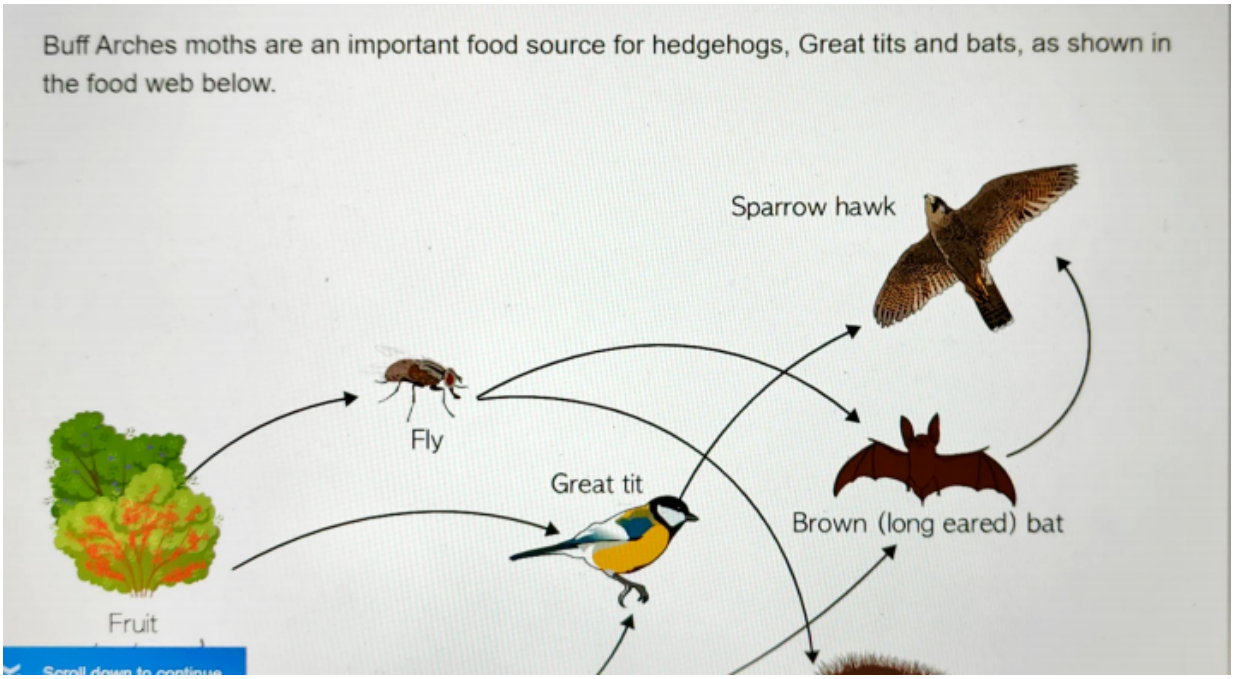
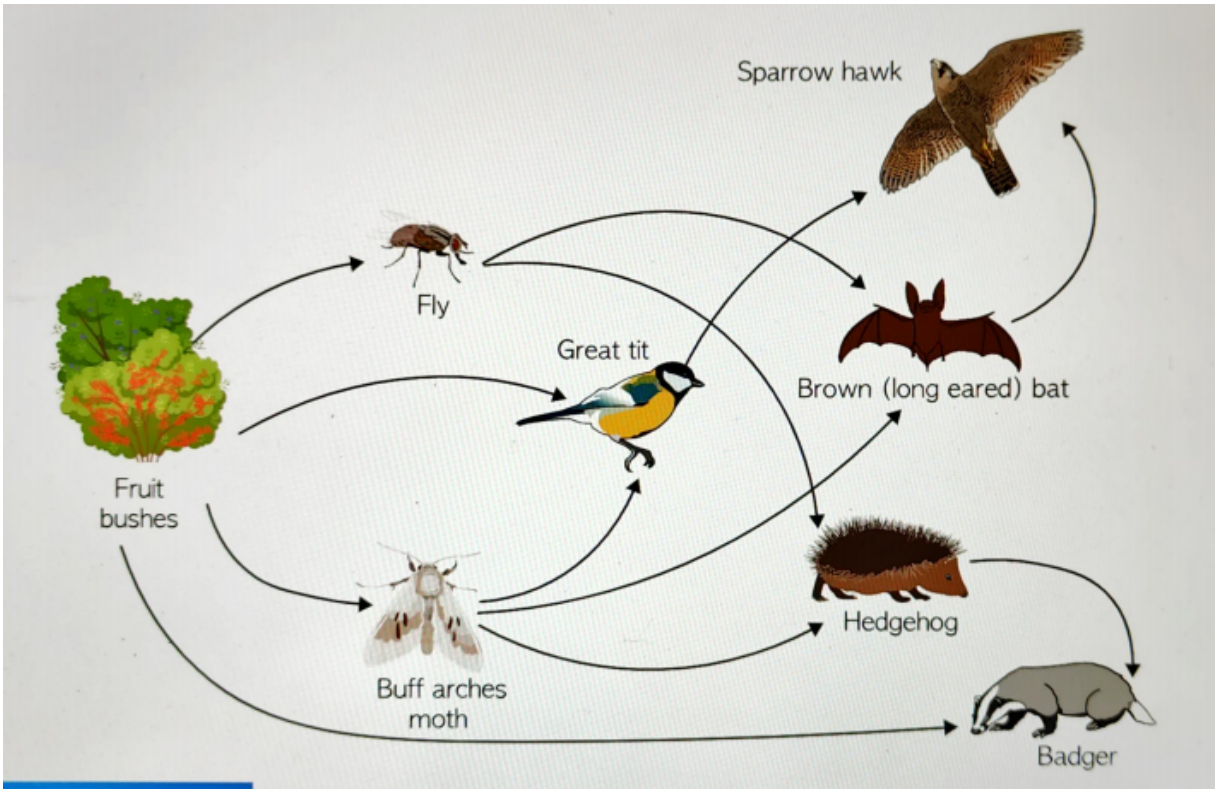
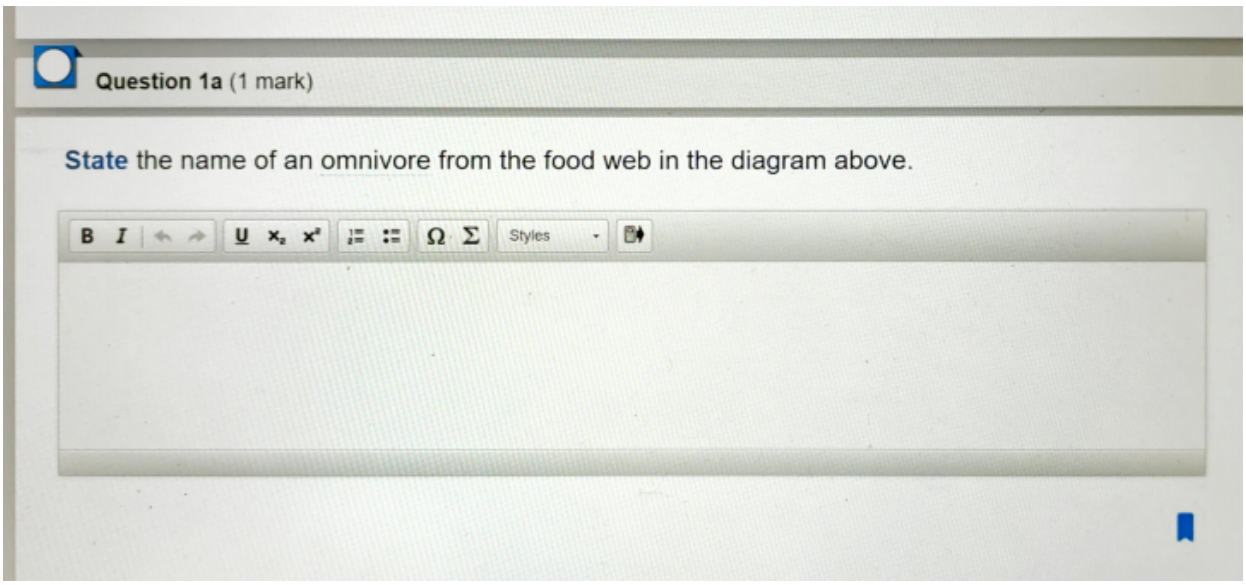
Question 1 (9 marks)

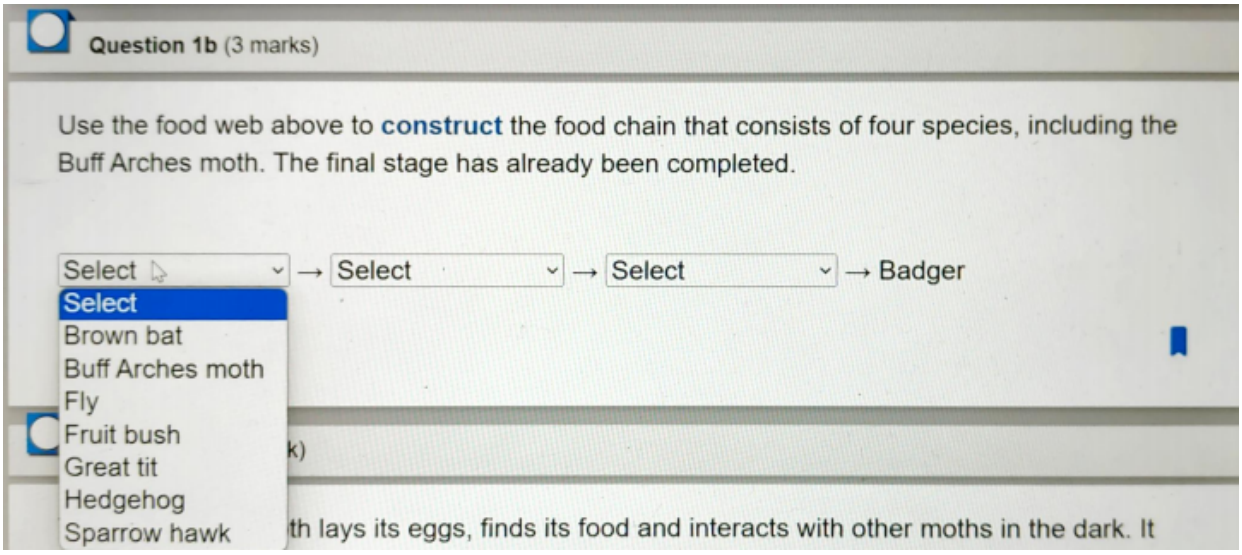
The Buff Arches moth is a species that lives in gardens, parks and woodlands around Great Britain and Ireland. Buff Arches moths live on fruit bushes.

Buff Arches moths are an important food source for hedgehogs, Great tits and bats, as shown in the food web below.




Sparrow hawk
Fly
Great tit
Brown (long eared) bat
Fruit bushes
Hedgehog
Buff arches moth
Badger

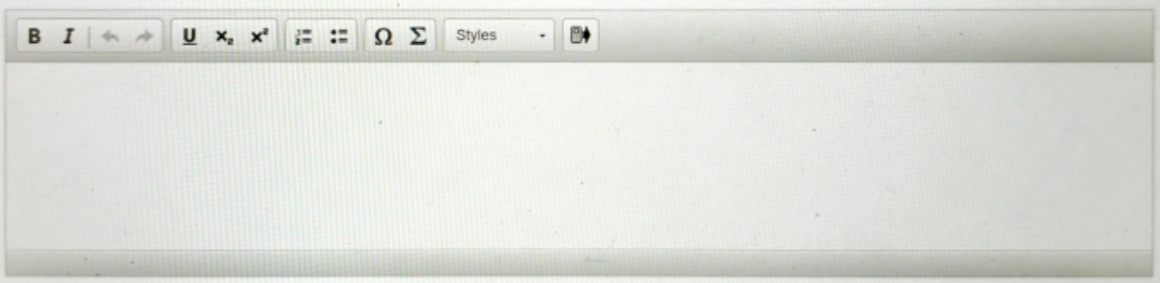

Question 1a (1 mark)
State the name of an omnivore from the food web in the diagram above.
Styles

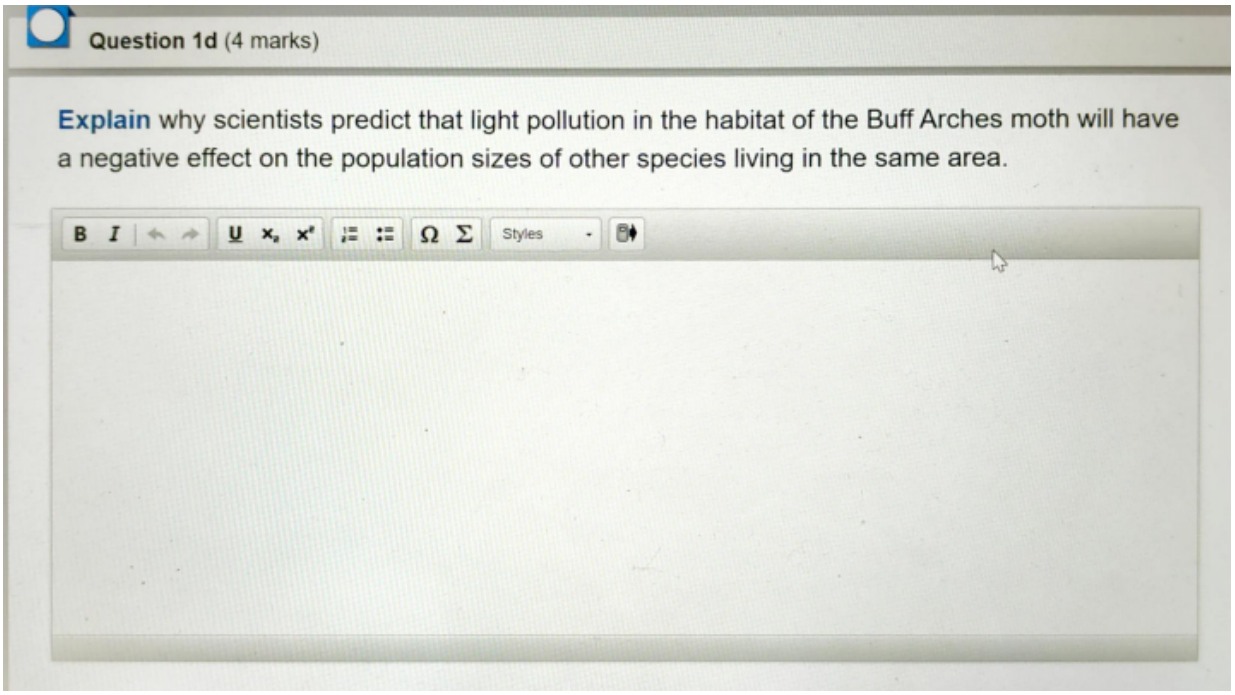

Question 1b (3 marks)
Use the food web above to construct the food chain that consists of four species, including the Buff Arches moth. The final stage has already been completed.
Select → Select → Select → Badger
Select
Brown bat
Buff Arches moth
Fly
Fruit bush
Great tit
Hedgehog
Sparrow hawk
th lays its eggs, finds its food and interacts with other moths in the dark. It

Question 1c (1 mark)

The Buff Arches moth lays its eggs, finds its food and interacts with other moths in the dark. It lives in areas where light pollution is increasing every year. Modern street lights especially seem to have a negative effect on the population size of these moths.

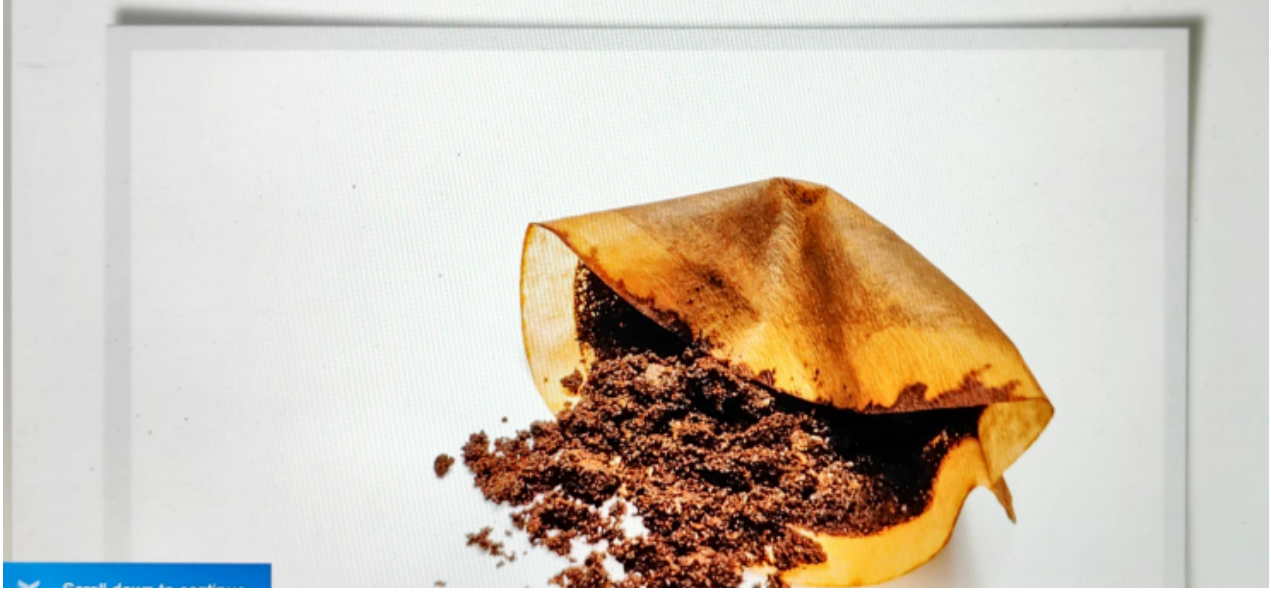
Suggest why modern street lights are causing a reduction in moth population size.

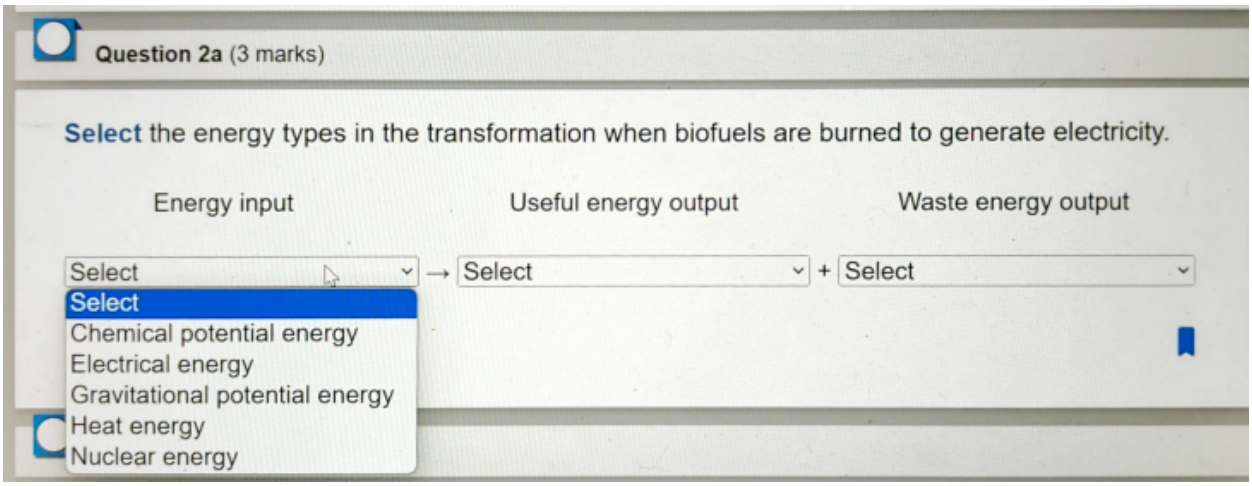


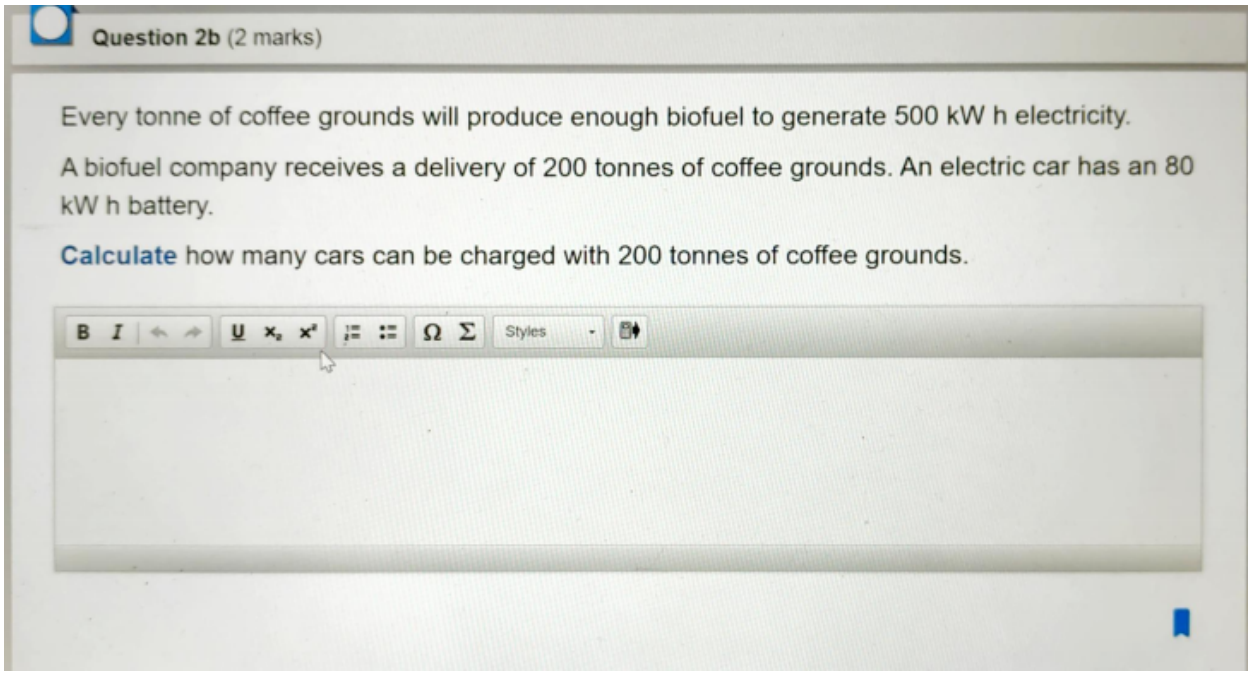

Question 1d (4 marks)
Explain why scientists predict that light pollution in the habitat of the Buff Arches moth will have a negative effect on the population sizes of other species living in the same area.
Styles

Question 2 (9 marks)

Coffee grounds are left over when coffee beans are used to make coffee. The coffee grounds can be processed into biofuels. These biofuels can then be burned to generate electricity.




Question 2a (3 marks)
Select the energy types in the transformation when biofuels are burned to generate electricity.
Energy input
Useful energy output
Waste energy output
Select
→
Select
+
Select
Select
Chemical potential energy
Electrical energy
Gravitational potential energy
Heat energy
Nuclear energy

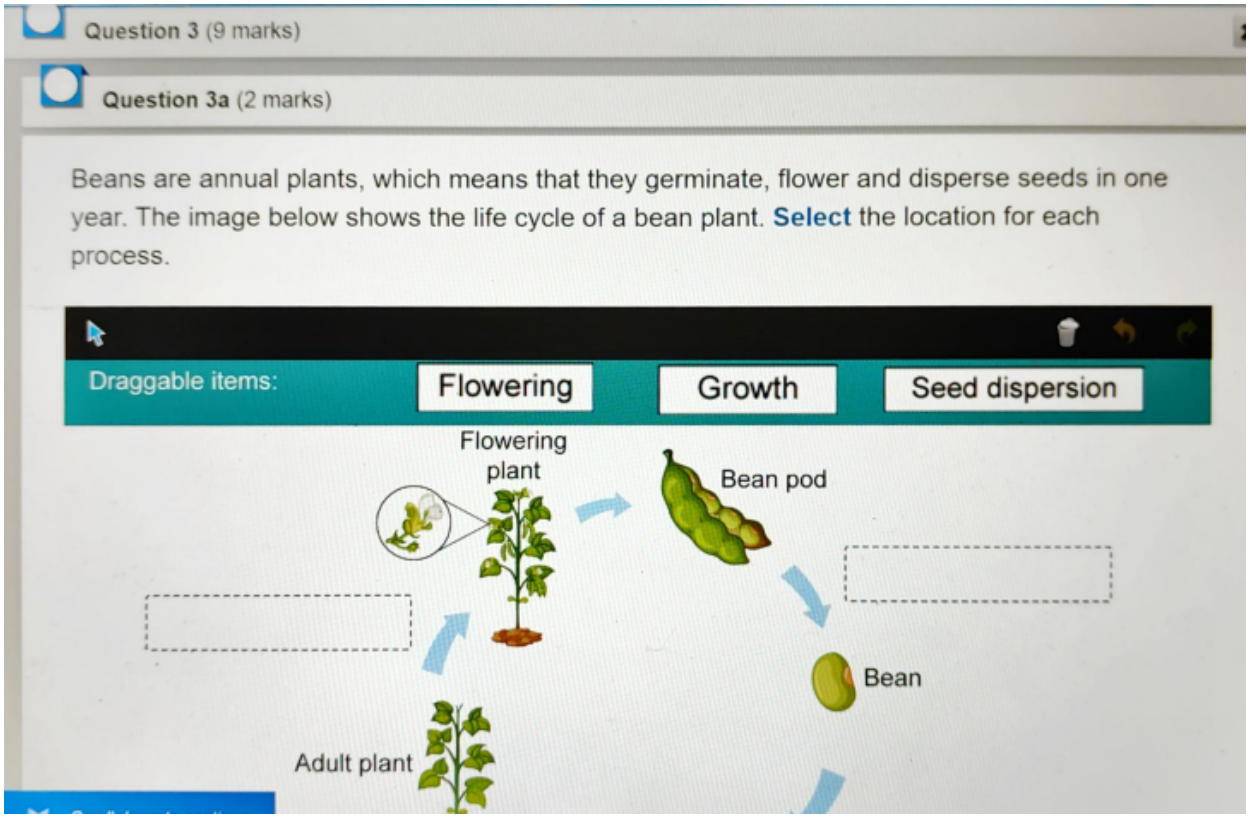

Question 2b (2 marks)
Every tonne of coffee grounds will produce enough biofuel to generate 500 kW h electricity.
A biofuel company receives a delivery of 200 tonnes of coffee grounds. An electric car has an 80 kW h battery.
Calculate how many cars can be charged with 200 tonnes of coffee grounds.
Styles

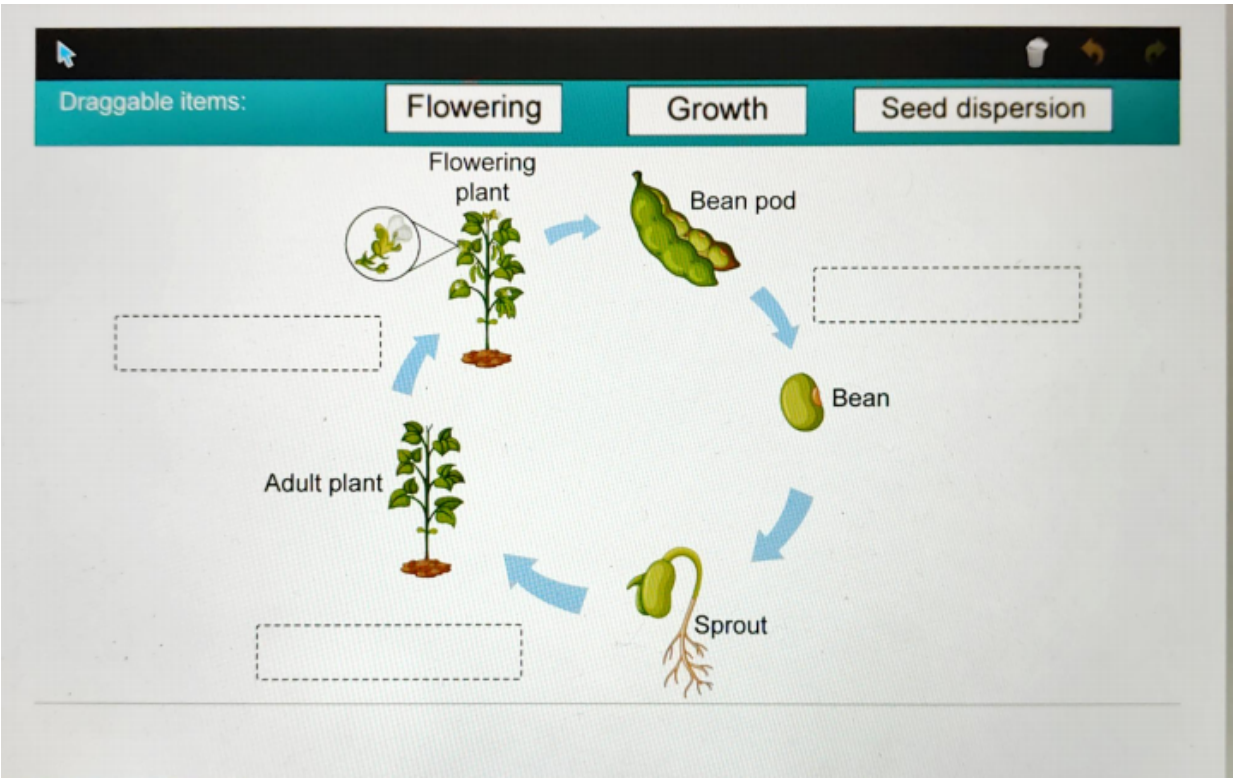
Question 2c (4 marks)

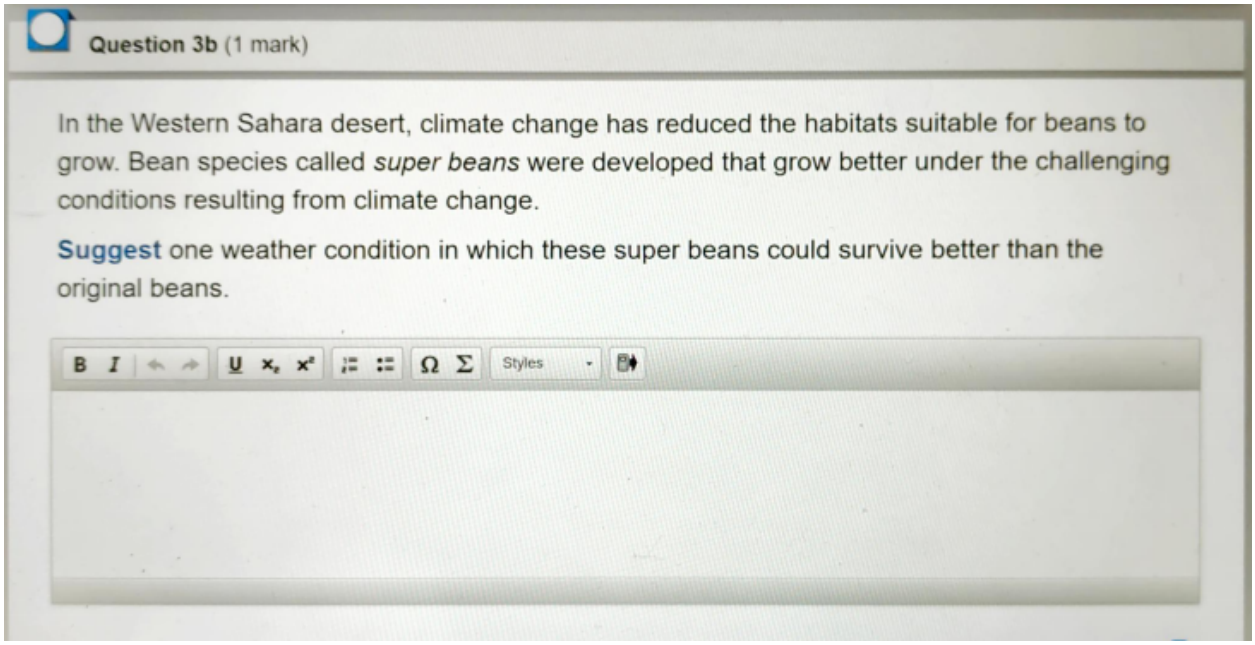
Another source of biofuel is corn. This is an energy and protein rich crop that is often used for animal feed. The electricity produced per tonne for coffee grounds and corn is shown in the table below.

Biofuel source	Electricity produced per tonne of biofuel / kW h
Coffee grounds	500
Corn	335

Using data from the table, **discuss** which biofuel source would be the most suitable for use with electric cars.

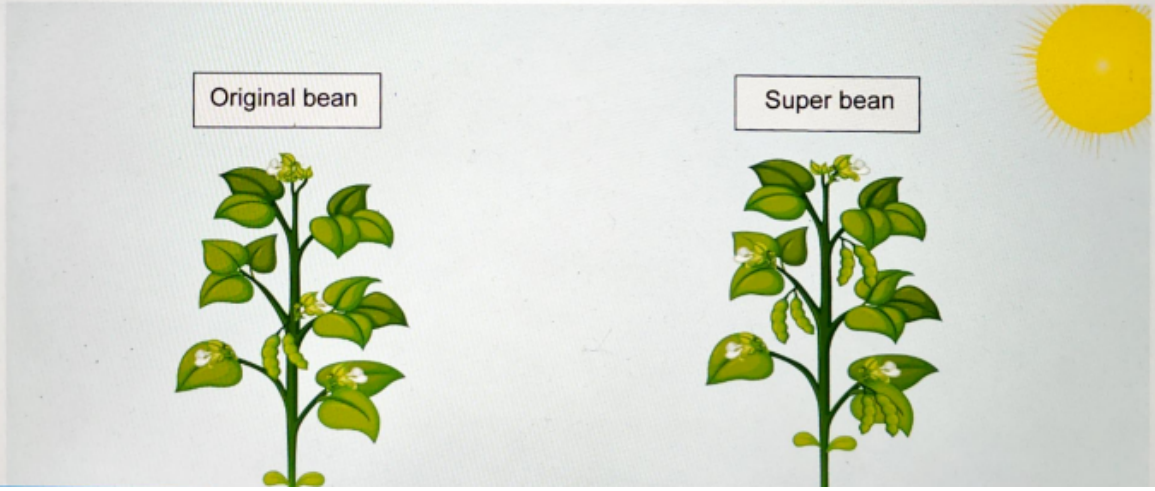

Question 3 (9 marks)
Question 3a (2 marks)
Beans are annual plants, which means that they germinate, flower and disperse seeds in one year. The image below shows the life cycle of a bean plant. Select the location for each process.
Draggable items:
Flowering
Growth
Seed dispersion
Flowering plant
Bean pod
Bean
Adult plant


Draggable items:
Flowering
Growth
Seed dispersion
Flowering plant
Bean pod
Bean
Sprout
Adult plant


Question 3b (1 mark)
In the Western Sahara desert, climate change has reduced the habitats suitable for beans to grow. Bean species called *super beans* were developed that grow better under the challenging conditions resulting from climate change.
Suggest one weather condition in which these super beans could survive better than the original beans.
Styles

Question 3c (3 marks)

One of the ways in which the super beans grown in the desert were adapted is shown in the images below. The adaptation leads to a much greater harvest compared to the original bean plant species.



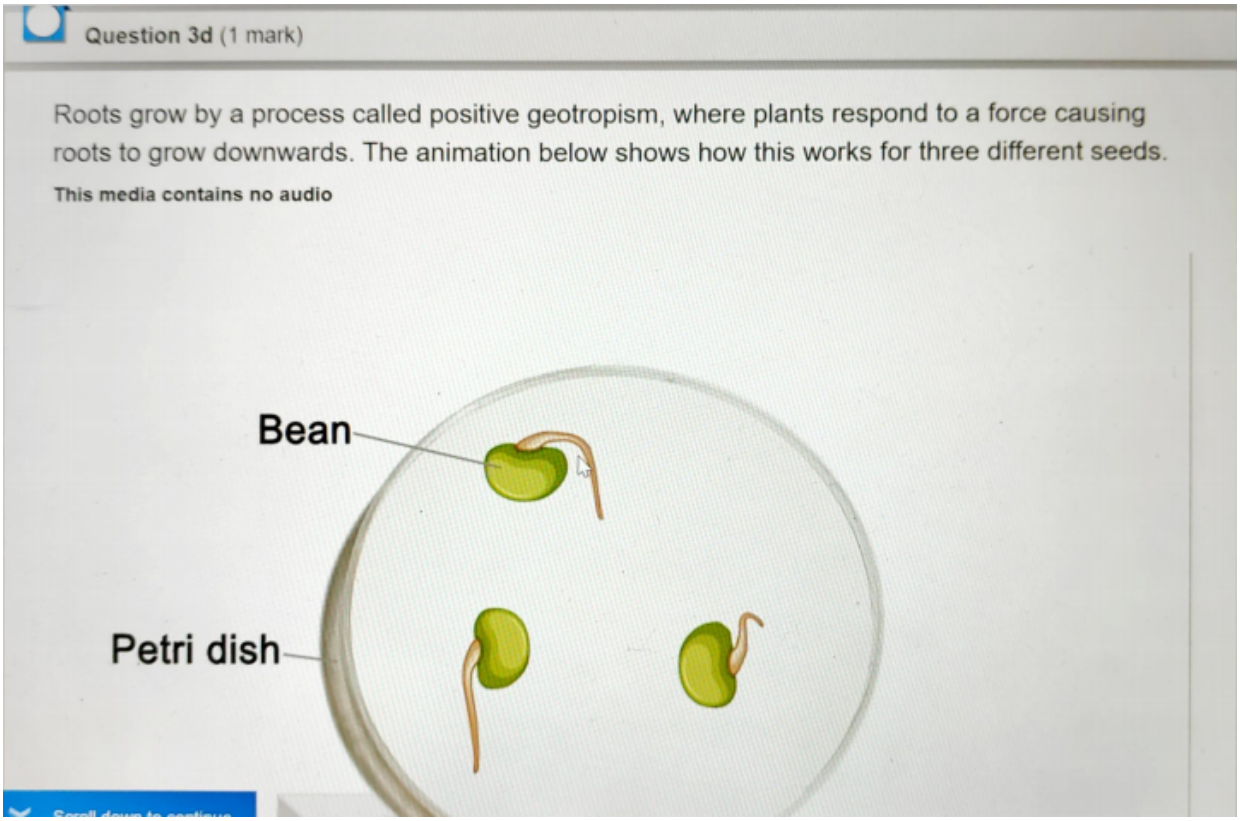
Using the image, **state** one adaptation in the super bean plants. **Justify** how this adaptation increases the harvest.

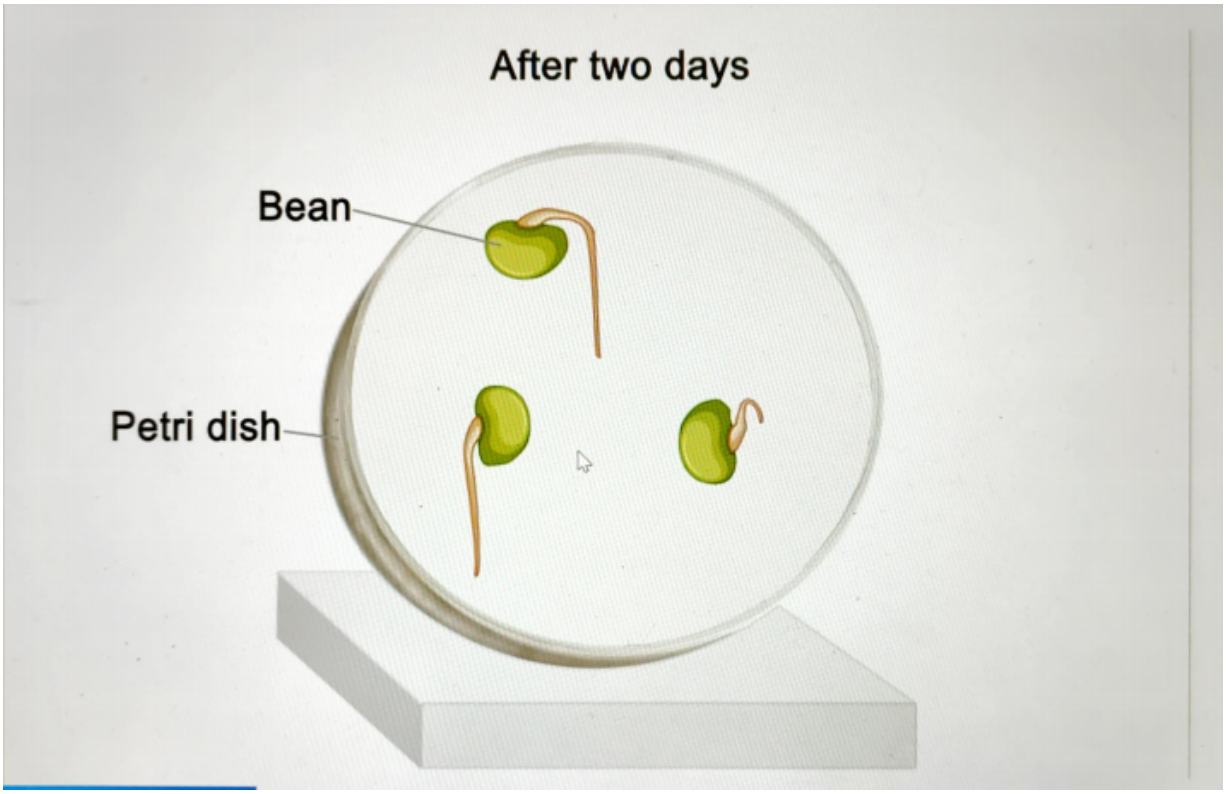
Adaptation	Justification

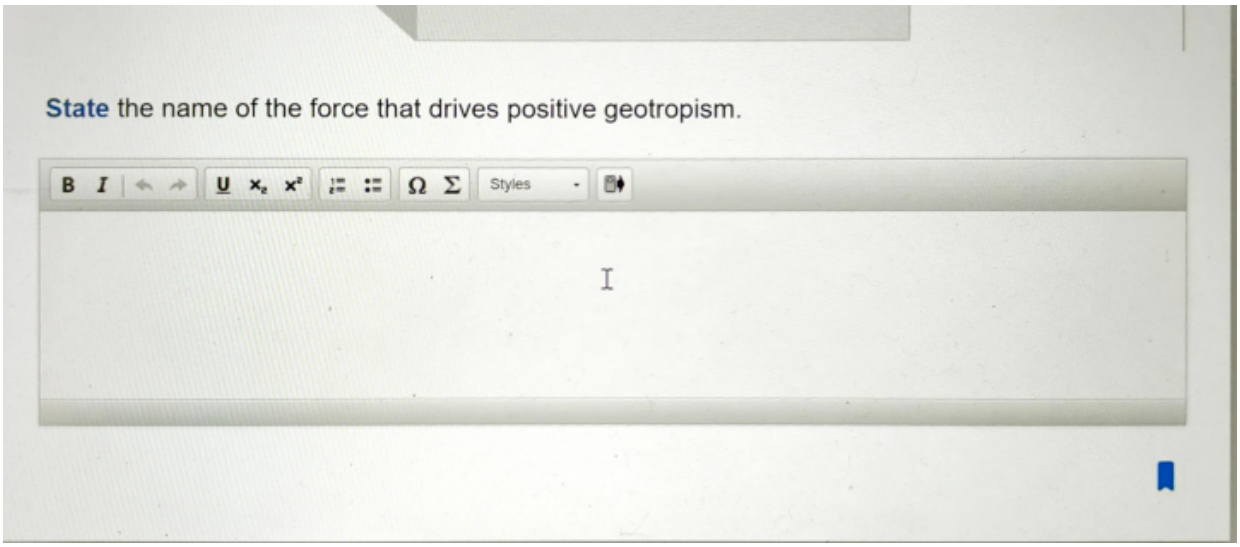
Question 3d (1 mark)

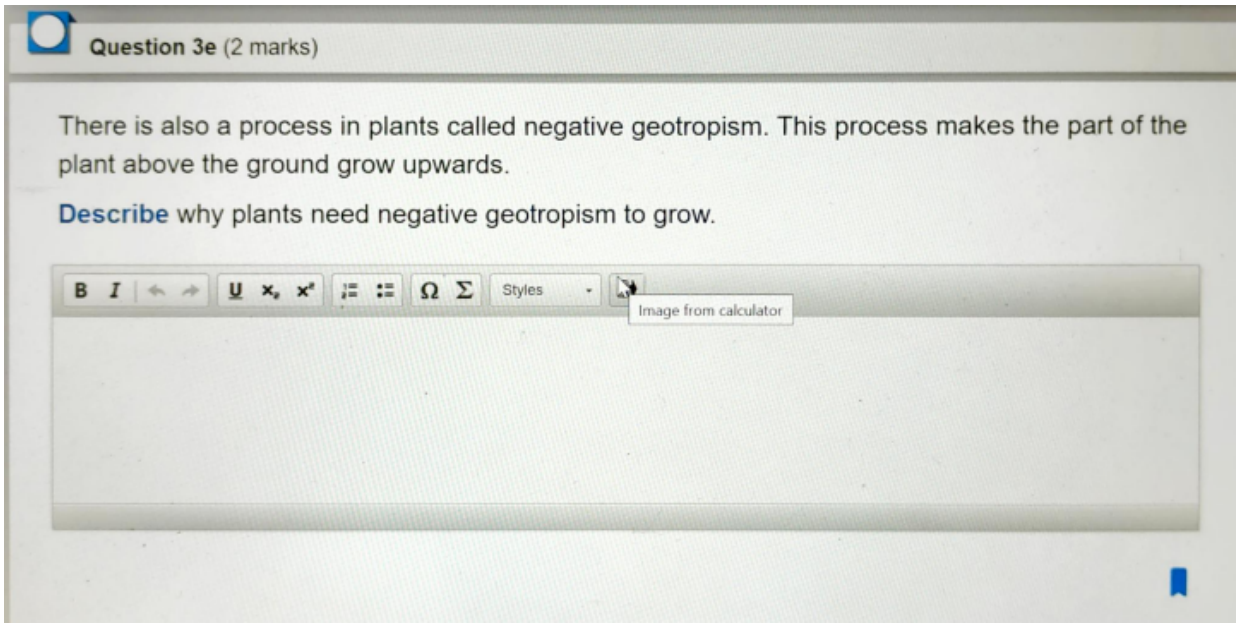
Roots grow by a process called positive geotropism, where plants respond to a force causing roots to grow downwards. The animation below shows how this works for three different seeds.

This media contains no audio



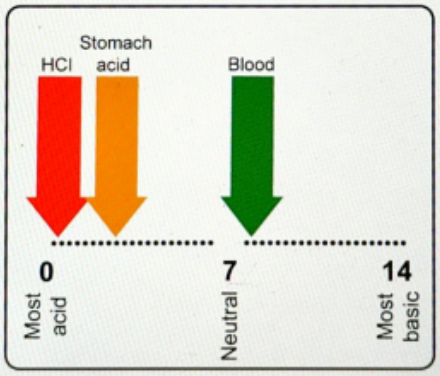

After two days
Bean
Petri dish

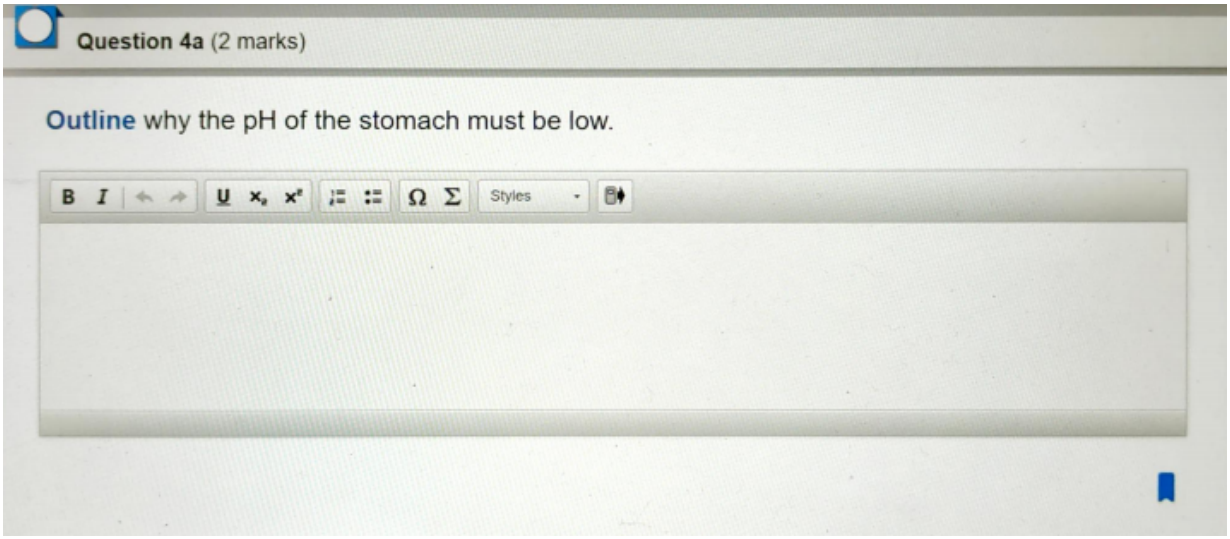

State the name of the force that drives positive geotropism.
Styles


Question 3e (2 marks)
There is also a process in plants called negative geotropism. This process makes the part of the plant above the ground grow upwards.
Describe why plants need negative geotropism to grow.
Styles
Image from calculator

Question 4 (31 marks)

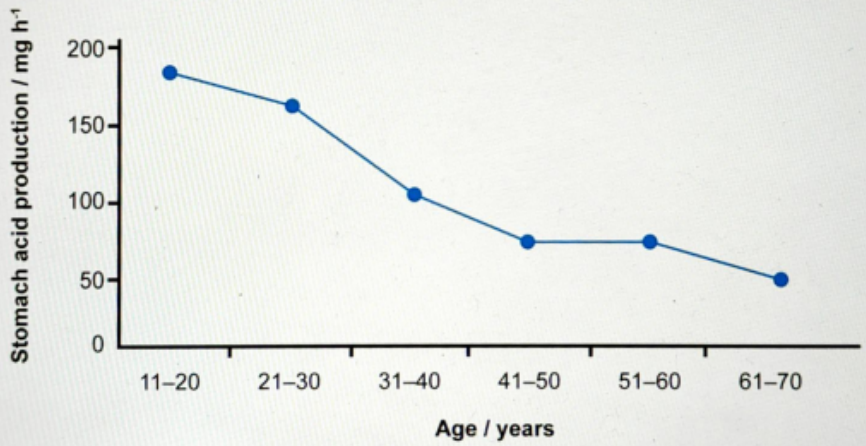
pH is a measure of how acidic or basic a solution is. The pH scale ranges from 0 to 14. Solutions with a pH less than 7 are acidic, those with a pH greater than 7 are basic and those with a pH of 7 are neutral. The human body has an average natural pH of 7.4. This pH is needed for the body to function properly. Some parts of the digestive system have a lower pH. The stomach is a reservoir of strong acid, with a much lower pH than any other part of the body.



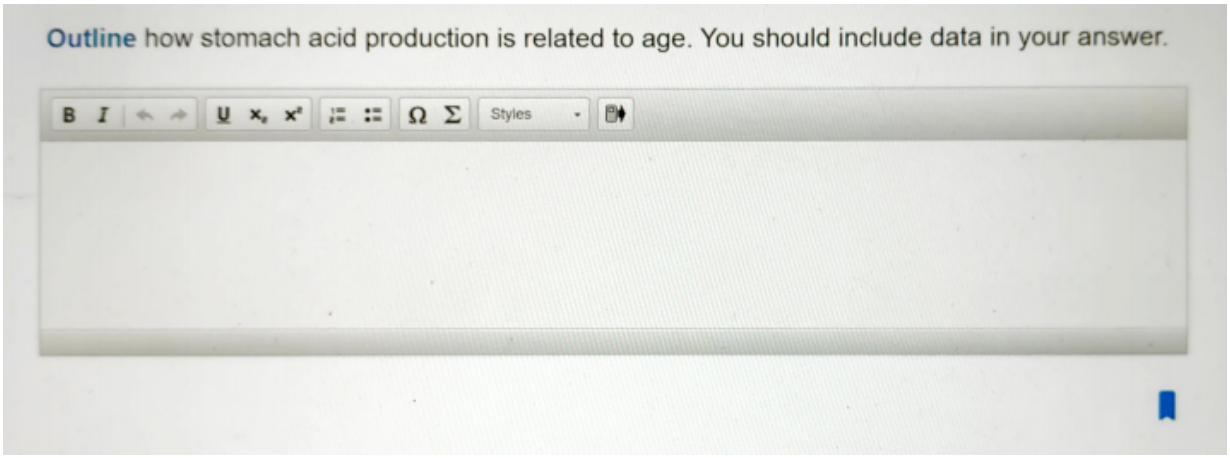

Question 4a (2 marks)
Outline why the pH of the stomach must be low.
Styles

Question 4b (2 marks)

Stomach acid production can change with age, as shown in the graph below.



Outline how stomach acid production is related to age. You should include data in your answer.

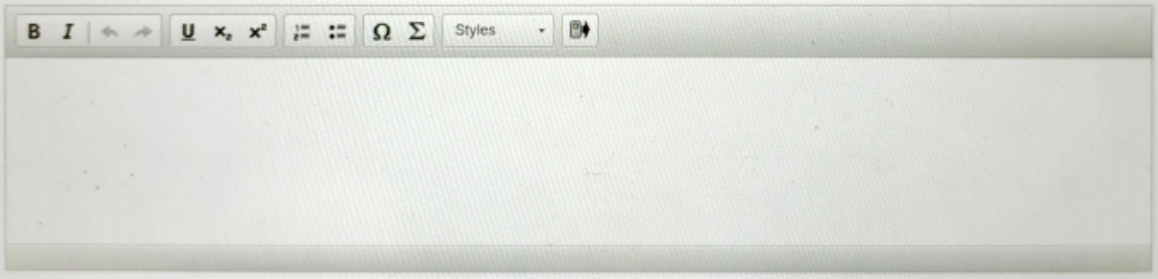

Outline how stomach acid production is related to age. You should include data in your answer.
Styles

Question 4c (1 mark)

Sometimes your stomach can produce too much acid, which can lead to a burning sensation called heartburn. Heartburn can be treated with medicines called antacids. Antacids contain sodium hydrogen carbonate, $NaHCO_3$, which can act as a base. The antacid reacts with hydrochloric acid present in the stomach fluids, according to the following equation:

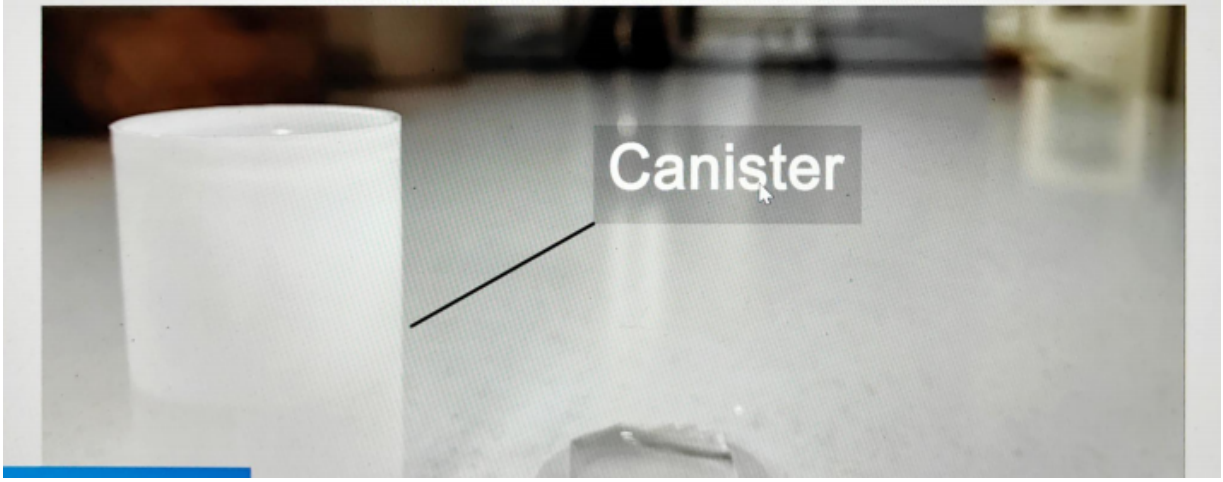
sodium hydrogen carbonate + hydrochloric acid → sodium chloride + carbon dioxide + water

State why stomach acidity decreases when antacids are taken.



Question 4d (4 marks)

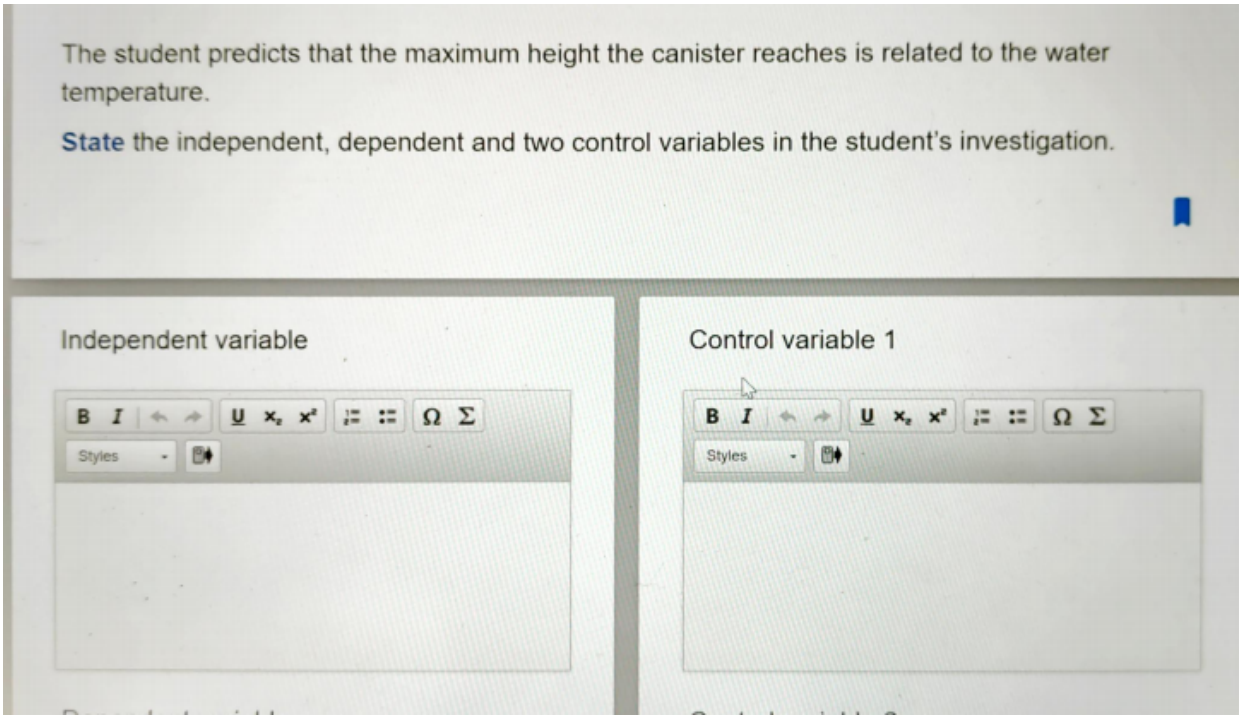
Antacids usually come in the form of a solid tablet that is easily dissolved in water. As well as containing sodium hydrogen carbonate, some antacids also contain citric acid. When you drop the tablet in water, a reaction happens which releases carbon dioxide that makes a fizz. An MYP student wants to use the released carbon dioxide to launch a canister.



The student predicts that the maximum height the canister reaches is related to the water


CO_2 gas


Replay


The student predicts that the maximum height the canister reaches is related to the water temperature.
State the independent, dependent and two control variables in the student's investigation.
Independent variable
Styles
Control variable 1
Styles

Question 4e (15 marks)

You are provided with standard laboratory equipment and the following items:

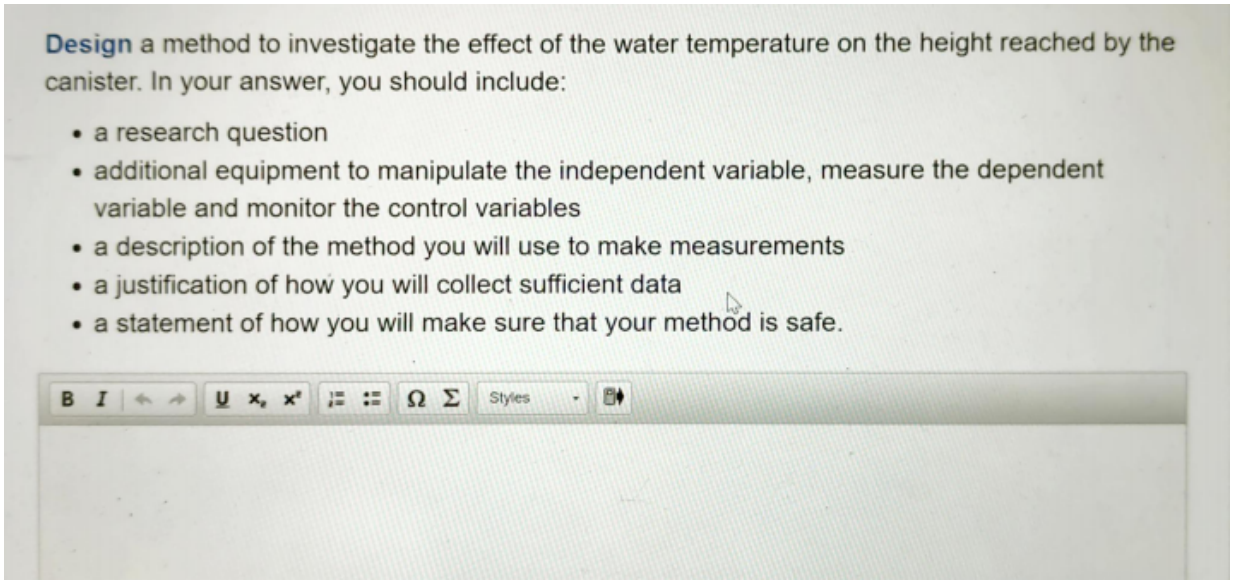
Canisters 35 cm^3

Electric kettle

Measuring cylinder
50 cm^3

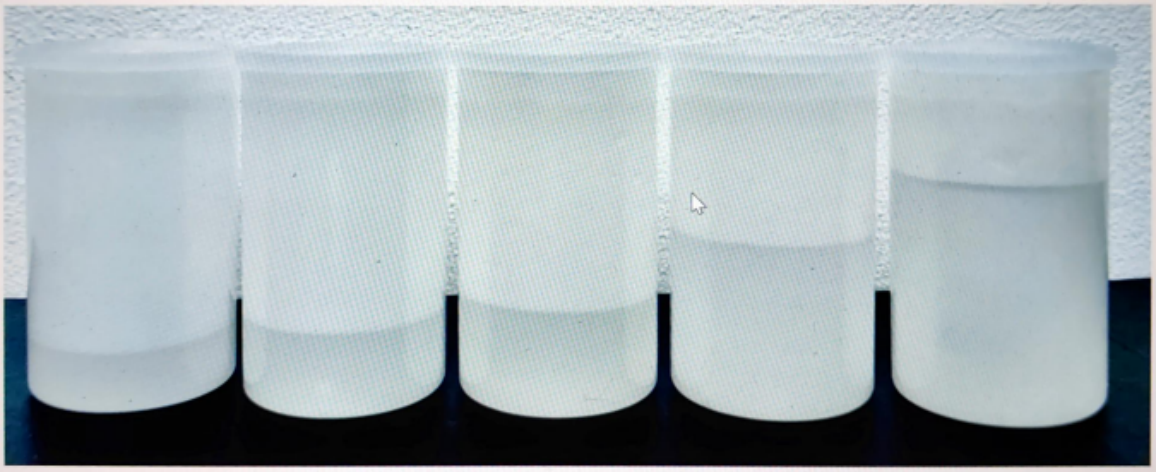
Water

Design a method to investigate the effect of the water temperature on the height reached by the canister. In your answer, you should include:


Design a method to investigate the effect of the water temperature on the height reached by the canister. In your answer, you should include:
• a research question
• additional equipment to manipulate the independent variable, measure the dependent variable and monitor the control variables
• a description of the method you will use to make measurements
• a justification of how you will collect sufficient data
• a statement of how you will make sure that your method is safe.
Styles

Question 4f (5 marks)

Another MYP student wanted to extend this investigation. They used the volume of water as the independent variable. The canister had a total volume of 35 cm^3. The student carried out trials using 10, 14, 18, 25 and 30 cm^3 of water.



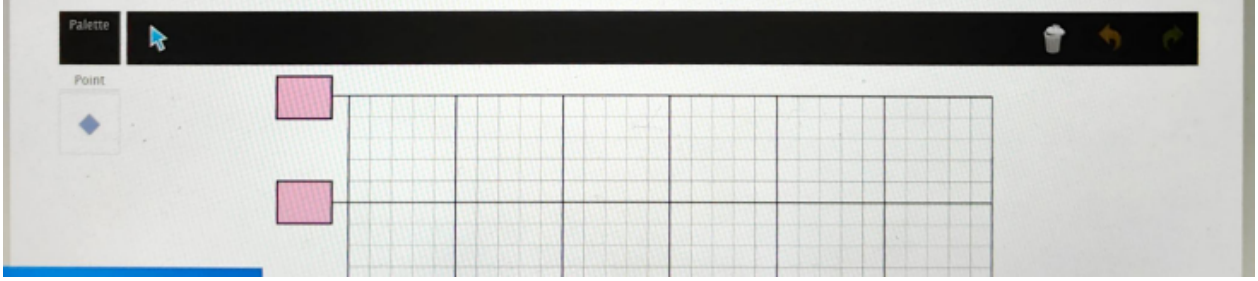
The student's average data is in the table below:

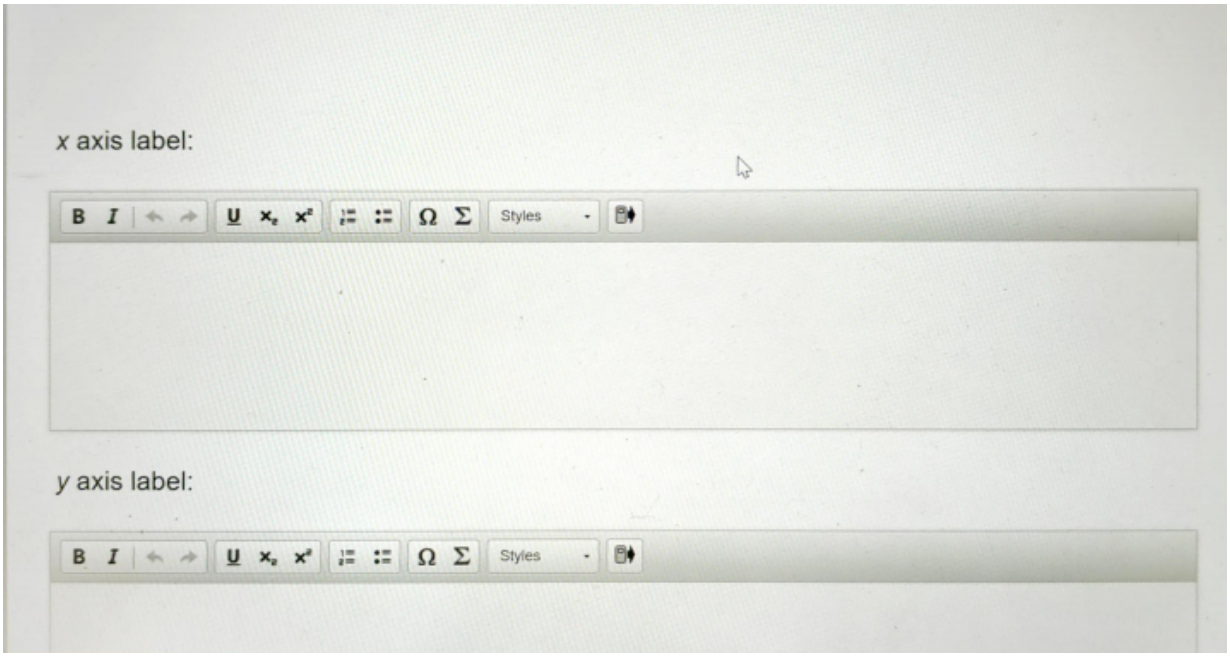
The student's average data is in the table below:

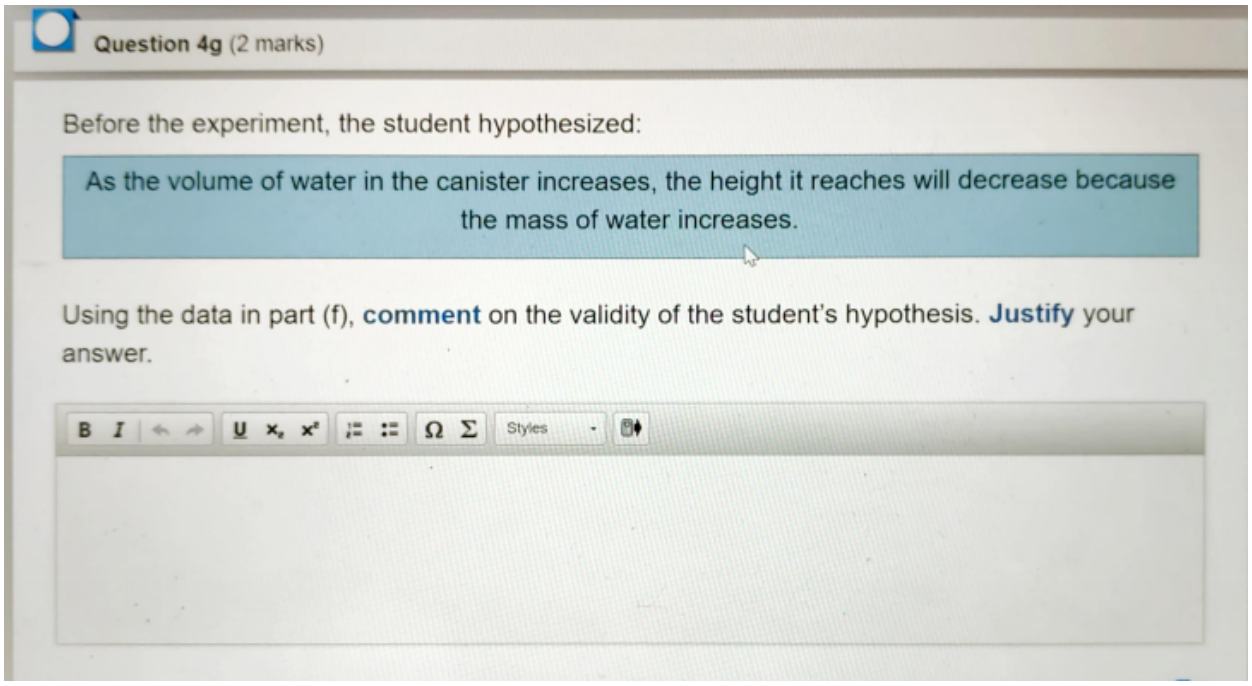
Volume of water / cm^3	Height / m
10	1.6
14	1.5
18	1.9
25	1.7
30	1.8

Present the student's data in a graph.

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

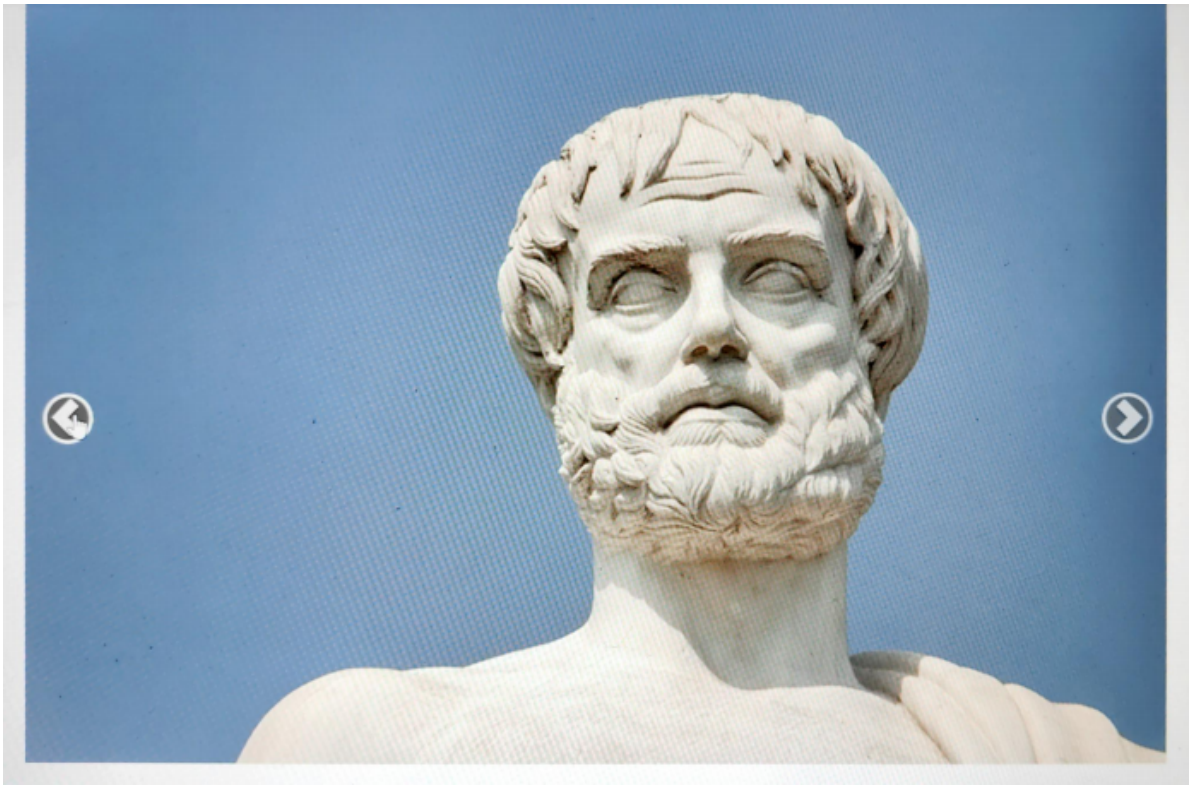



x axis label:
Styles
y axis label:
Styles


Question 4g (2 marks)
Before the experiment, the student hypothesized:
As the volume of water in the canister increases, the height it reaches will decrease because the mass of water increases.
Using the data in part (f), comment on the validity of the student's hypothesis. Justify your answer.
Styles

Question 5 (19 marks)

Marble is a rock made of 98% calcium carbonate ($CaCO_3$) and 2% other compounds. Because of its colour, resistance and appearance, marble is used in statues and in the home for building walls, floors and tabletops.



Question 5a (2 marks)

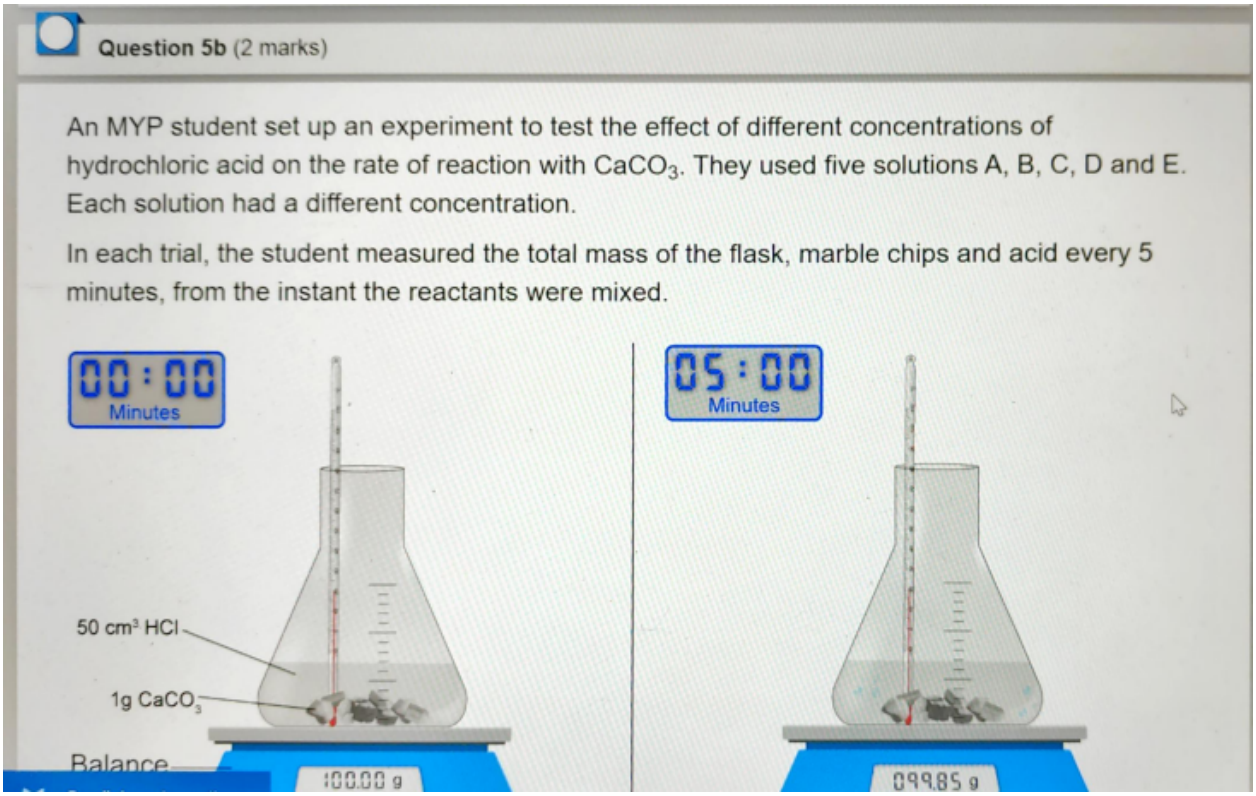
Select options to balance the equation for the reaction of calcium carbonate with hydrochloric acid.

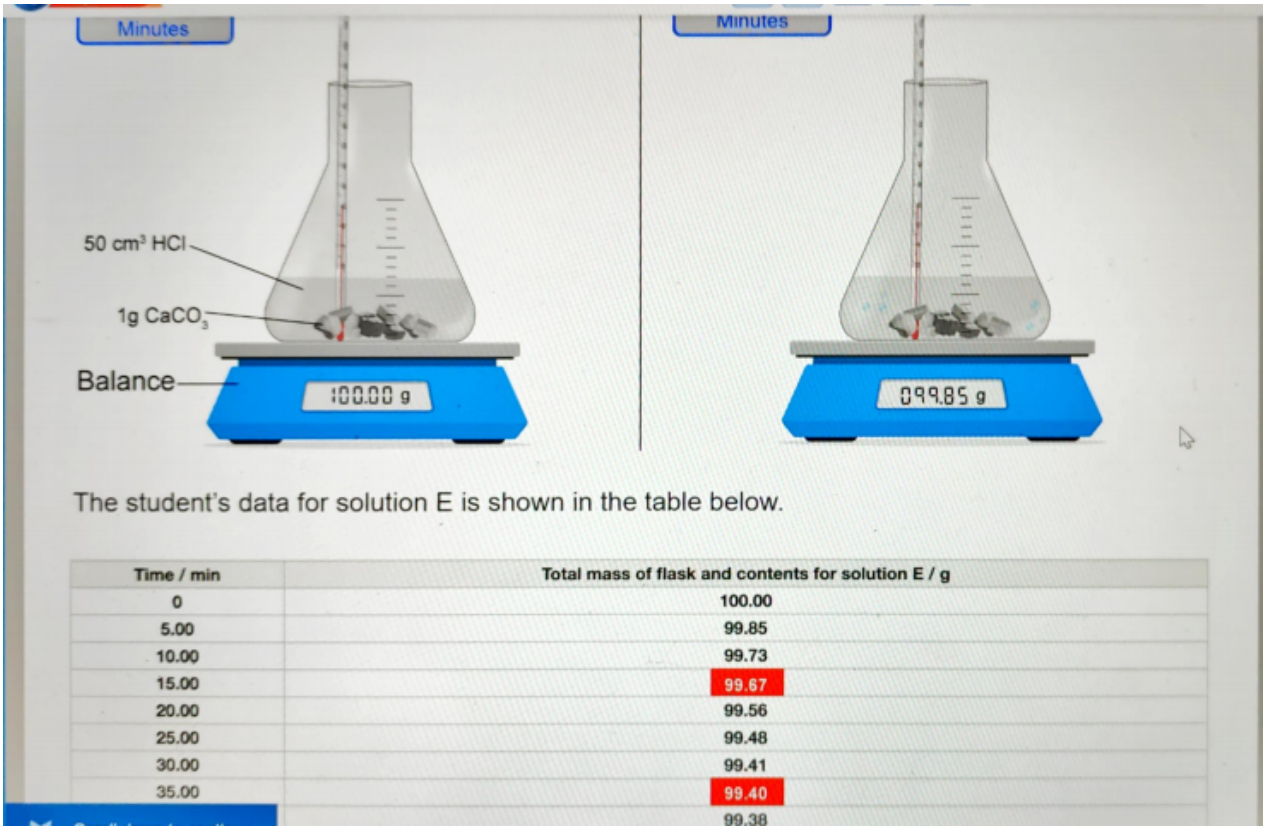
$$\text{?}\ CaCO_3(s) + \text{?}\ HCl(aq) \rightarrow CaCl_2(aq) + CO_2(g) + H_2O(l)$$

Question 5b (2 marks)

An MYP student set up an experiment to test the effect of different concentrations of hydrochloric acid on the rate of reaction with $CaCO_3$. They used five solutions A, B, C, D and E. Each solution had a different concentration.

In each trial, the student measured the total mass of the flask, marble chips and acid every 5 minutes, from the instant the reactants were mixed.





The student's data for solution E is shown in the table below.

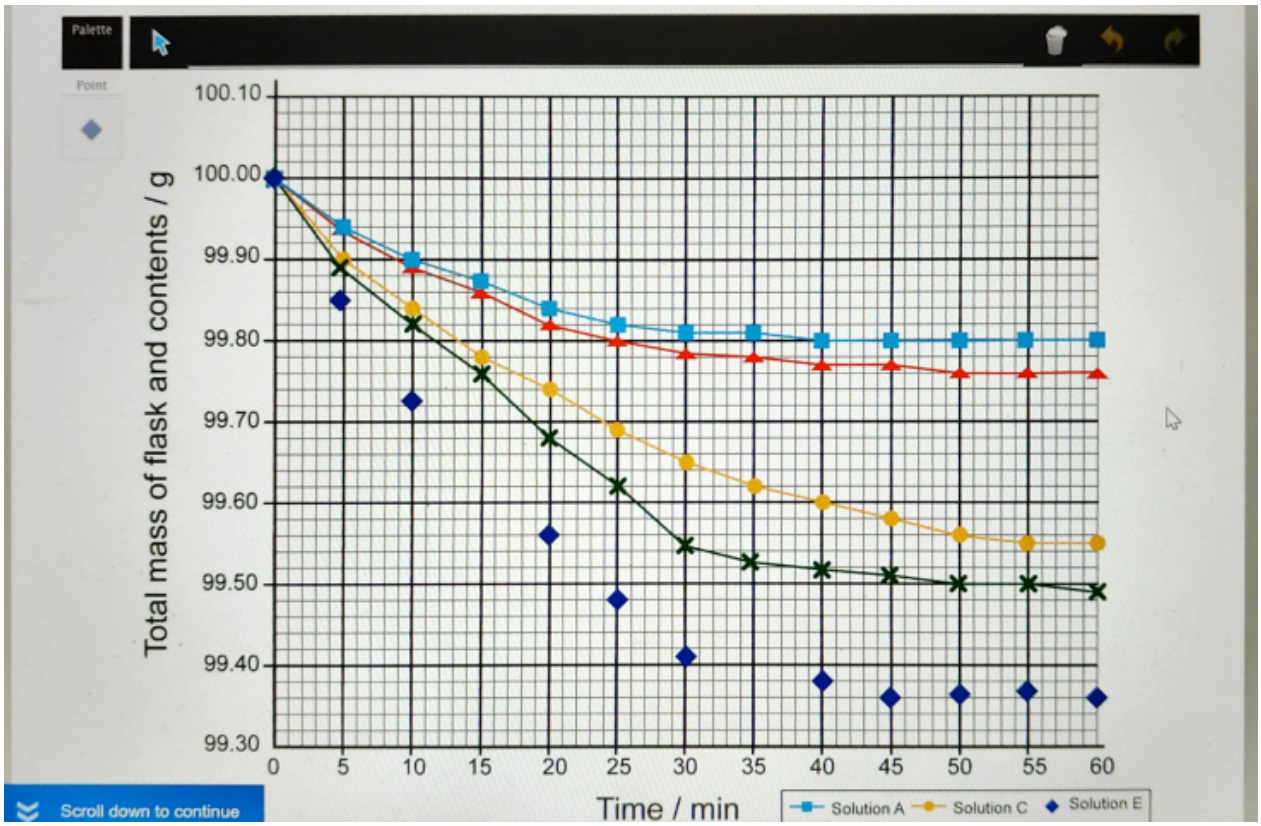
Time / min	Total mass of flask and contents for solution E / g
0	100.00
5.00	99.85
10.00	99.73
15.00	99.67
20.00	99.56
25.00	99.48
30.00	99.41
35.00	99.40
	99.38

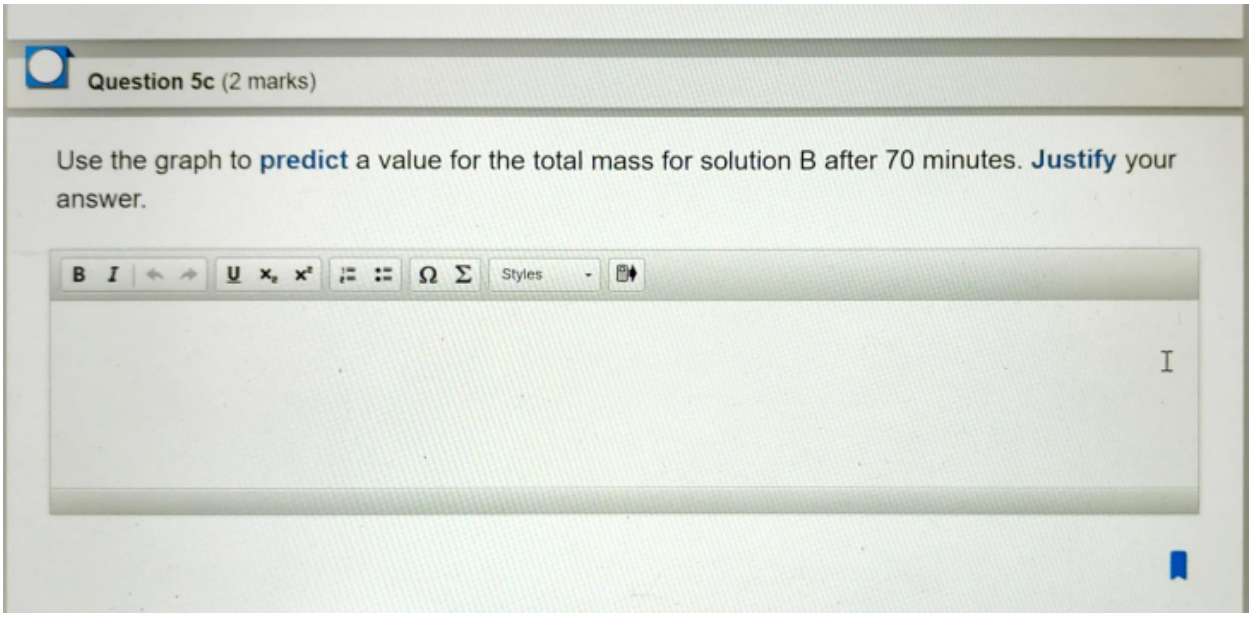
The student's data for solution E is shown in the table below.

Time / min	Total mass of flask and contents for solution E / g
0	100.00
5.00	99.85
10.00	99.73
15.00	99.67
20.00	99.56
25.00	99.48
30.00	99.41
35.00	99.40
40.00	99.38
45.00	99.36
50.00	99.37
55.00	99.37
60.00	99.36

The student plotted their data in a graph. Some of the data for solution E is missing from the graph. **Plot** the missing data points highlighted in the table to complete the graph.

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


Palette
Point
Total mass of flask and contents / g
100.10
100.00
99.90
99.80
99.70
99.60
99.50
99.40
99.30
0
5
10
15
20
25
30
35
40
45
50
55
60
Time / min
Solution A
Solution C
Solution E
Scroll down to continue


Question 5c (2 marks)
Use the graph to predict a value for the total mass for solution B after 70 minutes. Justify your answer.
Styles

Question 5d (2 marks)

For this reaction, rate can be defined as:

$$\text{rate of reaction} = \frac{\text{mass of } CO_2 \text{ lost}}{\text{time}}$$

The starting mass was 100g. Using data from the graph, **calculate** the rate of reaction for the first five minutes for solution D.

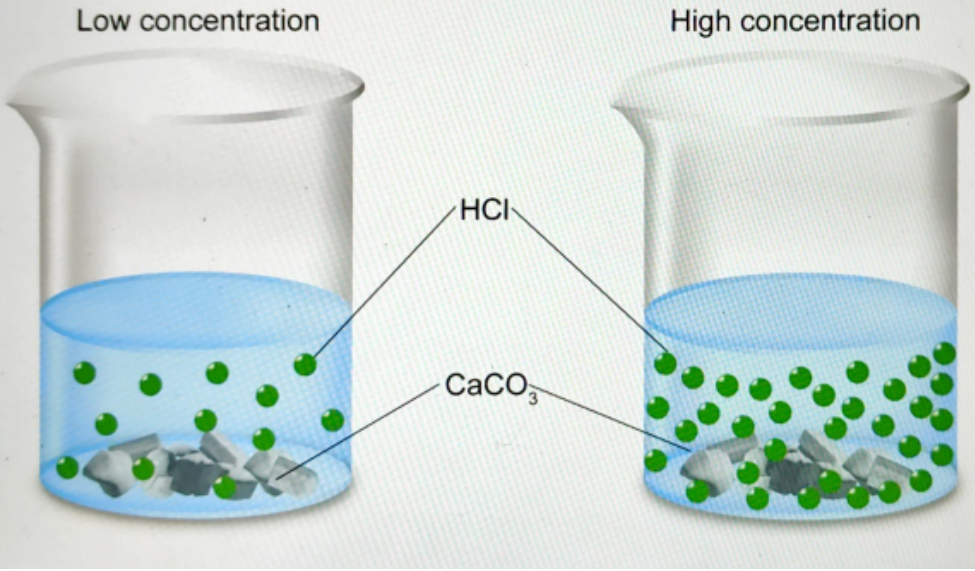
Question 5e (1 mark)

The rate of reaction for the first five minutes for solution B is 0.01 g min^{-1}. Using your answer from part (d) and the graph in part (b), **identify** which of the five solutions has the highest concentration.

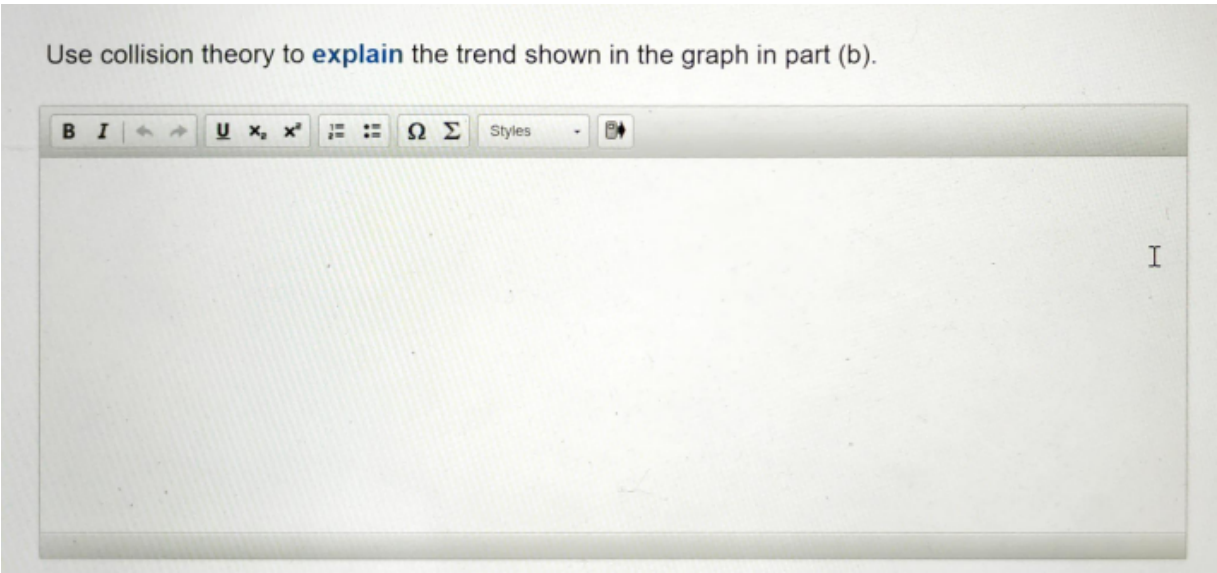
- ○ Solution A
- ○ Solution B
- ○ Solution C
- ○ Solution D
- ○ Solution E

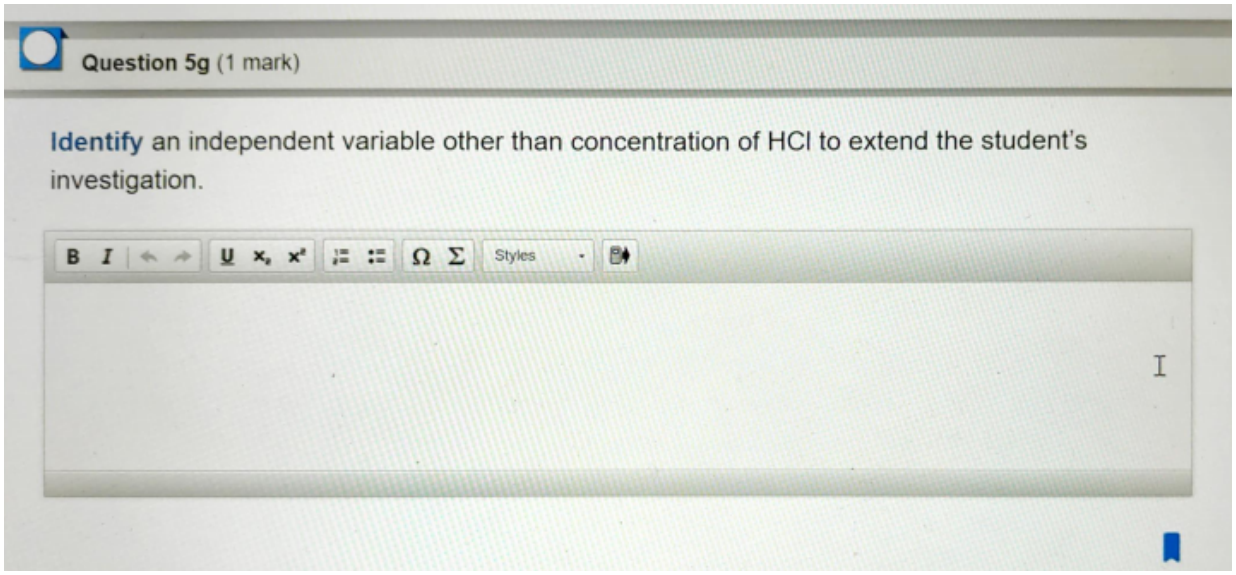
Question 5f (4 marks)

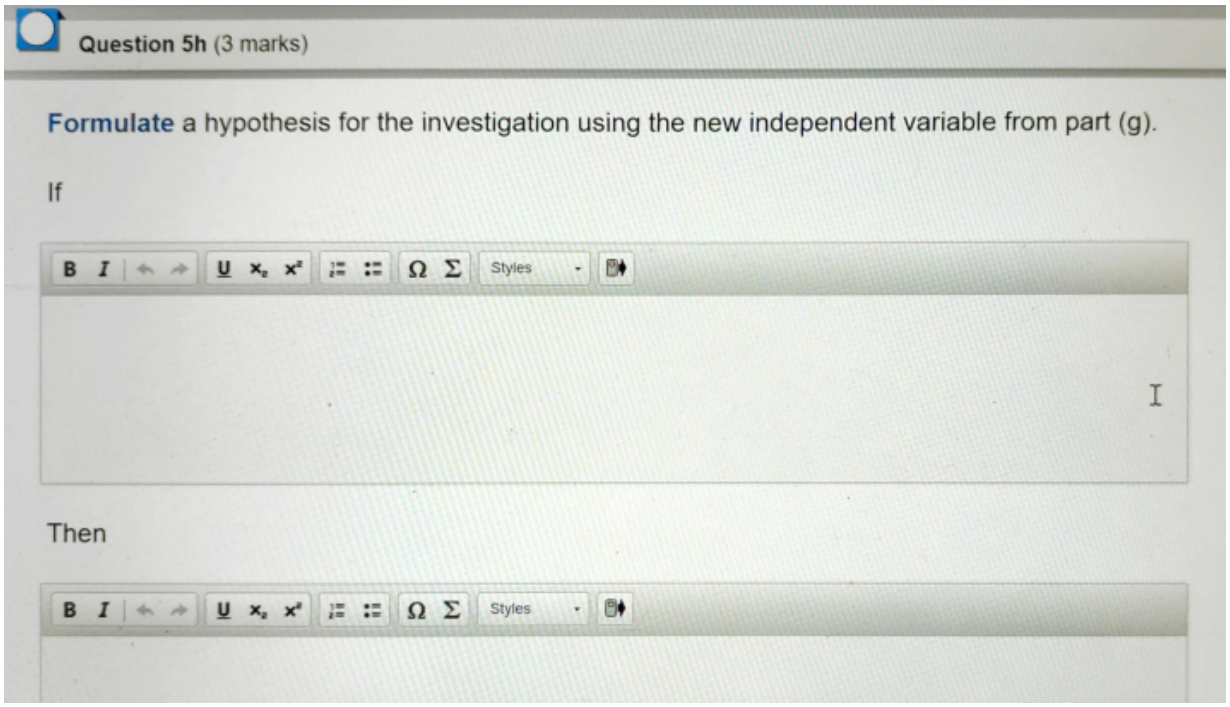
Reactions happen when particles collide. This is known as collision theory. The following diagrams represent $CaCO_3$ in solutions of HCl at different concentrations.



Use collision theory to **explain** the trend shown in the graph in part (b).

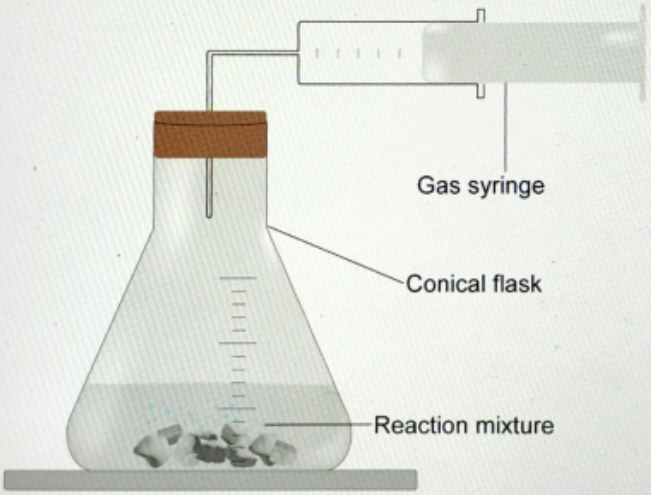


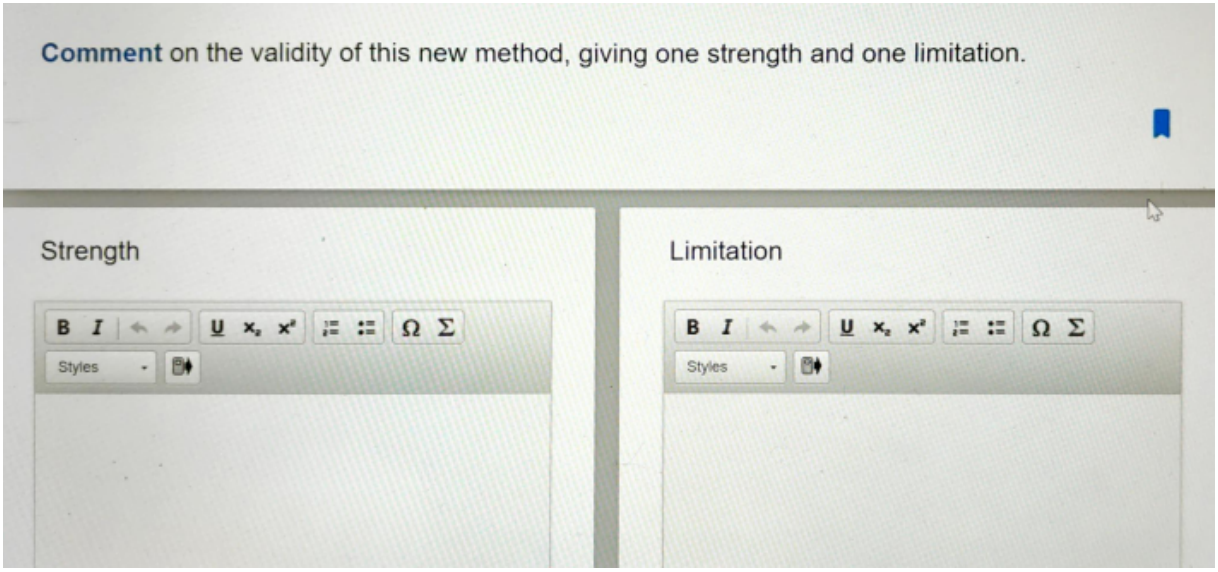

Question 5g (1 mark)
Identify an independent variable other than concentration of HCl to extend the student's investigation.
Styles

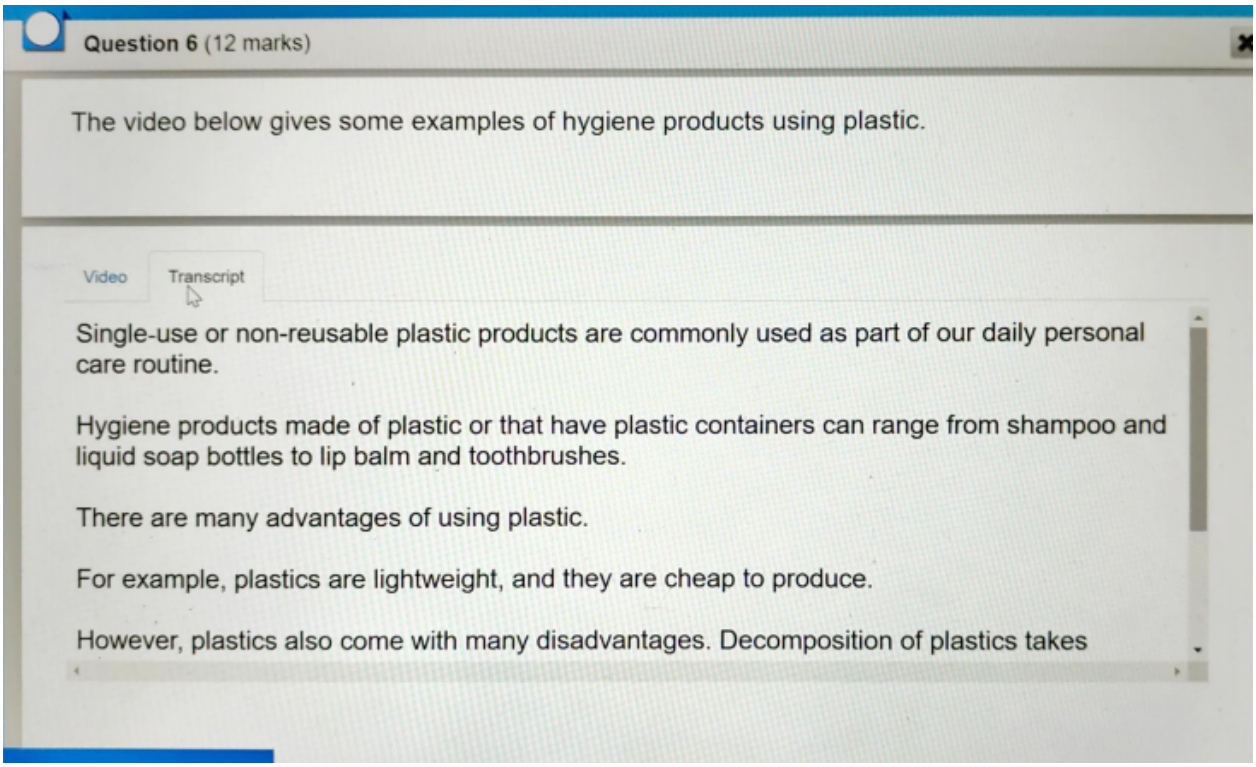

Question 5h (3 marks)
Formulate a hypothesis for the investigation using the new independent variable from part (g).
If
Styles
Then
Styles

Question 5i (2 marks)

Another student used the following setup to investigate the rate of reaction by measuring the volume of CO_2 gas produced.




Comment on the validity of this new method, giving one strength and one limitation.
Strength
Styles
Limitation
Styles


Question 6 (12 marks)
The video below gives some examples of hygiene products using plastic.
Video
Transcript
Single-use or non-reusable plastic products are commonly used as part of our daily personal care routine.
Hygiene products made of plastic or that have plastic containers can range from shampoo and liquid soap bottles to lip balm and toothbrushes.
There are many advantages of using plastic.
For example, plastics are lightweight, and they are cheap to produce.
However, plastics also come with many disadvantages. Decomposition of plastics takes

Question 6 (12 marks)

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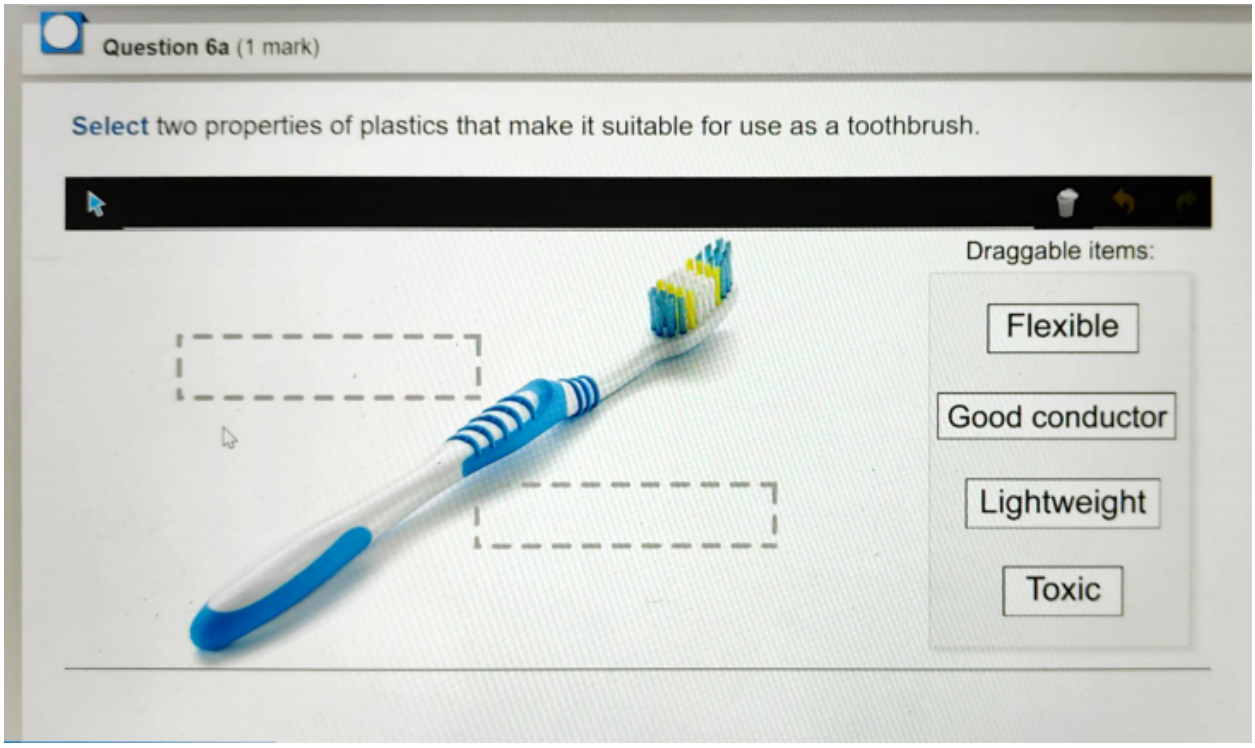
Video | Transcript

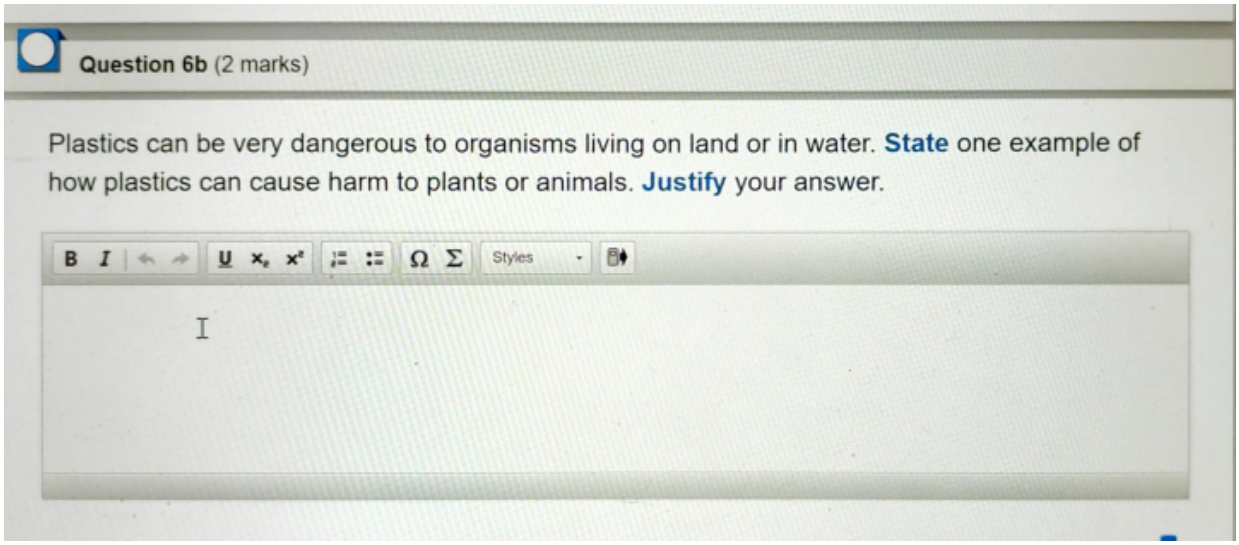
There are many advantages of using plastic.

For example, plastics are lightweight, and they are cheap to produce.

However, plastics also come with many disadvantages. Decomposition of plastics takes hundreds of years. Plastics end up negatively affecting plants and animals in their natural habitats.

Although recycling plastics is an option, the cost is very high.
Most of the time, plastic waste ends up stockpiled in landfills, littered by the sides of the road or washed down to nearby rivers, lakes or oceans.


Question 6a (1 mark)
Select two properties of plastics that make it suitable for use as a toothbrush.
Draggable items:
Flexible
Good conductor
Lightweight
Toxic


Question 6b (2 marks)
Plastics can be very dangerous to organisms living on land or in water. State one example of how plastics can cause harm to plants or animals. Justify your answer.
Styles

Question 6c (1 mark)

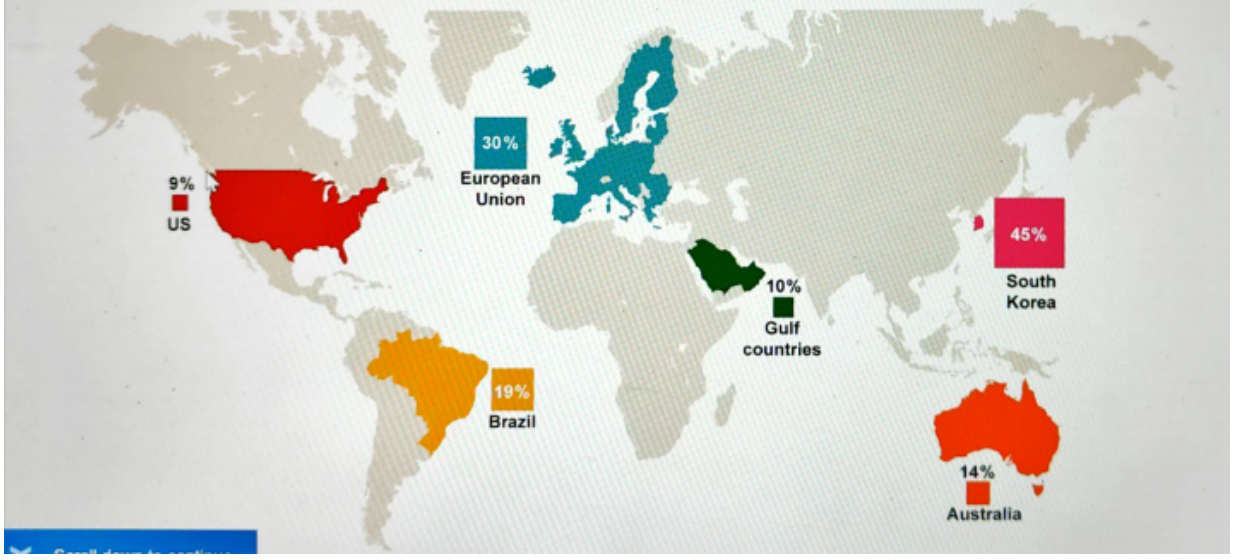
Single-use or non-reusable plastic products are commonly used as part of our daily personal care routine.

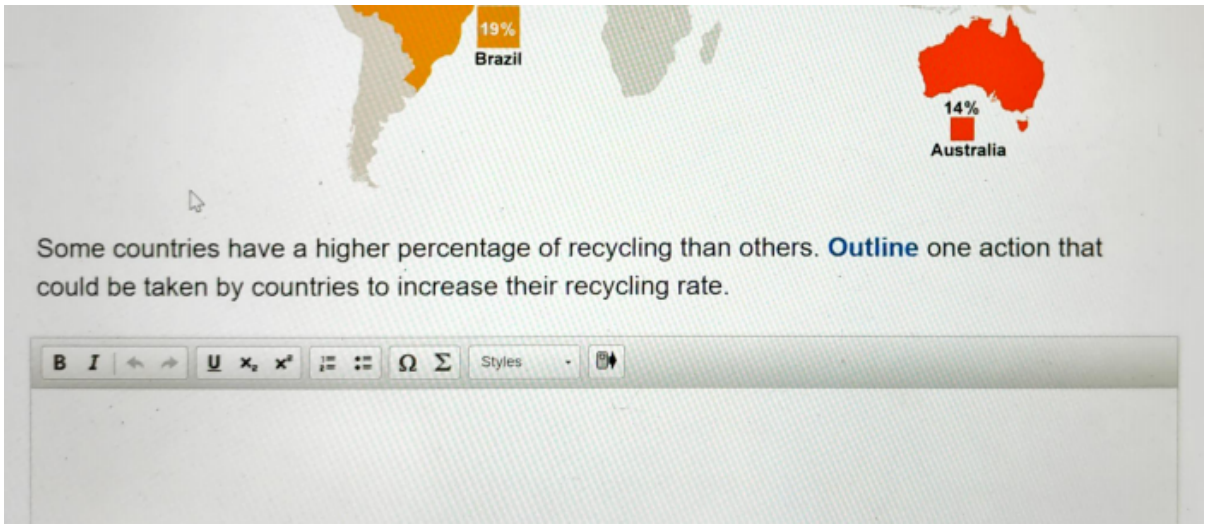
Suggest one advantage of using single-use or non-reusable plastics in hygiene products.

Question 6d (2 marks)

Plastics can be recycled. The map below shows the percentage of plastic waste recycling for a number of countries around the world.

(Data from 2016)




19%
Brazil
14%
Australia
Some countries have a higher percentage of recycling than others. Outline one action that could be taken by countries to increase their recycling rate.
Styles

Question 6e (6 marks)

An environmentally aware student decides to stop using plastic toothbrushes and toothpaste in plastic tubes. The video below gives some information about alternative products.

Video | Transcript

Every year, the UK uses 300 million tubes of toothpaste, the US uses 400 million tubes and Australia uses 50 million tubes.

One way to reduce plastic waste is to stop using plastic toothpaste tubes and instead to buy eco-friendly toothpaste products.

An eco-friendly toothpaste has a plastic-free container made of glass or paper. The regular toothpaste is replaced by chewable tablets which are better suited to this type of packaging.

When the tablets are chewed, they create a foam, and you then brush your teeth in the

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Video Transcript

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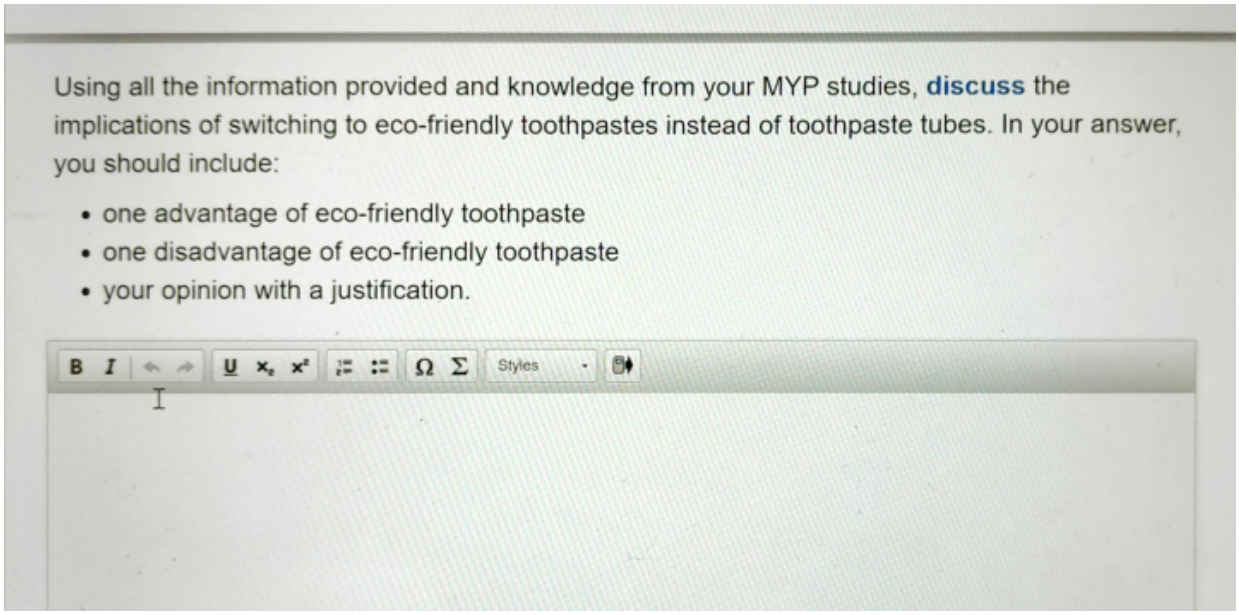
An eco-friendly toothpaste has a plastic-free container made of glass or paper. The regular toothpaste is replaced by chewable tablets which are better suited to this type of packaging.

When the tablets are chewed, they create a foam, and you then brush your teeth in the usual way.


Using all the information provided and knowledge from your MYP studies, discuss the implications of switching to eco-friendly toothpastes instead of toothpaste tubes. In your answer, you should include:
one advantage of eco-friendly toothpaste
one disadvantage of eco-friendly toothpaste
your opinion with a justification.
Styles

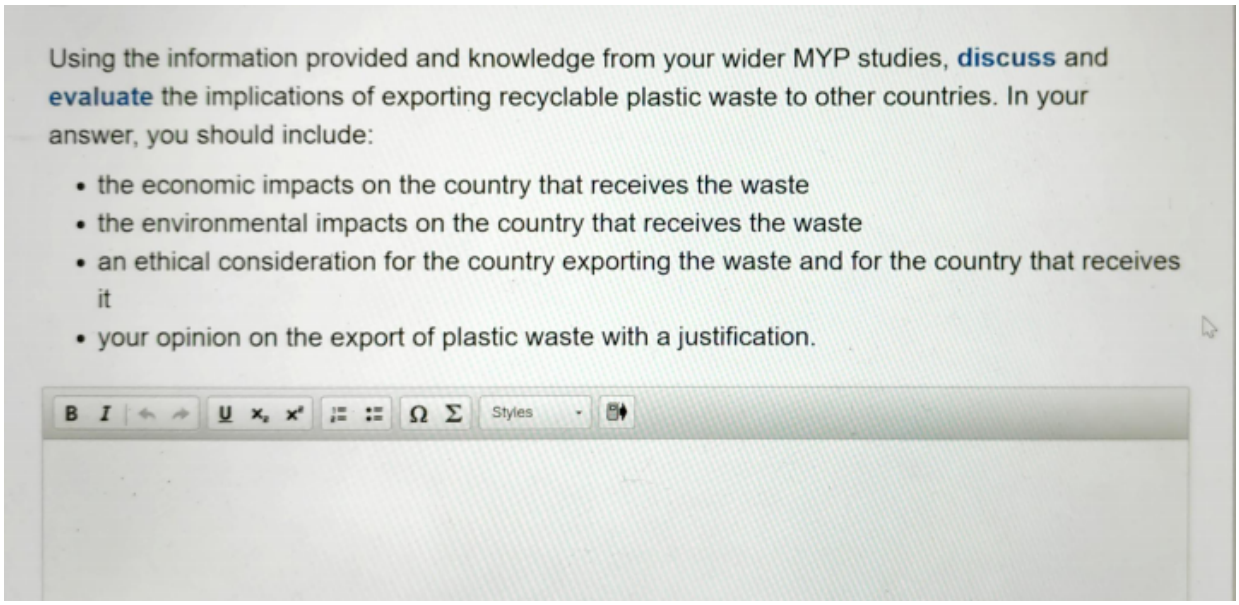
Question 7 (11 marks)

Some wealthy countries pay other countries to take and recycle their plastic waste. Recycled plastic waste can be re-sold, re-processed and used again. India and Malaysia are two of the countries that accept plastic waste from other countries. Although it is separated from other waste, the plastic waste is a mixture of different types of plastic. Further separation is needed and up to 15–20% cannot be recycled at all. This part of the plastic waste ends up being burned or going to landfill.

The image below shows the amount of plastic waste that was sent to different countries for recycling by the US in 2018.

Using the information provided and knowledge from your wider MYP studies, **discuss** and **evaluate** the implications of exporting recyclable plastic waste to other countries. In your answer, you should include:

- the economic impacts on the country that receives the waste


Using the information provided and knowledge from your wider MYP studies, discuss and evaluate the implications of exporting recyclable plastic waste to other countries. In your answer, you should include:
• the economic impacts on the country that receives the waste
• the environmental impacts on the country that receives the waste
• an ethical consideration for the country exporting the waste and for the country that receives it
• your opinion on the export of plastic waste with a justification.
Styles