

Question 1 (11 marks)

This question is about diet and exercise. Lifestyle choices are important for health.

Question 1a (2 marks)



For each item, **select** the main nutrient this food contains.

Rice

Olive oil

Milk

Fish

- Rice
  - Fats
  - Proteins
  - Carbohydrates
- Olive oil  
Milk



**Question 1b** (1 mark)

**State** why protein is needed as part of a balanced diet.

**B** **I** **U**  $x_2$   $x^2$   $\Omega$   $\Sigma$  Styles



**Question 1c** (2 marks)

Before going to school, a student eats a cheese sandwich and drinks a glass of orange juice.

The cheese sandwich contained 10 g of protein which is equivalent to 20 % of the recommended daily intake.

**Calculate** the total mass of protein needed daily.

**B** **I** **U**  $x_2$   $x^2$   $\Omega$   $\Sigma$  Styles

The nutritional value of the student's breakfast is shown below.



<b>Nutrition facts</b>	
Cheese sandwich	
<b>Nutrient</b>	<b>Daily % per 100 g</b>
Fat	18
Carbohydrates	9
Protein	20
Calcium	10
Vitamin C	0

<b>Nutrition facts</b>	
Orange juice	
<b>Nutrient</b>	<b>Daily % per 240 cm<sup>3</sup></b>
Fat	0
Carbohydrates	9
Protein	0
Calcium	2
Vitamin C	120

**Analyse** the information in the tables to discuss whether or not the breakfast is part of a balanced diet.

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### Question 1e (2 marks)

Obesity is a condition where a person's body mass is too high. **Outline two** causes of obesity.



### Question 2 (12 marks)

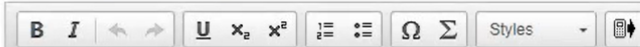
Some interactions between organisms are harmful. Yearly, thousands of people die because of infection with the bacterium *Vibrio cholerae*, which causes the disease cholera.



### Question 2a (1 mark)

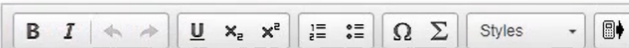
*Vibrio cholerae* is a pathogen.

**State** the meaning of the term *pathogen*.



### Question 2b (2 marks)

**List two** life processes that a bacterium has in common with other living organisms.





**Question 2c** (2 marks)

*Vibrio cholerae* is transmitted through drinking contaminated water.

**Suggest** why cholera outbreaks often happen after natural disasters, such as hurricanes or floods.

**B** *I* ← → U  $\times_2$   $\times^2$   $\equiv$   $\equiv$   $\Omega$   $\Sigma$  Styles ▾



**Question 2d** (2 marks)

The human body has natural defences which protect it from infection.

**Outline** how the skin and white blood cells protect the body from infection.

Skin

**B** *I* ← → U  $\times_2$   $\times^2$   $\equiv$   $\equiv$   $\Omega$   $\Sigma$  Styles ▾

White blood cells

**B** *I* ← → U  $\times_2$   $\times^2$   $\equiv$   $\equiv$   $\Omega$   $\Sigma$  Styles ▾



### Question 2e (5 marks)

Vaccinations have been developed against many other deadly diseases such as measles and polio. Vaccines work with the body's own immune system.

**Explain** how vaccinations lead to immunity.

**B** *I* ← → U  $x_2$   $x^2$  ☰ ☱ Ω Σ Styles ↕



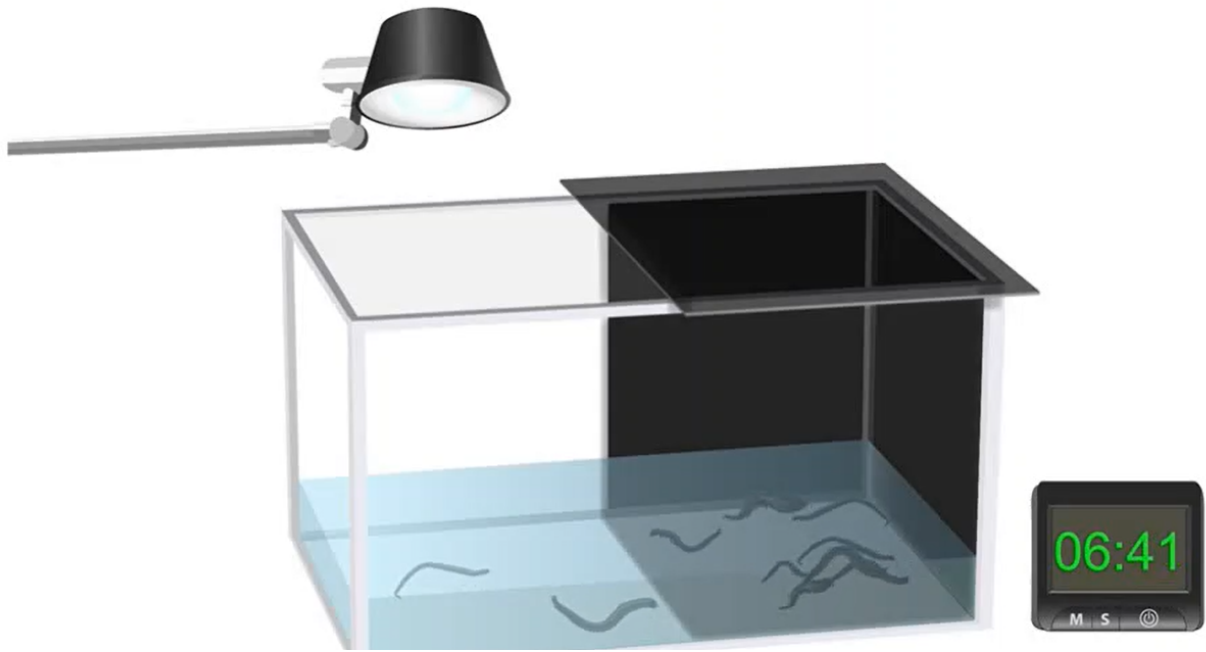
### Question 3 (14 marks)

Plants and animals can both respond to a stimulus in their environment. When a plant responds to a stimulus, it is called a tropism and when an animal responds to a stimulus, it is called a *taxis*.

A group of students had just returned from a trip to a stream and had observed leeches hiding under rocks or in the muddy water. The students wanted to learn more about leech behaviour. They knew that leeches did not have true eyes, but they could detect light and dark and movement. The students decided to investigate how leeches responded to light. This would be an example of a *phototaxis*.

The animation below shows how the students conducted their experiment.





Question 3a (1 mark)

**Select** the body system related to the leeches' response to light.

- Nervous
- Endocrine
- Respiratory
- Digestive



Question 3b (1 mark)

**State** one ethical consideration related to the leeches used in the investigation.

**B** *I* ← → U  $x_2$   $x^2$   $\frac{1}{2}$   $\frac{3}{4}$   $\Omega$   $\Sigma$  Styles



Question 3c (3 marks)

**Identify** the variables in this investigation. The dependent variable has been completed for you.



Independent variable:

**B** *I* ← → U  $x_2$   $x^2$   $\frac{1}{2}$   $\frac{3}{4}$   $\Omega$   $\Sigma$   
Styles

Control variable 1:

**B** *I* ← → U  $x_2$   $x^2$   $\frac{1}{2}$   $\frac{3}{4}$   $\Omega$   $\Sigma$   
Styles

Dependent variable:

**B** *I* ← → U  $x_2$   $x^2$   $\frac{1}{2}$   $\frac{3}{4}$   $\Omega$   $\Sigma$   
Styles   
*Number of leeches on each side after 10 minutes*

Control variable 2:

**B** *I* ← → U  $x_2$   $x^2$   $\frac{1}{2}$   $\frac{3}{4}$   $\Omega$   $\Sigma$   
Styles



Question 3d (3 marks)

Formulate and explain a testable hypothesis for this investigation.

**B** *I* ← → U  $x_2$   $x^p$   $\frac{1}{2}$   $\frac{3}{4}$   $\Omega$   $\Sigma$  Styles ▾



Question 3e (1 mark)

The students repeated the experiment twice. Justify the use of three trials in this experiment.

**B** *I* ← → U  $x_2$   $x^p$   $\frac{1}{2}$   $\frac{3}{4}$   $\Omega$   $\Sigma$  Styles ▾



Question 3f (2 marks)

Suggest two limitations of this method.

Limitation 1

Limitation 2



### Question 3g (2 marks)

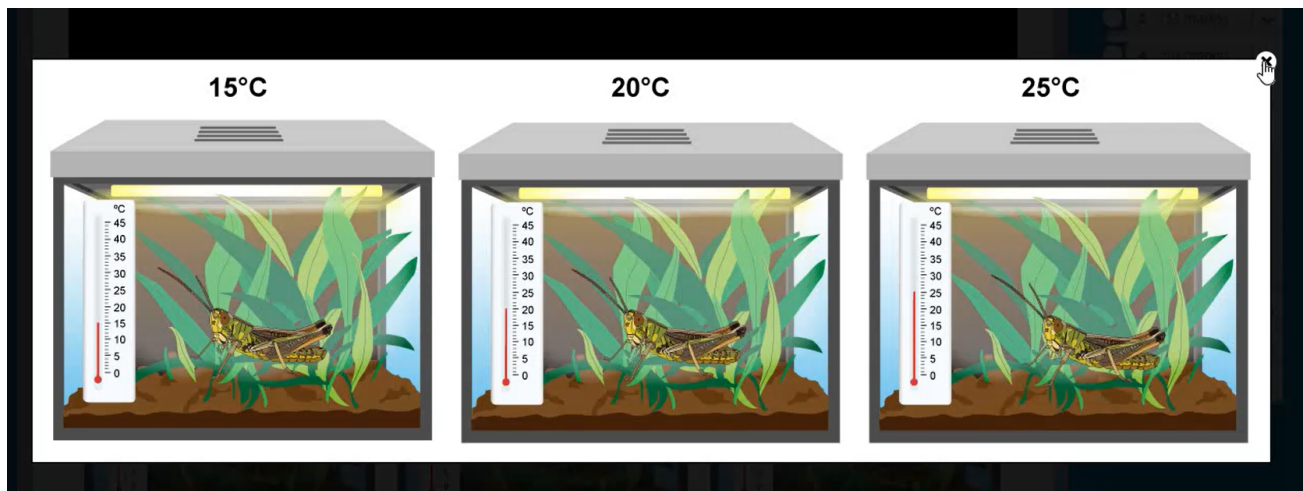
Suggest an improvement for this experiment. **Justify** your improvement.

**B** *I* | ← → | U  $x_2$   $x^2$  |  $\int$   $\sum$  |  $\Omega$   $\Sigma$  | Styles |



### Question 4 (10 marks)

After studying the leeches, the students decided to look into another animal behaviour. One student said she was tired because a cricket chirping in her room had kept her from sleeping. The student decided to study factors that could impact cricket chirping. She found information that indicated that you could estimate the temperature based on the rate of a cricket chirping so she decided to investigate this topic.





**Question 4a** (1 mark)

**State** the kingdom that includes crickets.

**B** *I* ← → U  $x_2$   $x^2$   $\int$   $\sum$   $\Omega$   $\Sigma$  Styles



**Question 4b** (3 marks)

The students predicted that the rate of cricket chirps would be low at low temp at warm temperatures, and decrease again above a certain temperature.

**Explain** the students' prediction using scientific reasoning.

**B** *I* ← → U  $x_2$   $x^2$   $\int$   $\sum$   $\Omega$   $\Sigma$  Styles



**Question 4b** (3 marks)

The students predicted that the rate of cricket chirps would be low at low temperatures, increase at warm temperatures, and decrease again above a certain temperature.

**Explain** the students' prediction using scientific reasoning.

**B** *I* ← → U  $x_2$   $x^2$   $\int$   $\sum$   $\Omega$   $\Sigma$  Styles

**Table A**

Temperature / °C	Number of chirps per minute for each cricket					Mean
	1	2	3	4	5	
15	91	80	89	78	77	
20	135	124	130	125	121	
25	180	169	176	158	157	

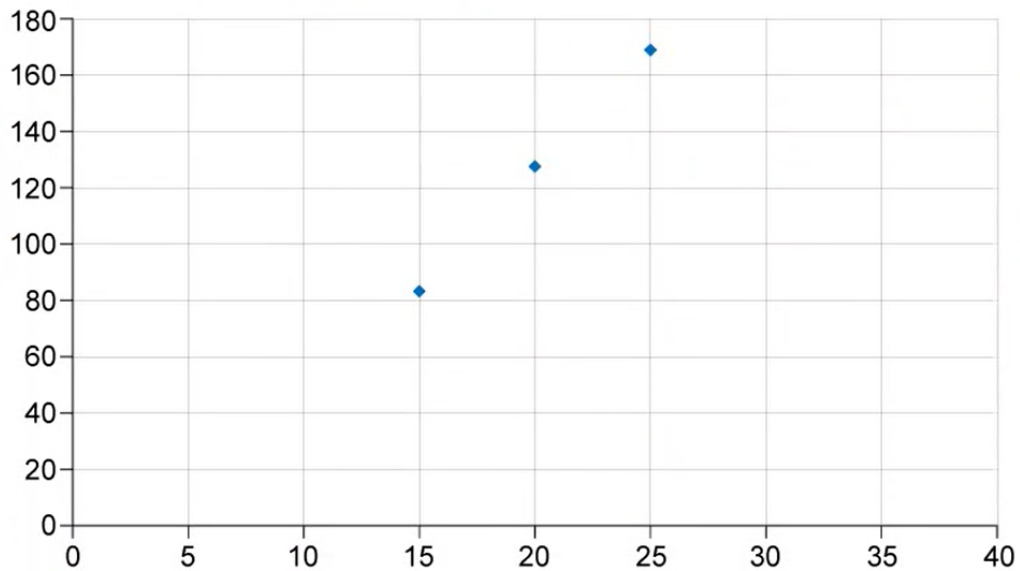
**Table B**

Temperature / °C	Number of chirps per minute for each cricket					Mean
	1	2	3	4	5	
15	91	80	89	78	77	
20	135	124	130	125	121	
25	180	169	176	158	157	
<b>Mean</b>						

**Justify** your answer.

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The students' mean data is plotted on the graph below.



The axes on the graph are not labelled. **State** appropriate labels for the axes.

x axis:

Rich text editor toolbar for the x-axis label, including buttons for Bold (B), Italic (I), text color, background color, Underline (U), subscript (x<sub>2</sub>), superscript (x<sup>2</sup>), bulleted list, numbered list, link (Ω), and unlink (Σ). Below the toolbar is a 'Styles' dropdown menu and a 'Send to Back' icon.

y axis:

Rich text editor toolbar for the y-axis label, identical to the x-axis label, including buttons for Bold (B), Italic (I), text color, background color, Underline (U), subscript (x<sub>2</sub>), superscript (x<sup>2</sup>), bulleted list, numbered list, link (Ω), and unlink (Σ). Below the toolbar is a 'Styles' dropdown menu and a 'Send to Back' icon.



#### Question 4e (2 marks)

The prediction the students made at the start of the experiment was:

*The rate of cricket chirps will be low at low temperatures, increase at warm temperatures, and decrease again above a certain temperature.*

Use the graph to **comment** on the validity of the method used to test this prediction.

Rich text editor toolbar for the answer, including buttons for Bold (B), Italic (I), text color, background color, Underline (U), subscript (x<sub>2</sub>), superscript (x<sup>2</sup>), bulleted list, numbered list, link (Ω), and unlink (Σ). Below the toolbar is a 'Styles' dropdown menu and a 'Send to Back' icon.



#### Question 5 (15 marks)

The students were interested in studying the behaviour of another animal. They discovered that woodlice work well for behavioural investigations. Woodlice from the genus *Armadillidiidae* are small terrestrial crustaceans with segmented exoskeletons. They have many common names including pill bugs, potato bugs, slaters and roly-polies. Woodlice live in cool, dark and damp environments, and feed on plant material.

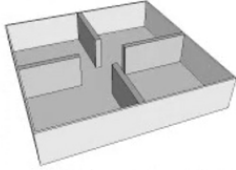


Woodlice  
Pill bugs  
Potato bugs  
Roly-polies  
Slaters



You are provided with a choice chamber and some additional items as shown below.

Not to scale



Choice chamber



Green leaves



Light meter



Gravel



Cucumber



Carrot



Lamp



Thermometer



Woodlice



Four types of paper with different transparency



Apple



Sand



Twigs



Pebbles



Potato

©

**Select** one factor to investigate.

- Food
- Light intensity
- Surface material

**Select** one factor to investigate.

- Food
- Light intensity
- Surface material

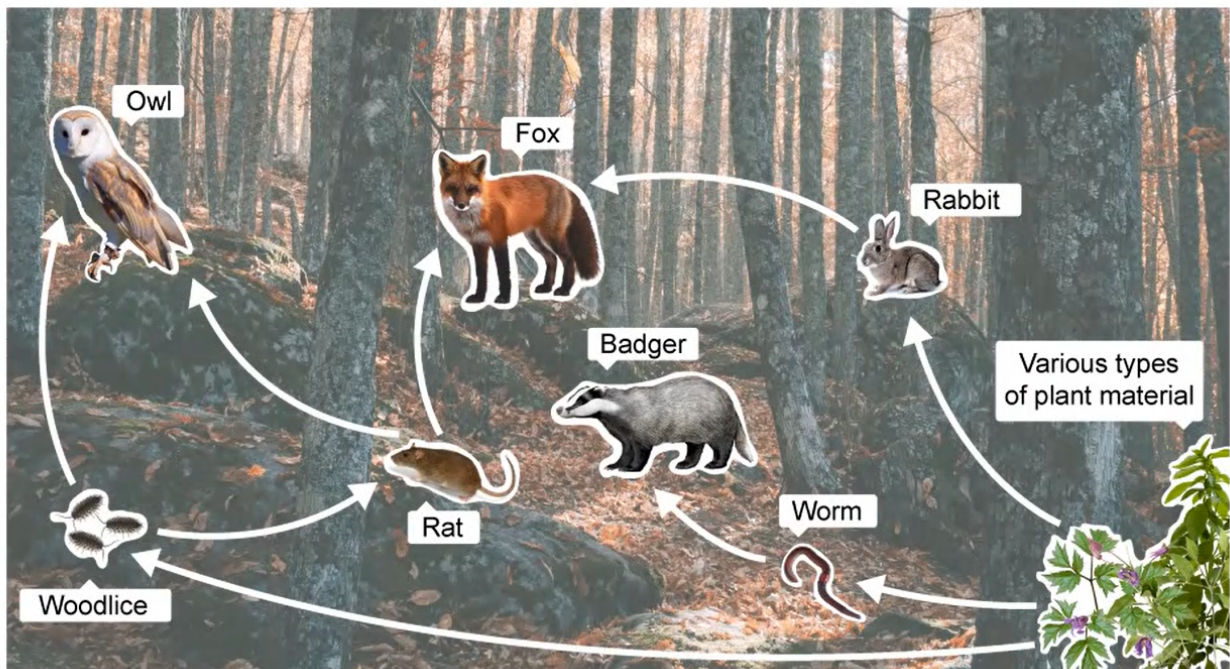
**Design** an investigation to study the relationship between the behaviour of the woodlice and your chosen factor. In your investigation, you should include:

- 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 ethical.



**Question 6** (10 marks)

Woodlice are eaten by several animals in the simplified woodland food web below.





Question 6a (1 mark)

Using this food web, **predict** how the number of woodlice will change if there is an increase in the number of worms. **Justify** your answer.

Rich text editor toolbar with icons for Bold (B), Italic (I), Undo, Redo, Underline (U), Subscript (x<sub>2</sub>), Superscript (x<sup>2</sup>), Bulleted List, Numbered List, Link, Unlink, Styles, and a mobile device icon.



Question 6b (2 marks)

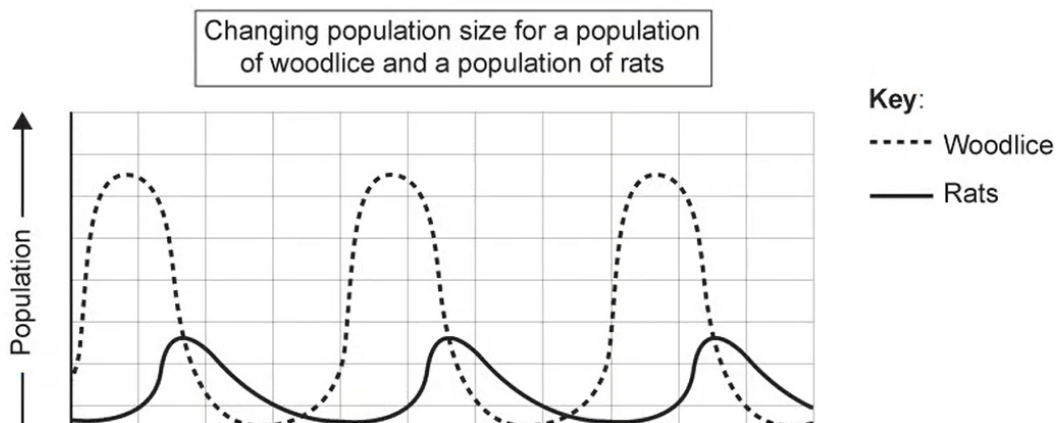
Using this food web, **predict** how the number of woodlice will change if there is a decrease in the number of owls. Use scientific language to **justify** your answer.

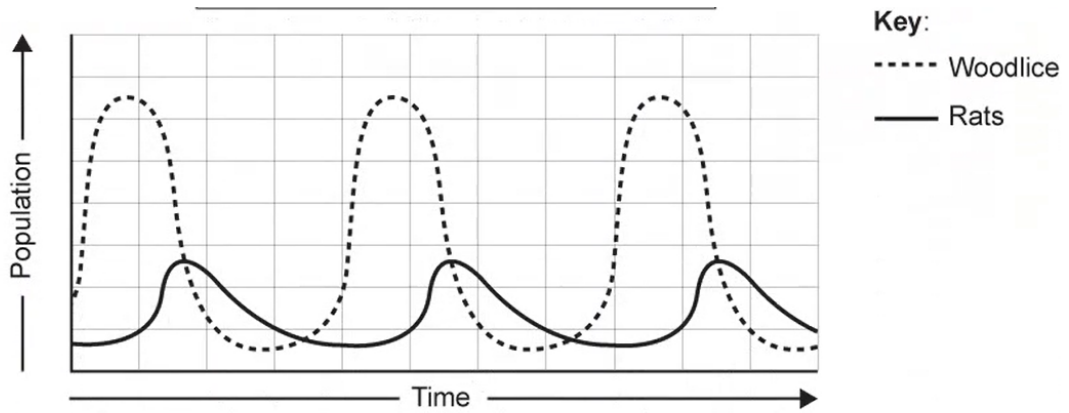
Rich text editor toolbar with icons for Bold (B), Italic (I), Undo, Redo, Underline (U), Subscript (x<sub>2</sub>), Superscript (x<sup>2</sup>), Bulleted List, Numbered List, Link, Unlink, Styles, and a mobile device icon.



Question 6c (1 mark)

The graph below shows changing population size for populations of woodlice and rats from the food web.





©

**Suggest** how the graph could be improved.

**Question 6d** (6 marks)

**Compare** the trend in populations of woodlice and rats in the graph in part (c) and **explain** each trend using scientific reasoning.

Rich text editor toolbar with buttons for Bold (B), Italic (I), Undo, Redo, Underline (U), Subscript (x<sub>2</sub>), Superscript (x<sup>2</sup>), Bulleted List, Numbered List, Link, Unlink, Styles, and a mobile device icon.

**Question 7** (14 marks)

The goal of farming is to produce enough food with a high nutritional content in order to provide a balanced diet across the world. Changes in the environment are causing more extreme weather which leads to severe floods and severe droughts. These environmental changes can make it impossible to grow food in some parts of the world. Farming methods must adapt to cope with these changing environmental conditions.

**Question 7a** (4 marks)

Fertilizers are used to increase crop yields. Most fertilizers contain nitrogen, phosphorus and potassium. **Describe** how plants take in and use these nutrients.

Rich text editor toolbar with buttons for Bold (B), Italic (I), Undo, Redo, Underline (U), Subscript (x<sub>2</sub>), Superscript (x<sup>2</sup>), Bulleted List, Numbered List, Link, Unlink, Styles, and a mobile device icon.



Question 7b (4 marks)

Fertilizers can be produced by the chemical industry, or they can be organic materials such as compost or manure from plant or animal waste. **Compare and contrast** the use of chemically produced fertilizers with organic-based fertilizers.

**B** *I* ← → U  $x_2$   $x^2$   $\equiv$   $\equiv$   $\Omega$   $\Sigma$  Styles ▾



Question 7c (1 mark)

Scientists have been working to map the genome of different organisms for many years. Surprisingly, the rice genome consists of approximately 40 000 genes on 12 chromosomes.

**Suggest** the meaning of the term *gene*.

**B** *I* ← → U  $x_2$   $x^2$   $\equiv$   $\equiv$   $\Omega$   $\Sigma$  Styles ▾



**Question 7d (3 marks)**

Biofortified crops are crops which are genetically modified to contain additional nutritional value. Food from these crops can be used to give nutrients to people suffering from specific nutritional deficiencies.

The image below shows information about different biofortified crops and the year that they were introduced.



**Maize**  
Beta-carotene  
Zambia



**Millet**  
Iron  
India



**Wheat**  
Zinc  
Pakistan



**Sweet potato**  
Beta-carotene  
Uganda



**Beans**  
Iron  
Rwanda

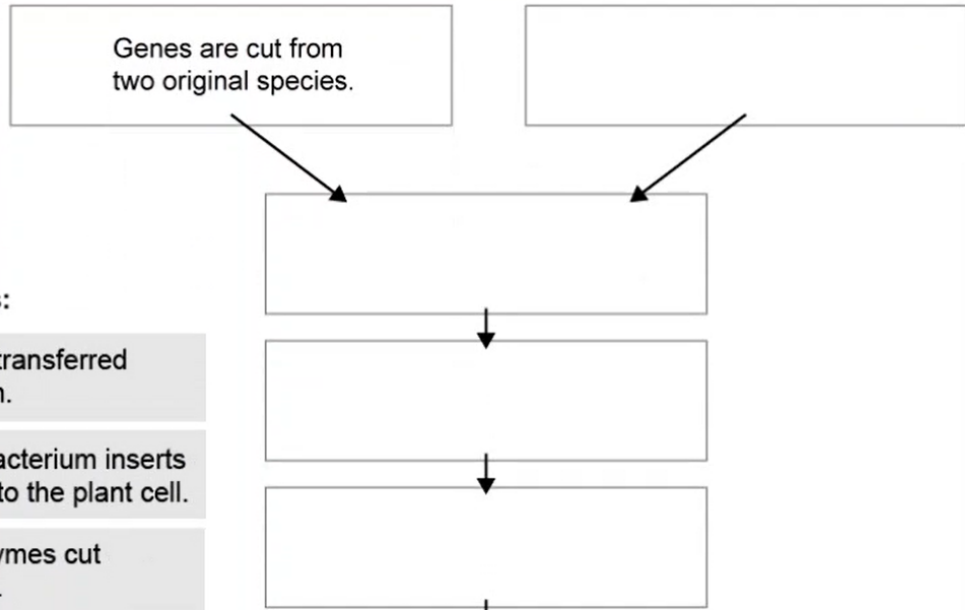


**Cassava**  
Beta-carotene  
Nigeria

**Organize** and **present** this data in an appropriate table.

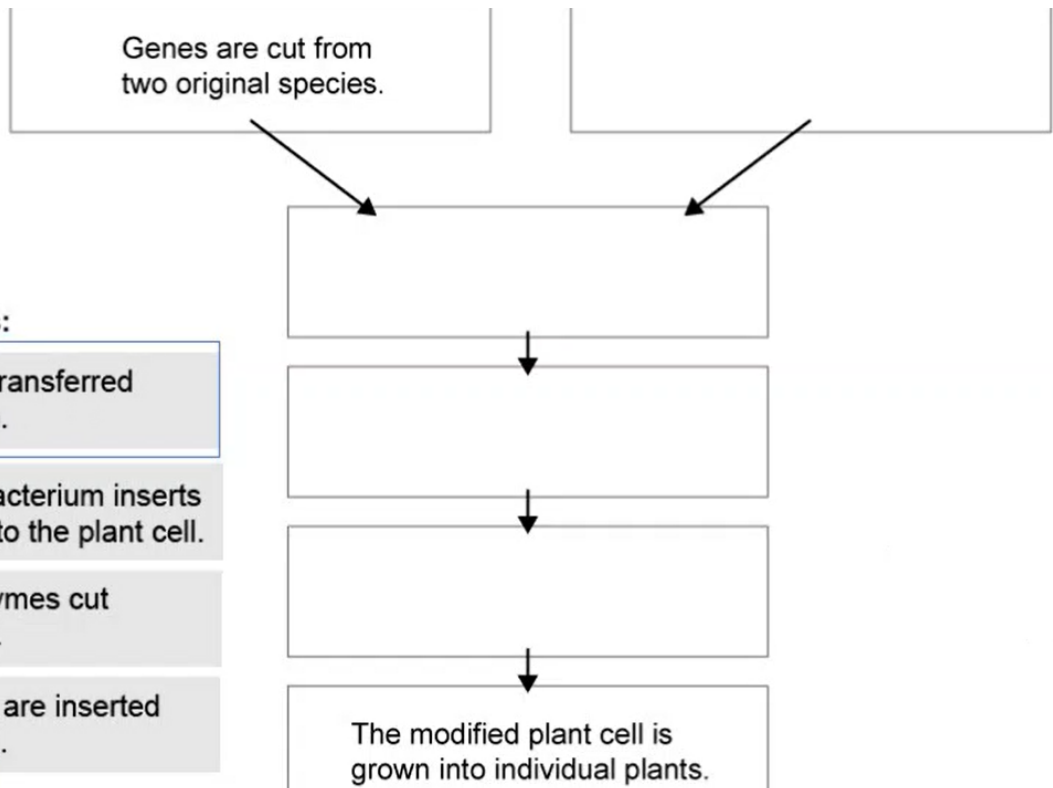
Create New Table


**Organize** the following statements into the correct order showing how biotechnology can be used to genetically modify a plant.



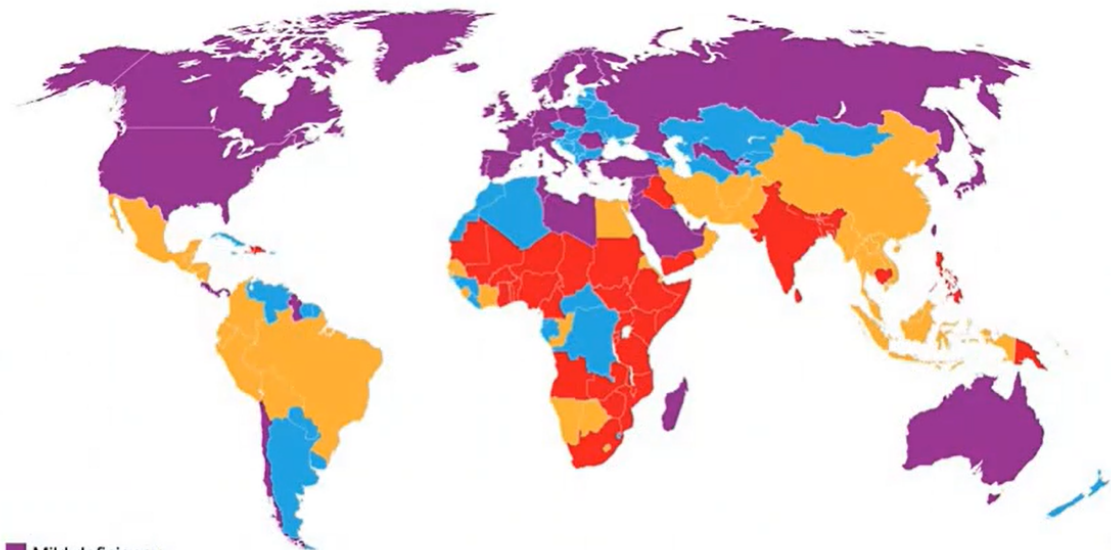
**Draggable items:**

- The plasmid is transferred into a bacterium.
- The modified bacterium inserts the new genes to the plant cell.
- Restriction enzymes cut open a plasmid.



**Draggable items:**

- The plasmid is transferred into a bacterium.
- The modified bacterium inserts the new genes to the plant cell.
- Restriction enzymes cut open a plasmid.
- The new genes are inserted into the plasmid.



- Mild deficiency
- Moderate deficiency
- Severe deficiency
- No data available

to people suffering from specific nutritional deficiencies.

# VITAMIN A DEFICIENCY

**Blindness  
Night  
blindness**



**Weakened  
immune  
function**

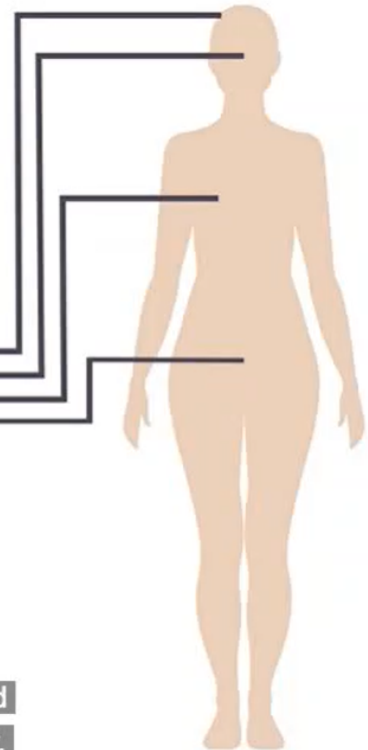


**Cancer**



**Birth**

and birth defects when the mother had vitamin A deficiency during pregnancy.



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Getting the right nutrition is essential for our health and well-being.

Food scarcity and poor nutrition are global problems that affect societies worldwide.

Changes in the environment are causing more extreme weather which leads to severe floods and severe droughts. These environmental changes can make it impossible to grow food in some parts of the world.

Biofortified crops are crops which are genetically modified to contain additional nutritional value. Food from these crops can be used to give nutrients to people suffering from specific nutritional deficiencies.

The most common consequence of vitamin A deficiency is blindness. Other conditions include night blindness, weakened immune function, cancer, and birth defects when the mother had vitamin A deficiency during pregnancy.

Golden rice is a genetically modified form of rice which contains beta-carotene in its grains. Beta-carotene is needed by the human body to produce vitamin A. Non-modified rice grains do not contain beta-carotene. In 2009, results of a clinical trial of golden rice carried out with adult volunteers found that beta-carotene from golden rice is effectively converted to vitamin A in humans. Despite these results, as of March 2016, golden rice has not yet been grown commercially.

Some groups are against the introduction of golden rice as they claim that people will eat this genetically modified rice without being aware of it or without having the choice not to.

Another concern is the possibility of this genetically modified type of rice cross-pollinating with non-modified rice grown in nearby fields. This could lead to new varieties of rice being unintentionally created, eventually leading to the loss of the non-modified form of rice.

Research continues in the biotechnology field of fortified foods and in 2016, the World Food Prize went to biofortified sweet potatoes.

Using the information provided in this question and your wider MYP knowledge, **discuss** and **evaluate** the possible implications of introducing biofortified food crops. In your answer, you should include:

- health impacts of introducing a new biofortified food on an individual
- environmental impacts of introducing biofortified food crops in areas where the species has never been cultivated before
- ethical impacts
- economic impacts for the local community
- a concluding recommendation based on the arguments you have discussed.

<b>B</b>	<b>I</b>	↶	↷	<u>U</u>	x <sub>2</sub>	x <sup>2</sup>	☰	☷	Ω	Σ	Styles	-	📄