results, the researchers concluded that the response was the result of the movement of a substance from the tip of the plant toward the base on the shaded side of the stalk.

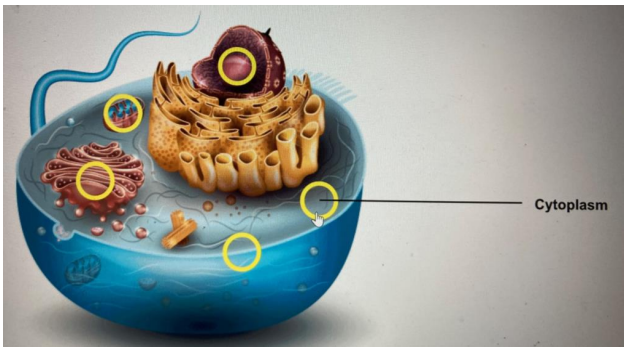
Use scientific knowledge and understanding to **justify** how these results support the conclusion.

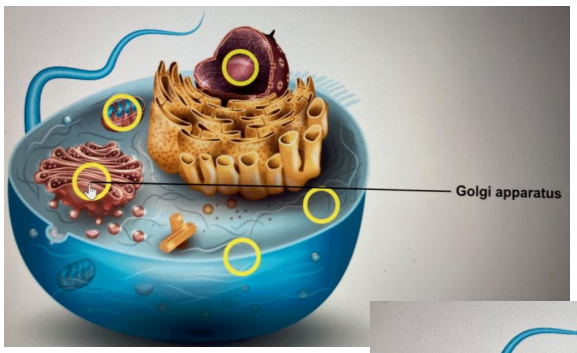
**Question 3** (10 marks)

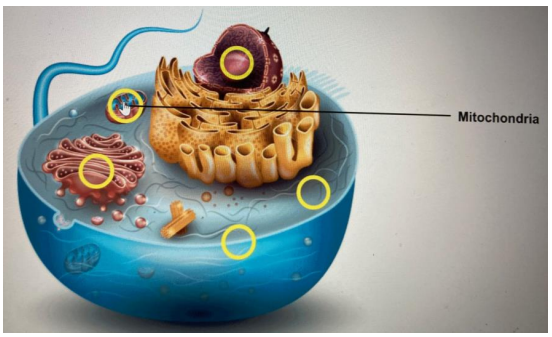
**Question 3a** (3 marks)

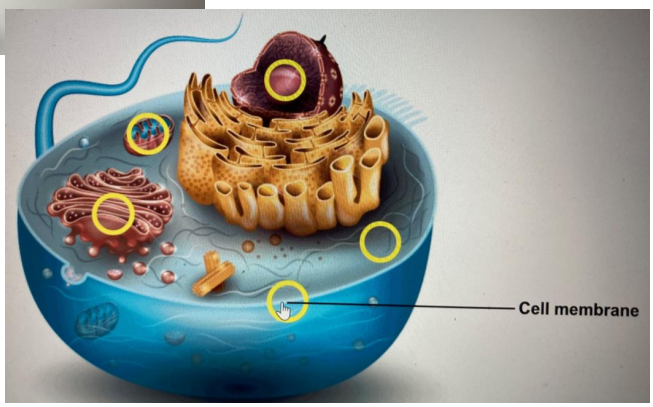
The cell is the basic structural, functional and biological unit of all living organisms. Cells are the smallest units of life that can reproduce independently and are often called the building blocks of life.



**Select** the correct organelle for each of the following functions.

Draggable items:

- Cell membrane
- Cytoplasm
- Golgi apparatus
- Mitochondria
- Nucleus

| Function | Organelle |
|---|---|
| The part of the cell containing DNA and responsible for control of growth and function | |
| Packaging of molecules like proteins, movement of lipids and the creation of lysosomes | |
| Conversion of energy in food molecules to energy | |

**Question 3b** (1 mark)

**State** the function of a gene.

**Question 3c** (4 marks)

Belgian Blue cattle are a good example of the application of selective breeding to produce an animal with desired traits.

**Compare and contrast** genetic engineering and selective breeding as methods to produce plants and animals with desired traits.

B I U $x_2$ $x^2$ Ω Σ

Styles

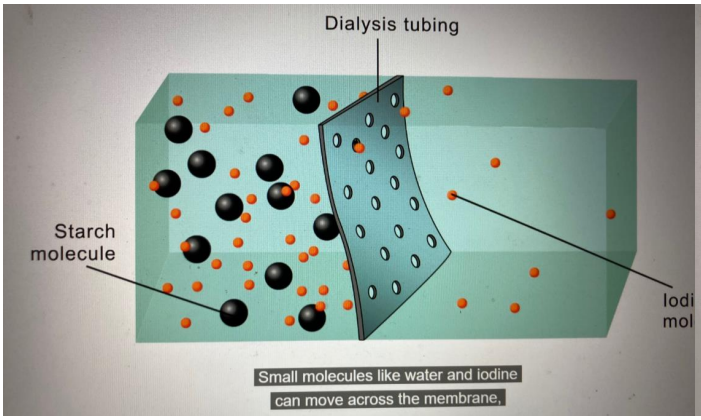
**Question 3d** (2 marks)

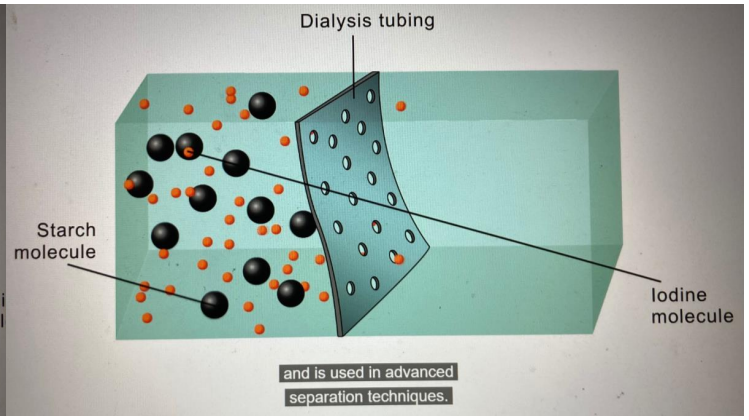
**Suggest** how selective breeding might weaken a species' ability to survive.

**Question 4** (20 marks)

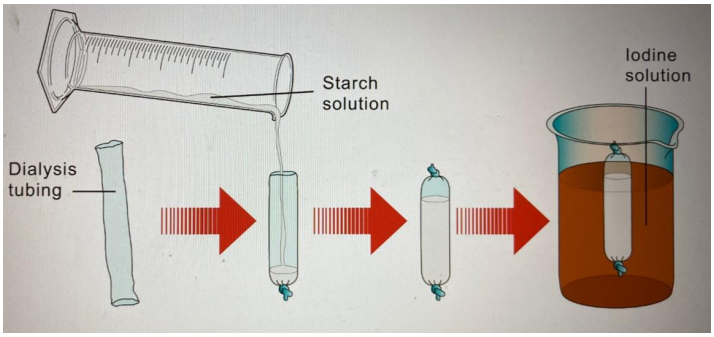
Cells take in molecules from their surroundings to use for energy and as building blocks for other molecules. Cells also produce waste and must move waste products out of the cell.

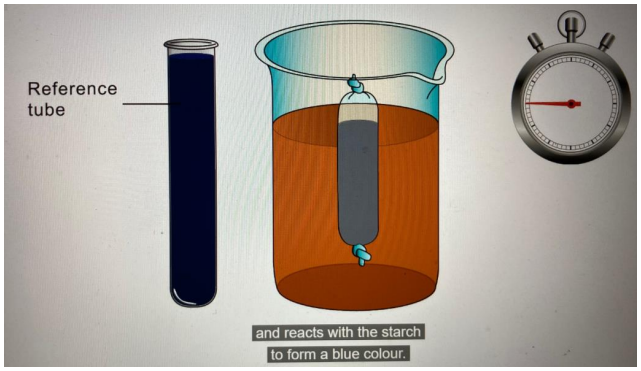
A group of students was interested in studying how molecules move in and out of cells. The students researched methods for measuring this process and decided to design an investigation using dialysis tubing as a model cell. Dialysis tubing is a semi-permeable membrane used in separation techniques.




The students set up an investigation with three beakers of 1 %, 5 %, and 15 % iodine solution and tubes filled with a 10 % solution of starch. The students knew that the iodine would turn dark blue when mixed with starch so they decided to time how long it took for each tube to change to dark blue throughout the tube. The students used a reference tube to hold up to the beaker and they stopped timing when they thought the tube was the same colour as the reference tube.



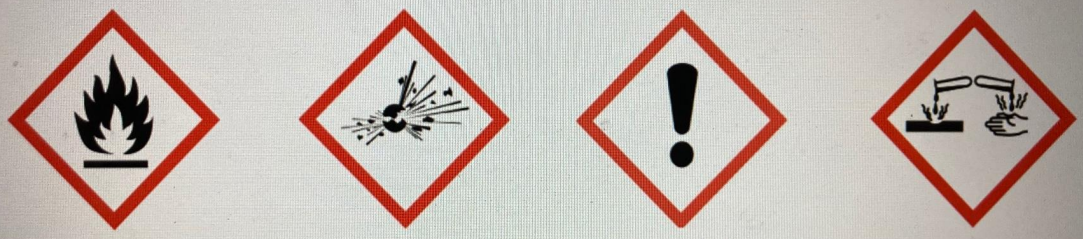
**Question 4a** (1 mark)

**Select** the name of the process that describes the movement of iodine molecules from a region of high concentration to a region of lower concentration.

- Active transport
- Diffusion
- Osmosis
- Transpiration

**Question 4b** (1 mark)

The iodine solution used in this investigation is harmful. **Select** the correct hazard sign to label the iodine bottle.



Sign A ○ Sign B ○ Sign C ○ Sign D ○

**Question 4c** (2 marks)

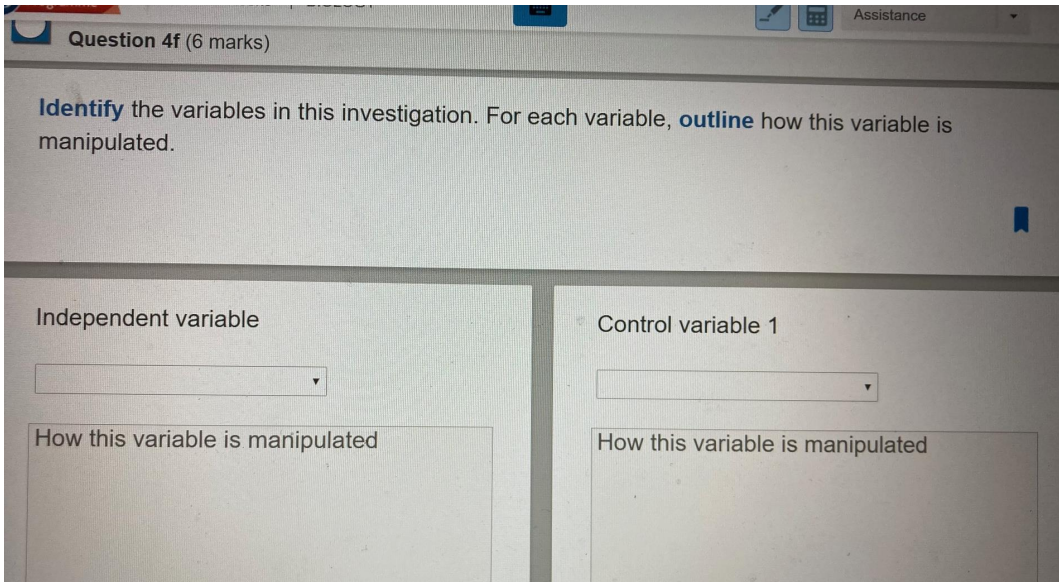
**Suggest two** precautions that the students should take before using iodine solution.

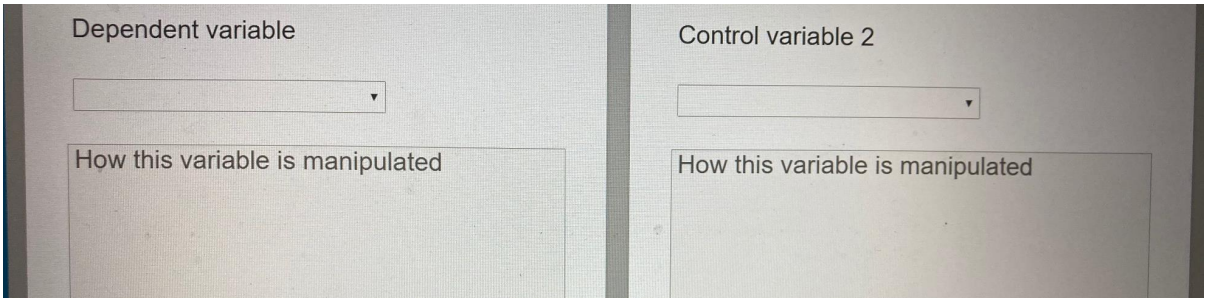
**Question 4d** (3 marks)

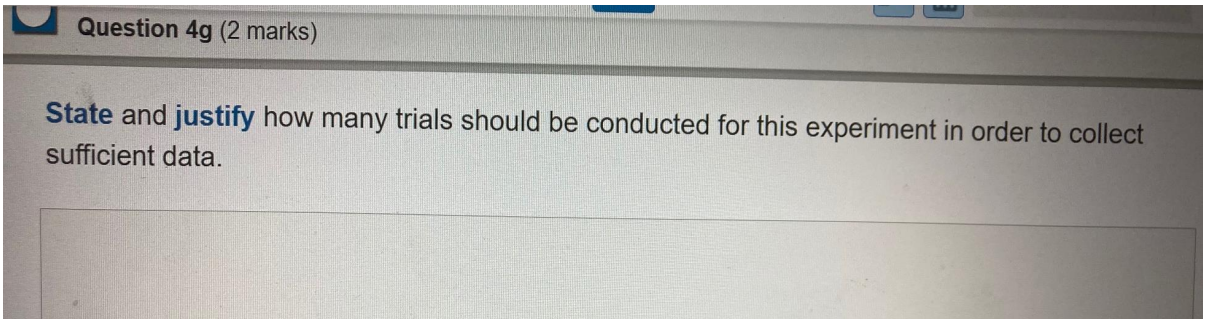
**State** the problem being tested by this experiment.

**Question 4e** (1 mark)

**Formulate** a testable prediction for this experiment.


Assistance
Question 4f (6 marks)
Identify the variables in this investigation. For each variable, outline how this variable is manipulated.
Independent variable
How this variable is manipulated
Control variable 1
How this variable is manipulated

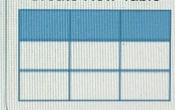

Dependent variable
How this variable is manipulated
Control variable 2
How this variable is manipulated


Question 4g (2 marks)
State and justify how many trials should be conducted for this experiment in order to collect sufficient data.

**Question 4h** (3 marks)

**Design** a table to collect sufficient data for this investigation.

Create New Table



Reset

**Question 4i** (1 mark)

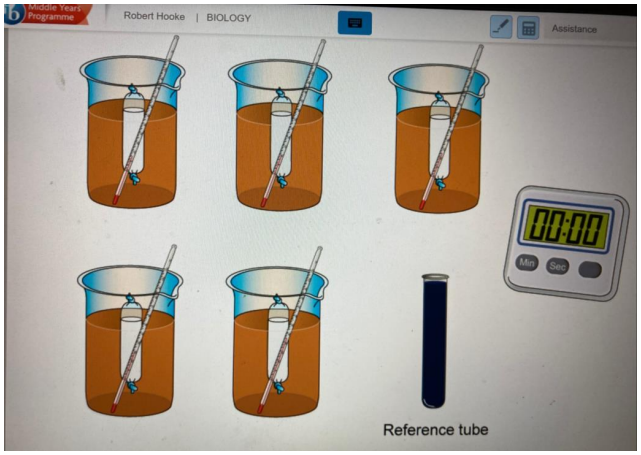
**Suggest one** weakness in the method.

**Question 5** (21 marks)

Osmosis is the movement of water molecules across a semi-permeable membrane. In osmosis, water molecules move from a region of low concentration of dissolved substances to a region of higher concentration of dissolved substances. This movement of water usually occurs until equilibrium is reached and the concentrations on both sides of the membrane are equal.

The students wanted to investigate whether the rate of osmosis was related to temperature. The students thought that as more water molecules moved into the tube, the mass of the tube would increase. They decided to use the mass of the tubes to determine the rate of osmosis.

The students planned to use dialysis tubing, beakers, a kettle, distilled water, ice, a timer, a balance, a measuring cylinder and a thermometer. They planned to use 10 $cm^3$ of starch solution in the tubing and to measure the mass change after 10 minutes. The start of the experiment is shown below.




**Question 5a** (1 mark)

**State** the problem being studied in this investigation.

**Question 5b** (3 marks)

**Outline** how the rate of osmosis is determined and **formulate** the unit for the rate of osmosis.

B I U $x_2$ $x^2$ Ω Σ Styles

**Question 5c** (2 marks)

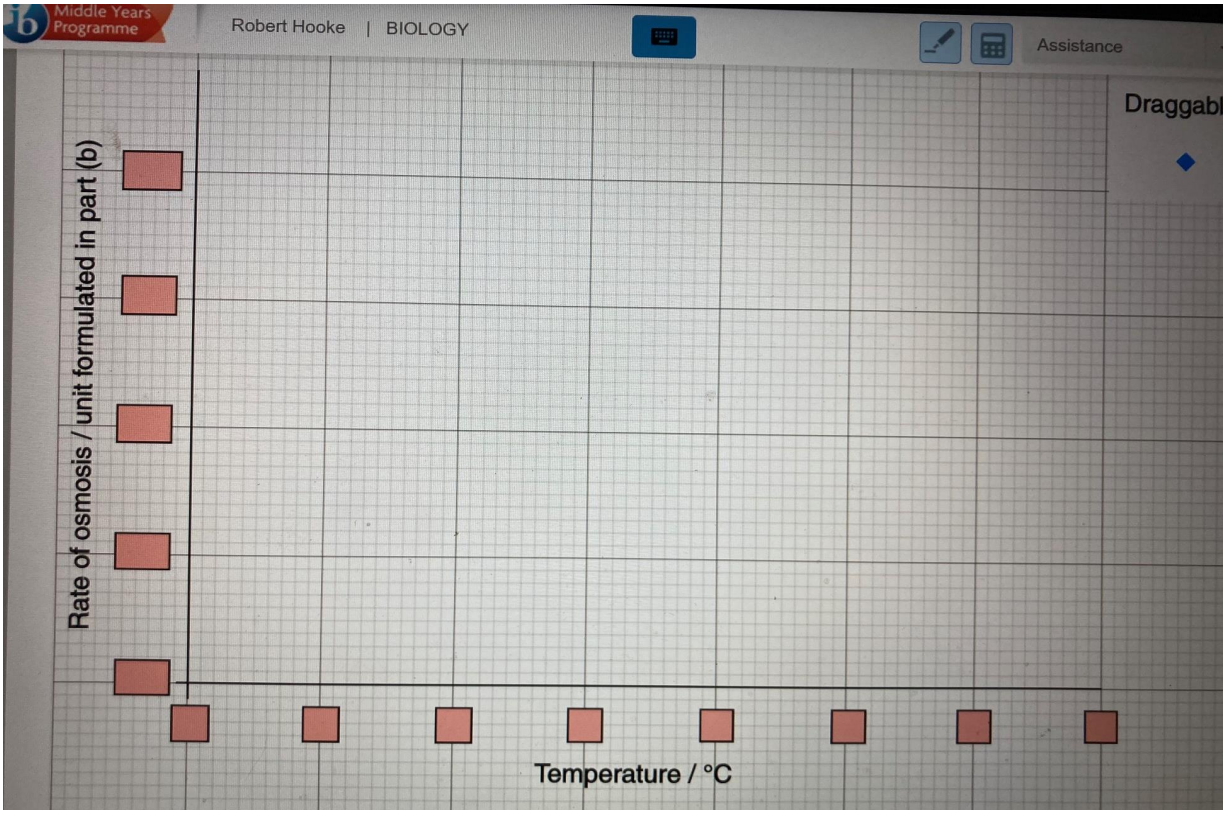
Complete the table below by **calculating** the missing value.

(Negligible: very small and not important)

| Temperature / °C | Average initial mass / g | Average final mass / g | Increase in mass after 10 minutes / g | Rate of osmosis / unit formulated in part (b) |
|---|---|---|---|---|
| 5 | 10.90 | 10.91 | 0.01 | Negligible |
| 10 | 11.06 | 11.76 | 0.70 | 0.07 |
| 15 | 11.10 | 12.11 | 1.01 | |
| 20 | 11.41 | 12.58 | 1.17 | 0.12 |
| 35 | 12.33 | 13.73 | 1.40 | 0.14 |

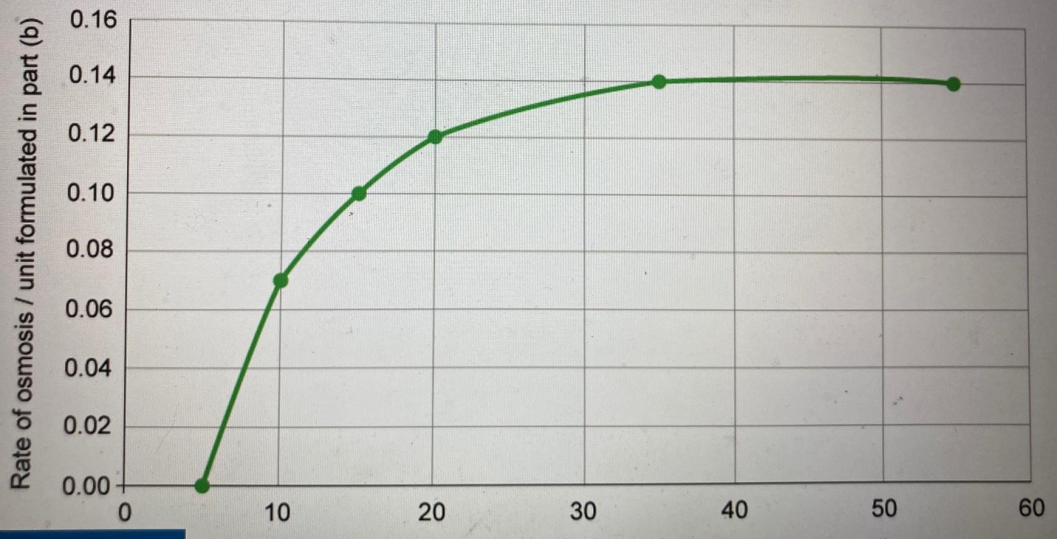
**Question 5d** (4 marks)

**Present** the data from the table in a graph.



**Question 5e** (4 marks)

After conducting their own investigation, the students researched other investigations to see if they reached similar conclusions. The students found a similar graph from a local university; a graph of this data is shown below.




Scroll down to continue

Scroll back to your graph in part (d) and **compare and contrast** the trend in the students' data in part (d) with the graph of the university data.

B I U $x_2$ $x^2$ Ω Σ Styles

**Question 5f** (4 marks)

**Explain one** scientific reason for **one** trend shown in the university data.

**Question 5g** (1 mark)

**Outline** whether the students' method is valid based on comparison of their data with the university data.

**Question 5h** (2 marks)

**Suggest one** extension and **one** improvement to this investigation.

Extension

Improvement

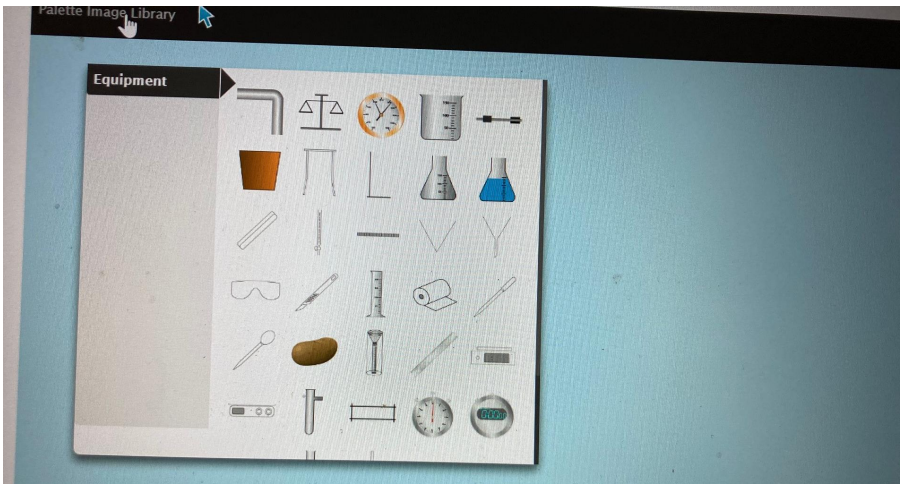
**Question 6** (17 marks)

The students then decided to study how molecules moved in and out of real cells. They decided to use potatoes to study how temperature is related to the movement of water in potato cells.

**Question 6a** (2 marks)

**Select** the equipment needed for this investigation.

Click the "Palette Image Library" button to display the equipment available.



**Question 6b** (15 marks)

**Design** an investigation to study how temperature is related to osmosis in potato cells. In your investigation, you should include:

- an identification of the independent, dependent and control variables
- a hypothesis that your method will test
- how you will manipulate the variables
- how you will collect sufficient data
- a description of your method
- how you will ensure your method is safe.

B I U $x_2$ $x^2$ Ω Σ Styles

**Question 7** (20 marks)

Living organisms need a balanced diet to remain healthy. A balanced diet should include the following nutrients: fat, carbohydrate, protein, minerals and vitamins.

**Question 7a** (3 marks)

**Select** the appropriate function for each nutrient.

Carbohydrate:

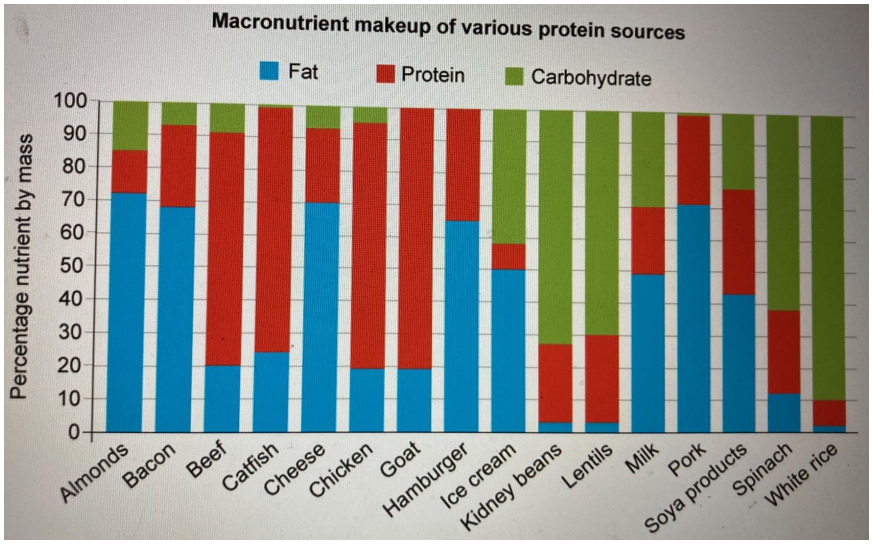
Fat:

Minerals and vitamins:

Protein:

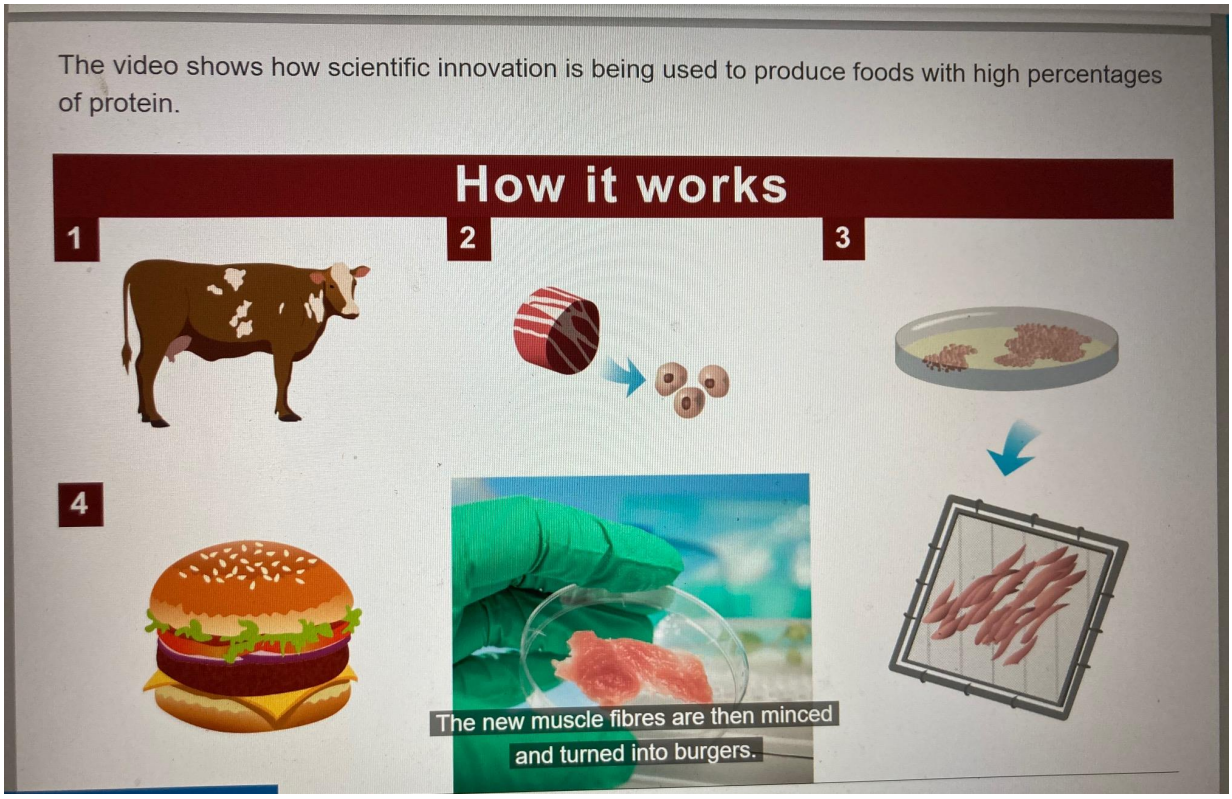
**Question 7b** (1 mark)

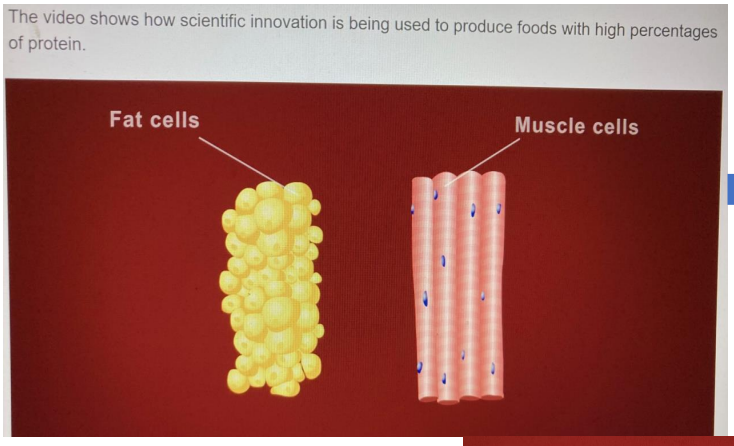
Diets are varied across the globe but all balanced diets need to contain a certain percentage of protein. The recommended mass of protein needed each day for an average sized adult is 50 g.

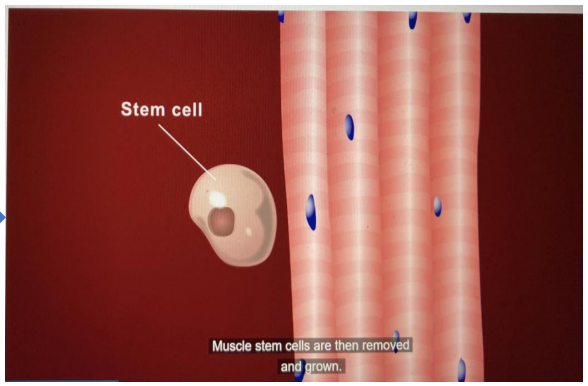


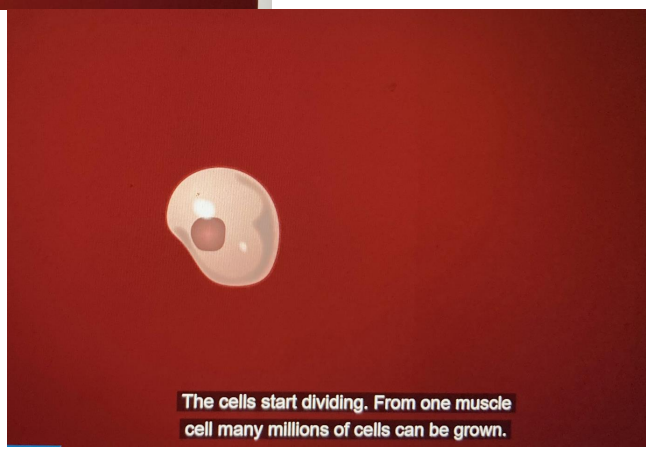

©

Use the information in the graph to **identify** the food with the highest percentage of protein.


The video shows how scientific innovation is being used to produce foods with high percentages of protein.
How it works
1
2
3
4
The new muscle fibres are then minced and turned into burgers.


The video shows how scientific innovation is being used to produce foods with high percentages of protein.
Fat cells
Muscle cells


Stem cell
Muscle stem cells are then removed and grown.


The cells start dividing. From one muscle cell many millions of cells can be grown.

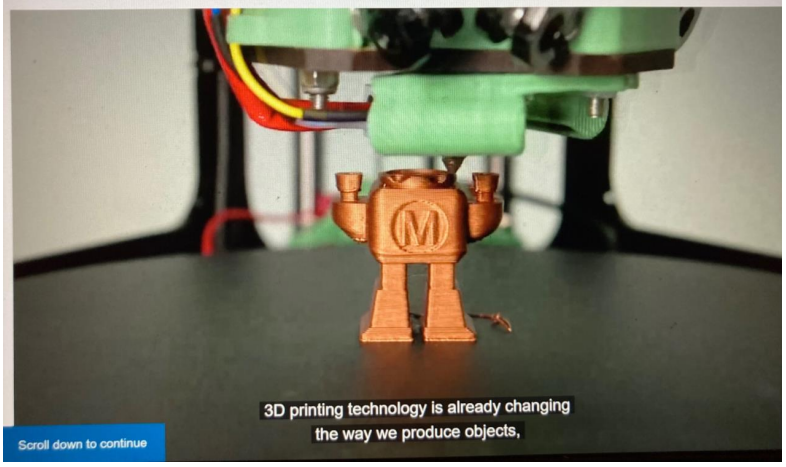
**Question 7c** (16 marks)

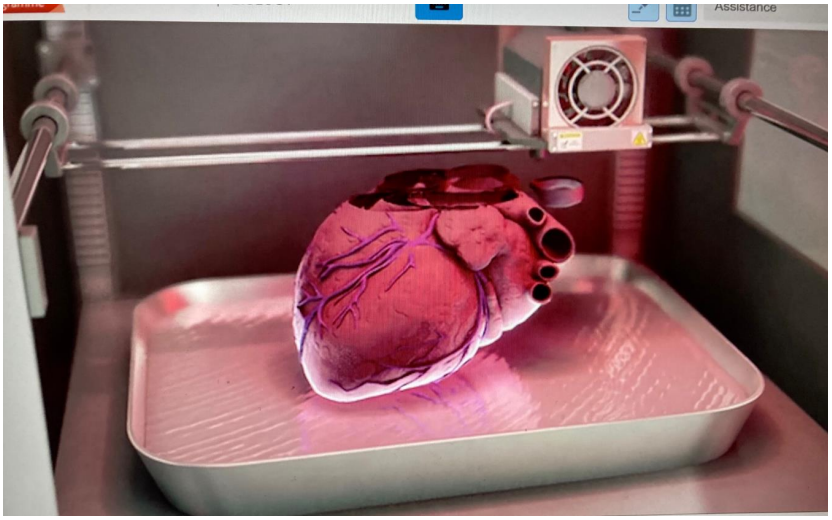
**Discuss** and **evaluate** the implications of using *in vitro* meat production to address unsustainable intensive meat farming. In your answer, you should consider:

- the impacts of intensive meat farming
- the strengths and limitations of *in vitro* meat production
- the environmental considerations of both intensive farming and *in vitro* production
- the ethical issues involved in both intensive farming and *in vitro* production
- a concluding appraisal.

B I U $x_2$ $x^2$ Ω Σ Styles

3D printers have been used to produce a wide variety of products from toys to intricate chocolate designs. Scientists are using 3D printers and *in vitro* cell culture techniques even more creatively to produce artificial organs and body parts.



3D printing has been suggested as a new source of body tissue for people with medical conditions requiring a transplant. Currently people requiring replacement body tissue must rely on transplanted material from a matching donor.

**Discuss** and **evaluate** the scientific implications of replacing traditional transplantation techniques with 3D bio-printing. In your answer, you should include:

- the advantages of 3D printing for transplant patients
- the disadvantages of 3D printing for transplant patients
- a concluding appraisal.