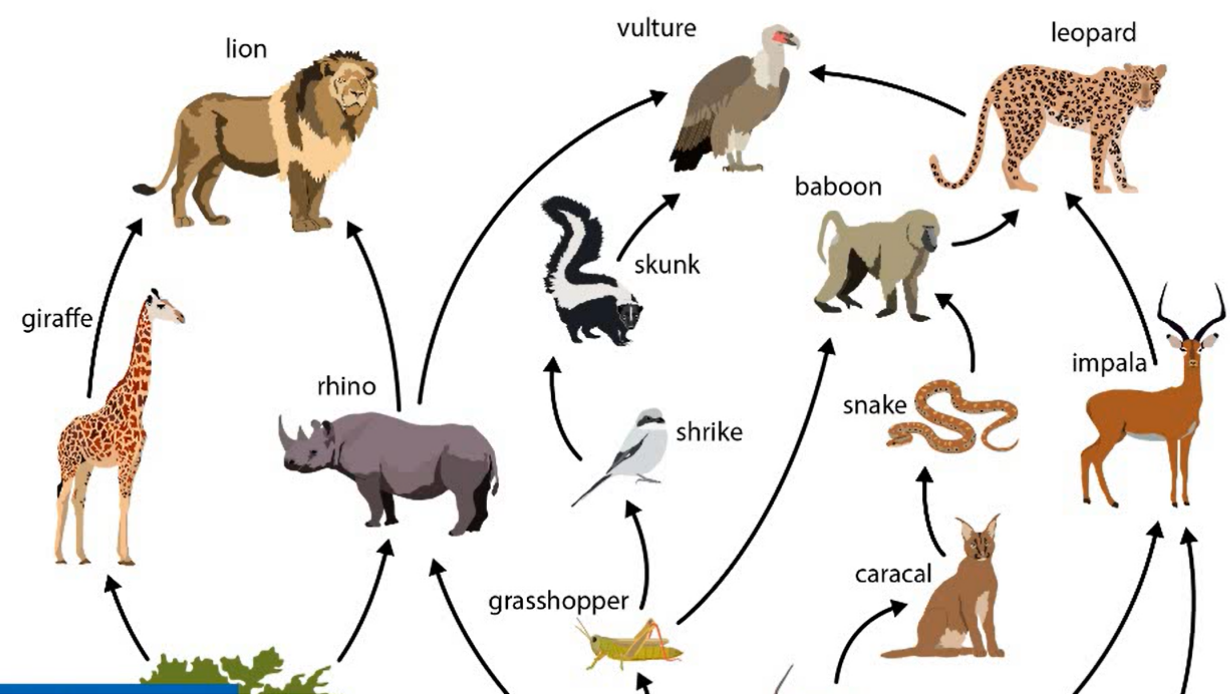
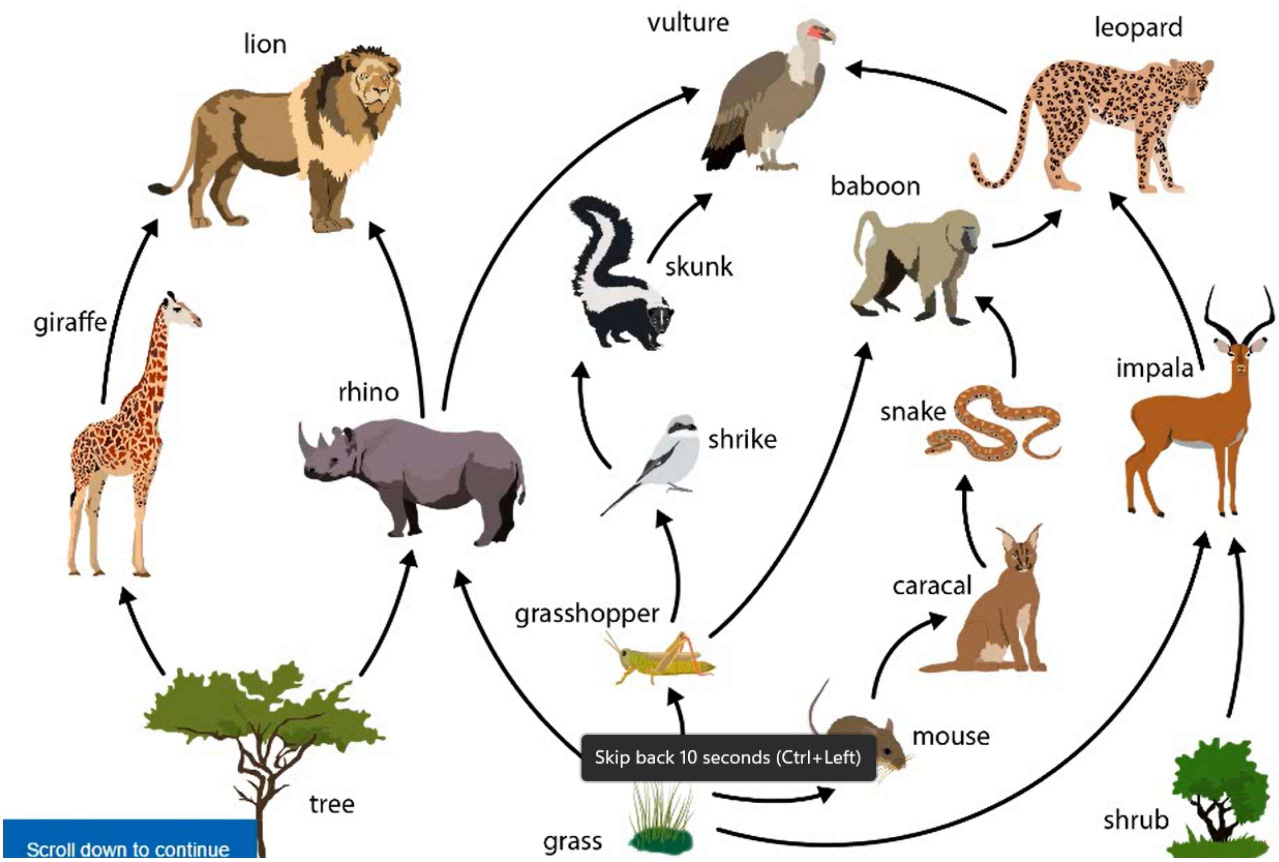
Question 1 (11 marks)

The model below is used to show how some organisms in an ecosystem are connected.



The model below is used to show how some organisms in an ecosystem are connected.



Question 1a (1 mark)

State one name for the type of model shown in the image.

Question 1b (1 mark)

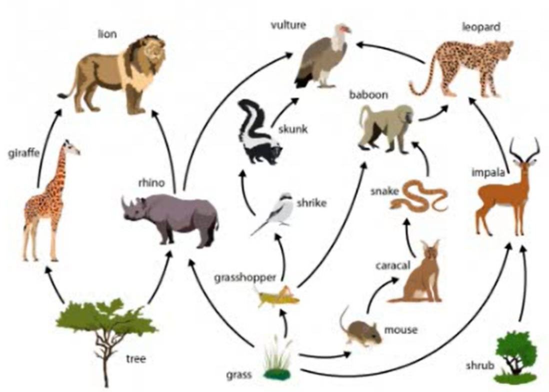
State what the arrows in the model represent.

Question 1c (2 marks)

Identify one producer and two secondary consumers in the model above.

Question 1d (5 marks)

Use the model to **explain** how the shrub and baboon populations might change if the impala population decreases.



Shrubs

Styles

Question 1e (1 mark)

The model shown above is a simplification of a real-life ecosystem. One limitation is that the model does not show all organisms. For example, decomposers are not included.

State the role of decomposers in an ecosystem.

Question 1f (1 mark)

Suggest one other limitation of the model.

Question 2 (12 marks)

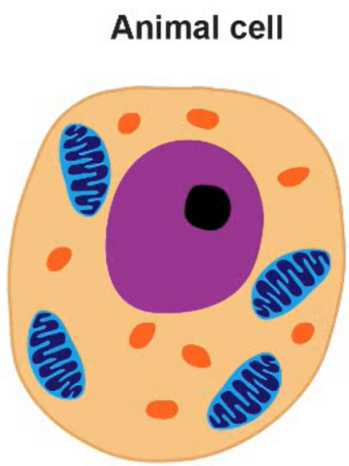
Question 2a (1 mark)

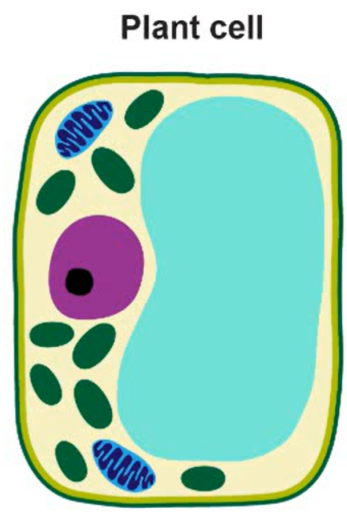
Select the statement that correctly describes cells.

- Cells are found in plants but not fungi
- Cells are the smallest unit of life
- All cells go through meiosis
- All cells are the same size

Question 2b (4 marks)

Models of cells are used to show cell organization and to compare differences between types of cells.





List two cell structures that plant cells have that animal cells do not have. **Outline** how each of these structures are related to the function of plant cells.

Structure 1

Styles

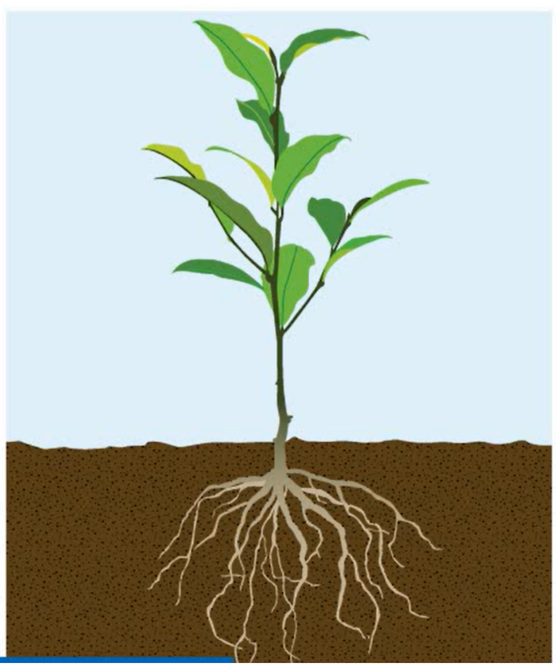
Structure 2

Styles

Question 2c (4 marks)

Describe the role of chlorophyll in glucose production in plants.

Question 2d (3 marks)



The roots of a plant cannot produce glucose but they need glucose for growth. **Outline** how the roots obtain glucose.

Question 3 (10 marks)

Yeast is a microorganism that is commonly used to make bread and beer.

Yeast must respire to survive. Respiration is a reaction that occurs in the cells of living things, and is controlled by specific enzymes.

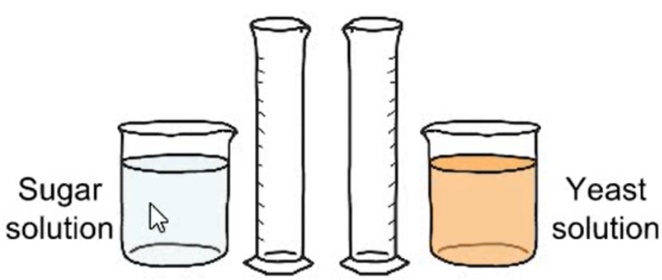
Some students planned a simple experiment to find out how temperature affects respiration in yeast. The students collected the carbon dioxide produced during respiration in a balloon. They suggested the following research question:

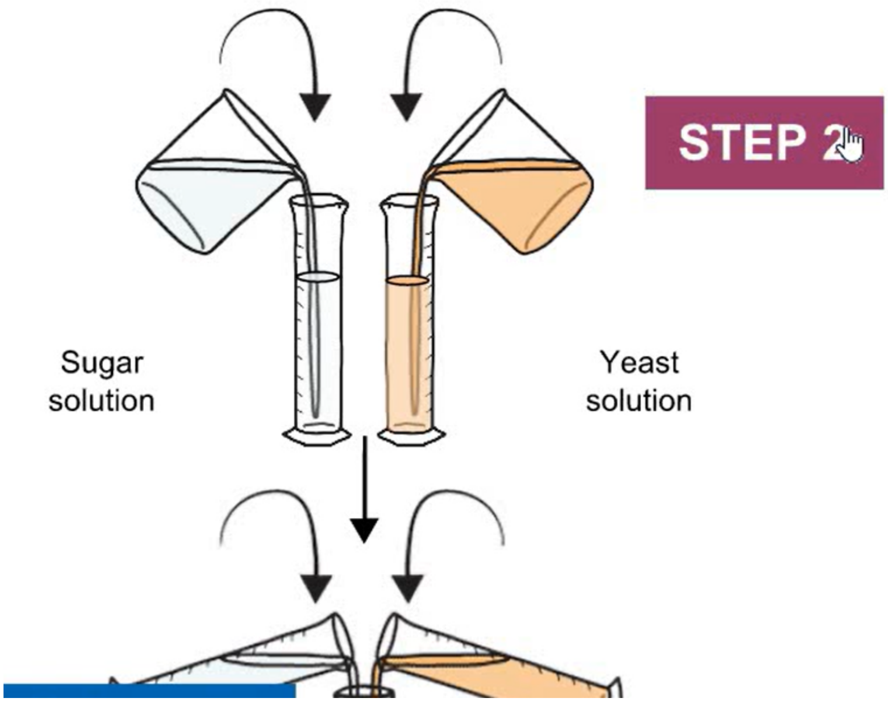
> How does temperature affect the rate of respiration in yeast as measured by the volume of carbon dioxide produced in 15 minutes?

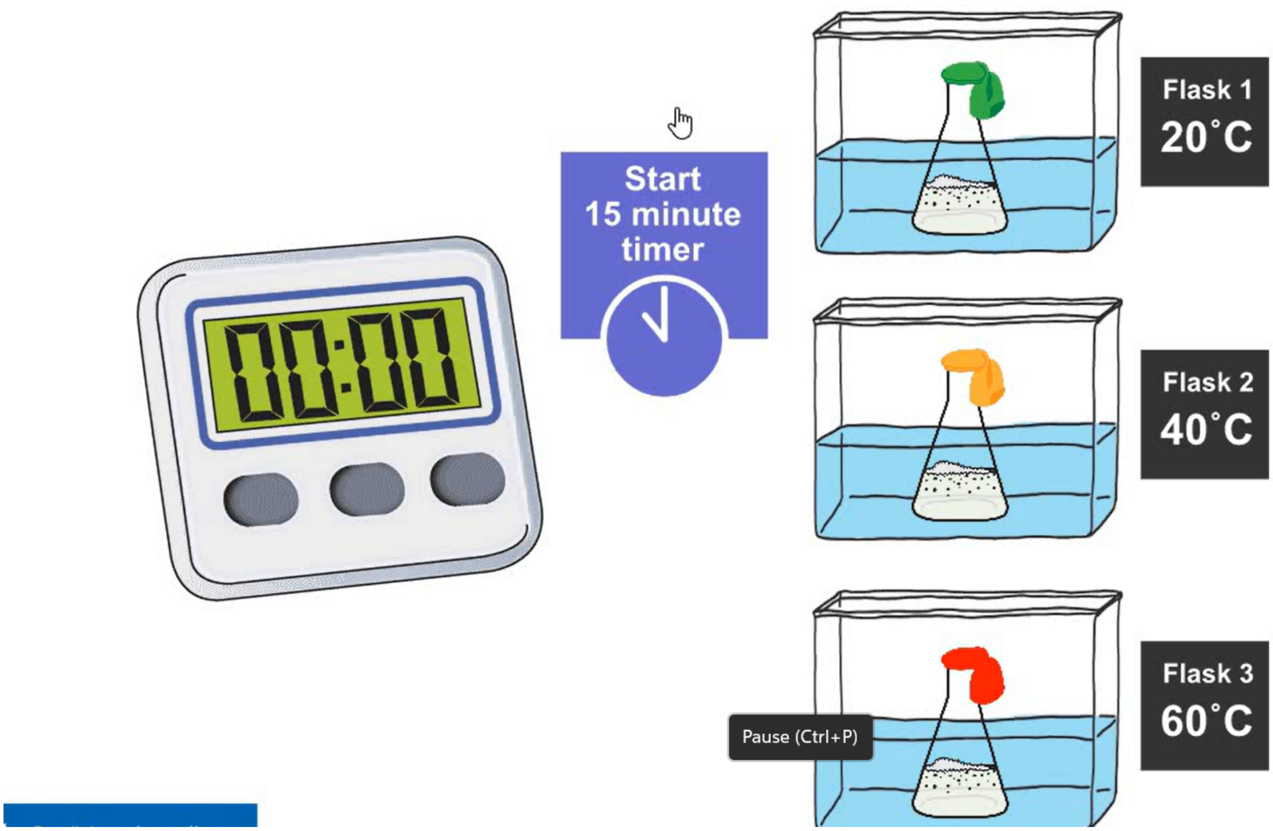
The interactive graphic below shows how they have set their experiment up and the results they obtained:

Click on the buttons to see each stage of the experiment.

STEP 1




STEP 2
Sugar solution
Yeast solution


00:00
Start 15 minute timer
Flask 1 20˚C
Flask 2 40˚C
Flask 3 60˚C
Pause (Ctrl+P)

Question 3a (4 marks)

State the variables in this experiment.

Independent variable

Styles

Control variable 1

Styles

Question 3b (2 marks)

Outline if the method in the interactive graphic above will give sufficient data to answer the research question.

Styles

Suggest two improvements to this experiment. **Justify** your improvements.

Improvement 1

Styles

Improvement 2

Styles

Question 4 (21 marks)

The students continued to investigate respiration in yeast. They were interested in investigating different sugars.

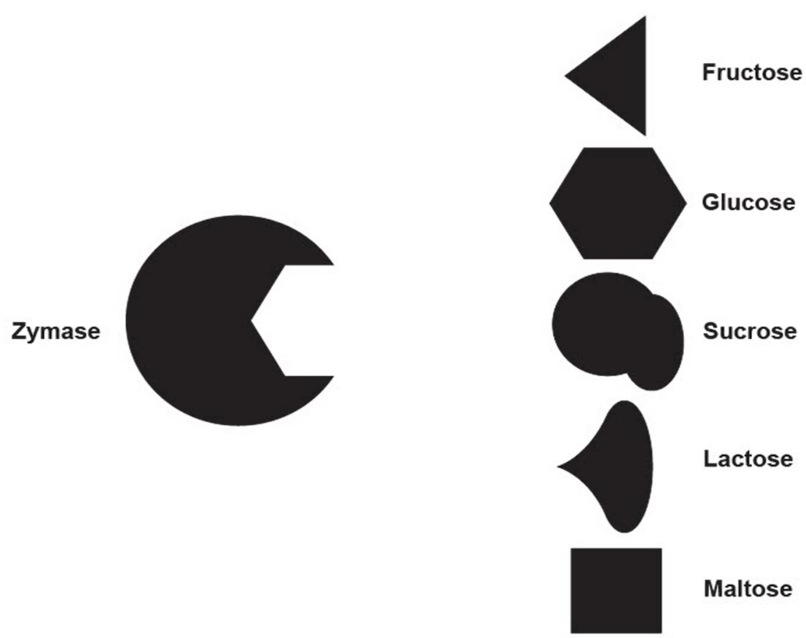
Question 4a (2 marks)

Formulate a research question for this investigation.

Question 4b (4 marks)

Zymase is an enzyme found in yeast which is important in respiration.

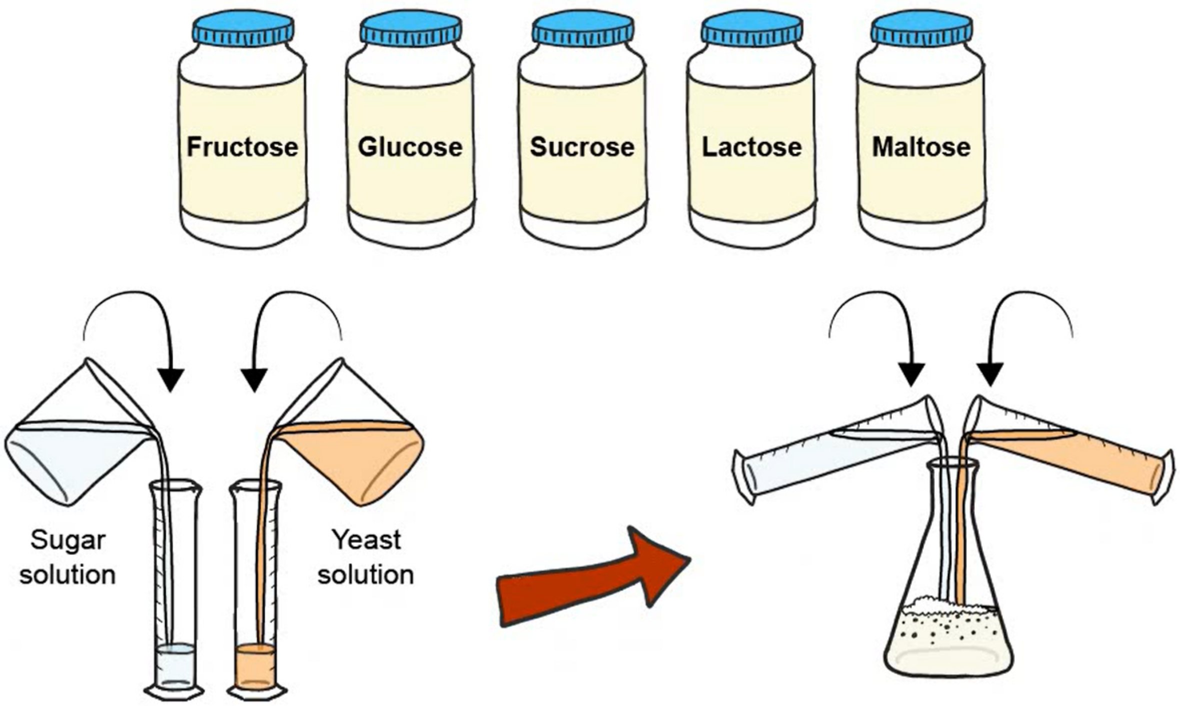
The image below shows a model of zymase and five different sugars: fructose, glucose, sucrose, lactose and maltose.



Predict which sugar is most likely to be respired by the yeast. **Justify** your answer.

B I U Styles

Question 4c (15 marks)



Design an investigation into the effect of different sugars on the **rate** of respiration of yeast. In your answer, you should include:

- the independent, dependent and two control variables
- how you will collect sufficient data and process it
- any additional equipment you will need to make measurements or to control variables
- the method that you will use.

B I U Styles

Question 5 (23 marks)

Another term for respiration in yeast is *fermentation*. Fermentation of plant materials is used to produce ethanol, which can be used as biofuel. The main sources of plant material used around the world today are wheat, corn, soybeans, and sugarcane. These food sources are used because they have a high sugar content and they ferment easily. Some students decided to investigate if other food sources could be fermented. They were particularly interested in waste products, parts of food that are thrown away rather than eaten.

Question 5a (1 mark)

State one advantage of biofuels over fossil fuels.

Question 5b (2 marks)

State two advantages of using food waste rather than food crops to produce biofuels.

Question 5c (1 mark)

The food waste they chose to study was from water chestnuts and pineapples.

The results from their investigation are shown in the table below.

	Mass of ethanol produced each day from 10 g of food waste / mg					
	Day 1	Day 3	Day 5	Day 7	Day 9	Day 11
Water chestnut	2.6	4.5	3.4	3.1	2.3	2.0
Pineapple	2.3	5.6	9.0	3.4	1.3	1.3

For each of the food wastes, **identify** the day on which the largest mass of ethanol was produced.

Water chestnut

Day

Pineapple

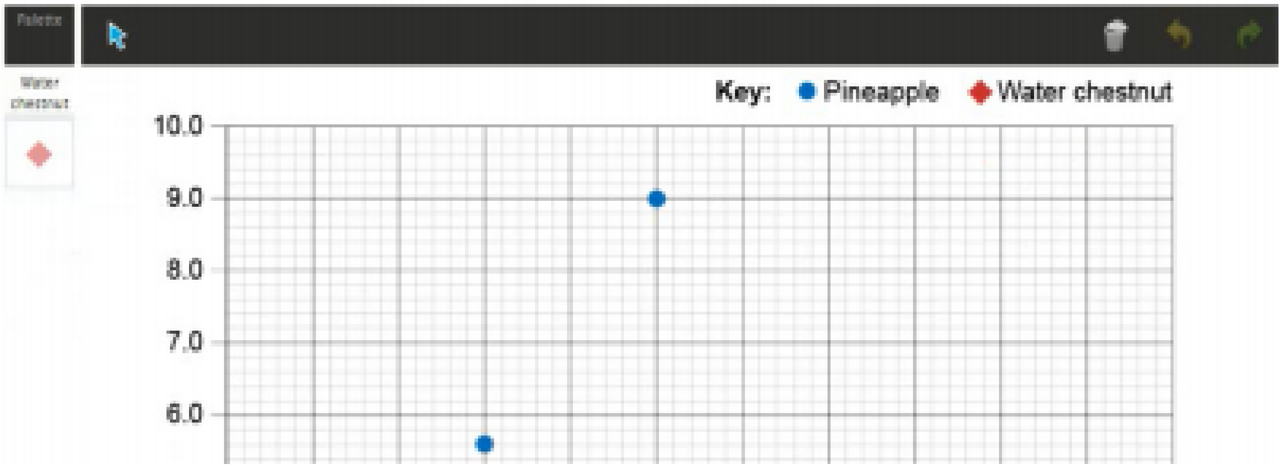
Day

Question 5d (5 marks)

The graph below shows the mass of ethanol produced from pineapple waste. **Plot** the data for water chestnut waste on the graph. You should also add a title to the graph and **label** the axes.

Click the icon in the palette and click to place on the graph.

Title:



Question 5e (6 marks)

Outline two trends in ethanol production for pineapple waste. **Explain** these trends using scientific reasoning.

Trend 1

Trend 2

Question 5f (1 mark)

The table below shows the results from the students' investigation.

	Mass of ethanol produced each day from 10 g of food waste / mg						Total mass of ethanol / mg
	Day 1	Day 3	Day 5	Day 7	Day 9	Day 11	
Water chestnut	2.6	4.5	3.4	3.1	2.3	2.0	17.9
Pineapple	2.3	5.6	9.0	3.4	1.3	1.3	

Calculate the total mass of ethanol produced by pineapple waste over the 11 days. Show your working in the box below and add your final value to the table.

Question 5g (1 mark)

Calculate the difference in mass produced for both types of food waste.

B *I* U x_2 x^2 Ω Σ Styles

Question 5h (2 marks)

Below is a summary of the information the students found in a book of nutritional information.

Nutrition facts

Pineapple

Amount of carbohydrates (including sugars) per 100 g	**13 g**

Nutrition facts

Water chestnut

Amount of carbohydrates (including sugars) per 100 g	**24 g**

The students predicted:

During fermentation, a food source containing more carbohydrate will produce more ethanol than a food source that contains less carbohydrate.

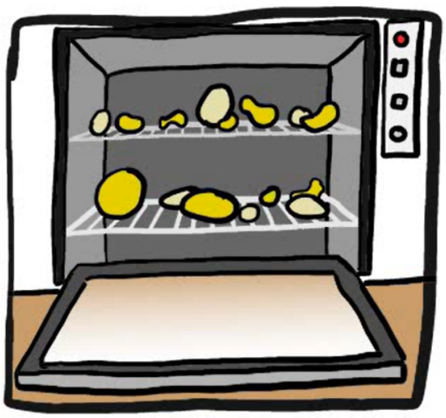
Suggest reasons why the prediction is not supported by the results in part (f).

Question 5i (4 marks)

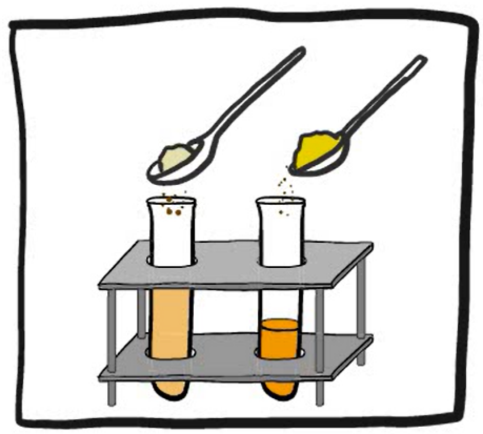
The students made the following brief notes on the method they used to ferment the food waste.

1. Grow the yeast.

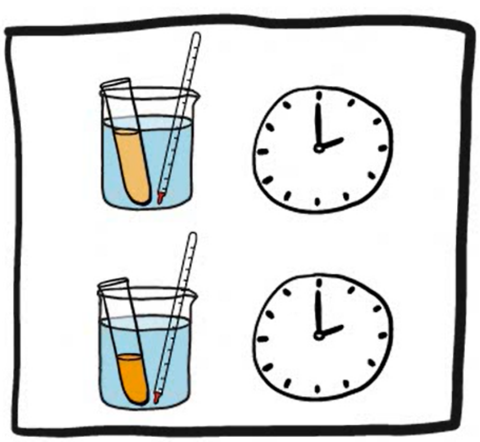
2. Collect food waste from different houses in the neighbourhood.



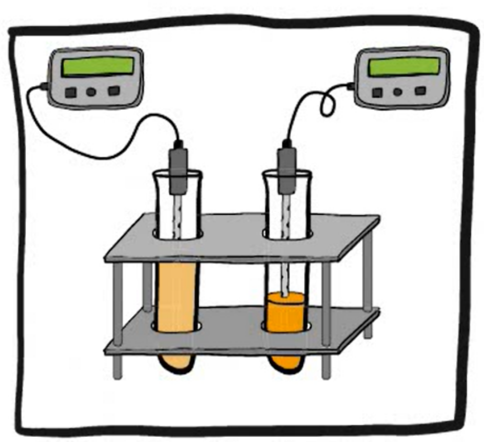
3. Dry the food waste in an oven and grind into a powder.



4. Mix the yeast solution and food waste powder.



5. Place in a beaker of warm water to allow fermentation to occur.



6. Measure the amount of ethanol present.

The temperature of the beakers of warm water was not controlled in the students' method. **Identify** two other variables that were not controlled and **suggest** how the results may have been affected.

Variable example

the temperature of the beaker of warm water

Effect example

a higher temperature might give a faster rate of reaction

Variable 1

Effect 1

Variable 2

Effect 2

Question 6 (23 marks)

Diabetes has been recognised since ancient times as a disease that can be linked to diet. We now know that this disease is caused when the body cannot regulate its blood sugar levels. In the 1920s, it was discovered that the hormone insulin is involved in regulating blood sugar levels.

Video script:

Diabetes has been recognised since ancient times as a disease linked to diet. Apart from regulating diet, there was no known treatment and people affected by this disease would develop other complications and would die early in life.

Now we know that diabetes is caused when the body cannot regulate its blood sugar levels. In the 1920s, it was discovered that insulin is a hormone involved in regulating blood sugar levels.

Between the 1930s and the 1980s, factories purified insulin extracted from pigs' pancreases. Insulin became available to people with diabetes, but many daily shots were necessary.

Around 1980, human insulin was produced by genetically modified bacteria for the first time. This was the start of a new industry and human insulin became more widely available at a much lower cost.

By changing the human insulin gene slightly, different versions of insulin are produced. This means that an appropriate form of insulin can be taken to meet the needs of a person with diabetes.

For example, fast-acting insulin can be used before a meal whereas long-lasting insulin can be used for longer-term control.

Insulin production by genetically modified bacteria can be considered to be an example of industrialization. This development has helped in the management of diabetes.

In 1980 there were 108 million people worldwide with diabetes. In 2014 this figure rose to 422 million.

However, over this time the death rate from diabetes dropped dramatically.

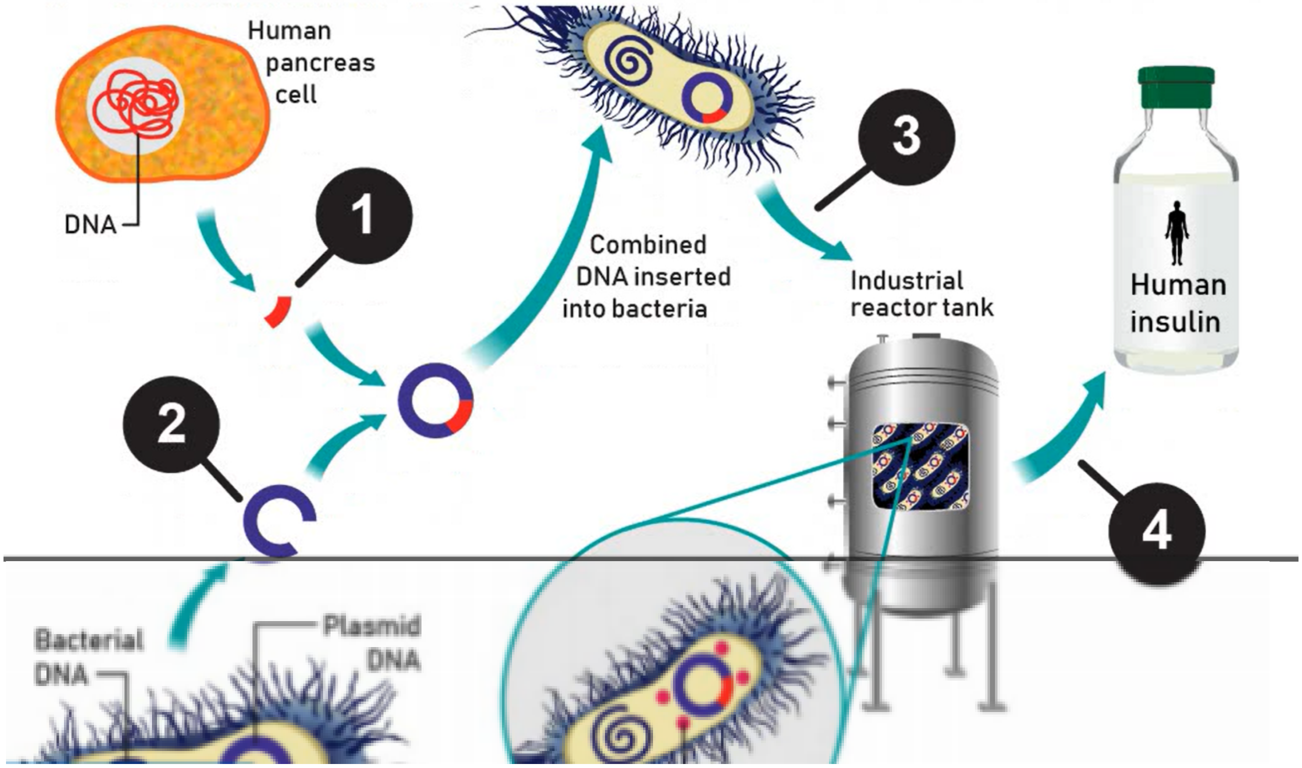
Question 6a (1 mark)

The regulation of blood sugar is an example of homeostasis. **Select** the correct meaning of the word *homeostasis*.

- the conversion of glucose to glycogen
- the maintenance of a constant internal environment
- the release of energy from glucose
- the development of red blood cells in bone marrow

Question 6b (4 marks)

Gene transfer is an example of genetic modification and is used to produce human insulin. The diagram below shows the industrial manufacture of insulin. **Select** the correct statements for the numbered stages in the diagram.



1.
2.
3.
4.

1.
2.
3.
4.

- Human insulin gene extracted
- Plasmid DNA opened
- Bacterial diabetes gene removed
- Extraction and purification of human insulin
- Genetically modified bacteria reproduce
- Insulin extracted from pancreas cell

Fast-acting insulin can be taken before a meal. **Suggest** why this might be necessary for people with diabetes.

B *I* U x_2 x^2 Ω Σ Styles

Question 6c (2 marks)

Fast-acting insulin can be taken before a meal. **Suggest** why this might be necessary for people with diabetes.

B *I* U x_2 x^2 Ω Σ Styles

Question 6d (14 marks)

The industrialization of insulin production has been developed to help manage diabetes.

Discuss and **evaluate** the impacts of the industrialization of insulin production. In your answer you should include:

- the impacts on an individual's health
- social implications for communities
- economic considerations
- your opinion of whether or not industrialization has improved the management of diabetes.

Question 6e (2 marks)

Insulin treatment is not always effective. Recently, scientists in China and Australia have been working together to develop a permanent cure for diabetes. This cure involves transplanting insulin-producing pancreas cells from pigs into humans. **Outline** the ethical implications of this procedure.