**Question 1** (8 marks)

Unlike traditional zoos, wildlife sanctuaries conserve animals in their natural habitats.

**Question 1a** (1 mark)

The image below shows a food chain that is part of a food web in a wildlife sanctuary in Africa.

**Diagram not to scale**


**State** the primary consumer in the food chain.

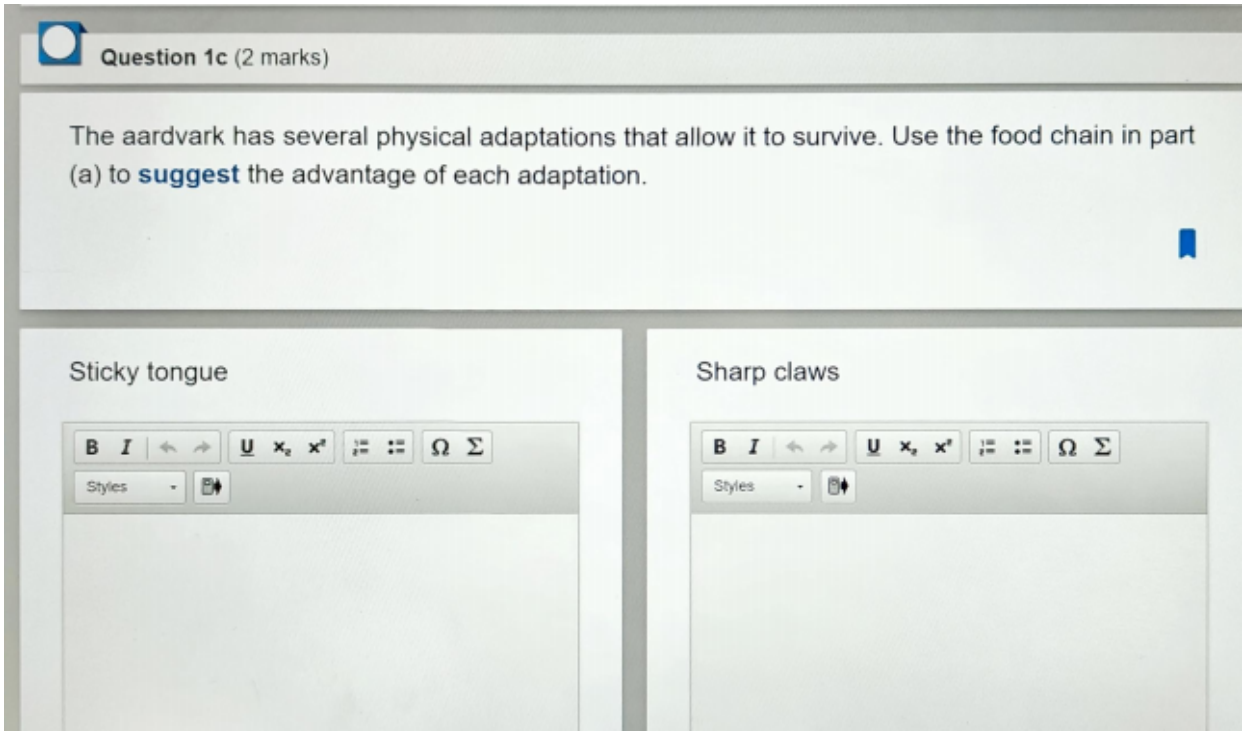
**Question 1b** (1 mark)

The grass makes its own food through photosynthesis. **Select** the two products of photosynthesis.

**Draggable items:**

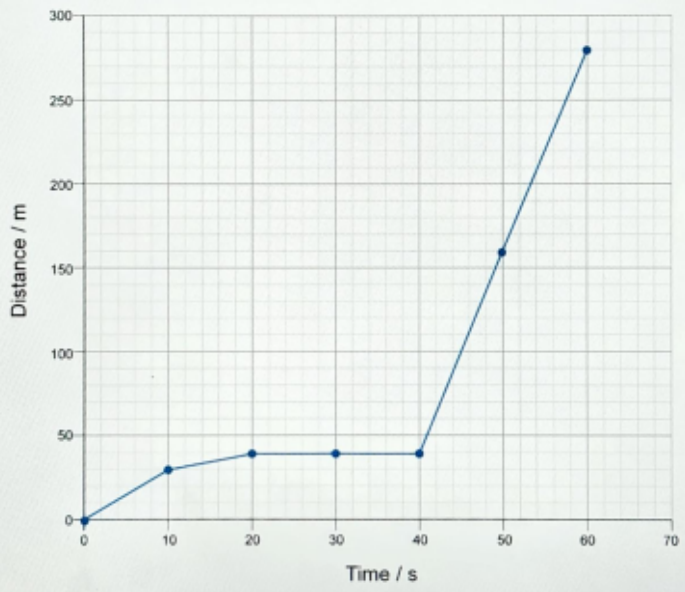
carbon monoxide | chlorophyll | glucose | hydrogen | oxygen

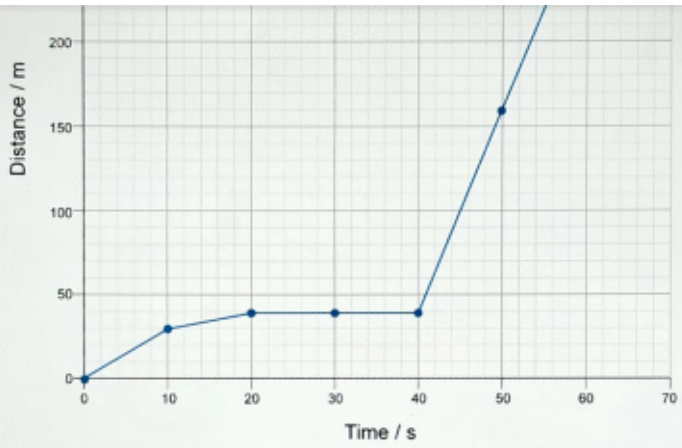
carbon dioxide + water → [ ] + [ ]


Question 1c (2 marks)
The aardvark has several physical adaptations that allow it to survive. Use the food chain in part (a) to suggest the advantage of each adaptation.
Sticky tongue
Styles
Sharp claws
Styles

**Question 1d** (1 mark)

The graph below can be used to determine the hyena's speed over a certain period.

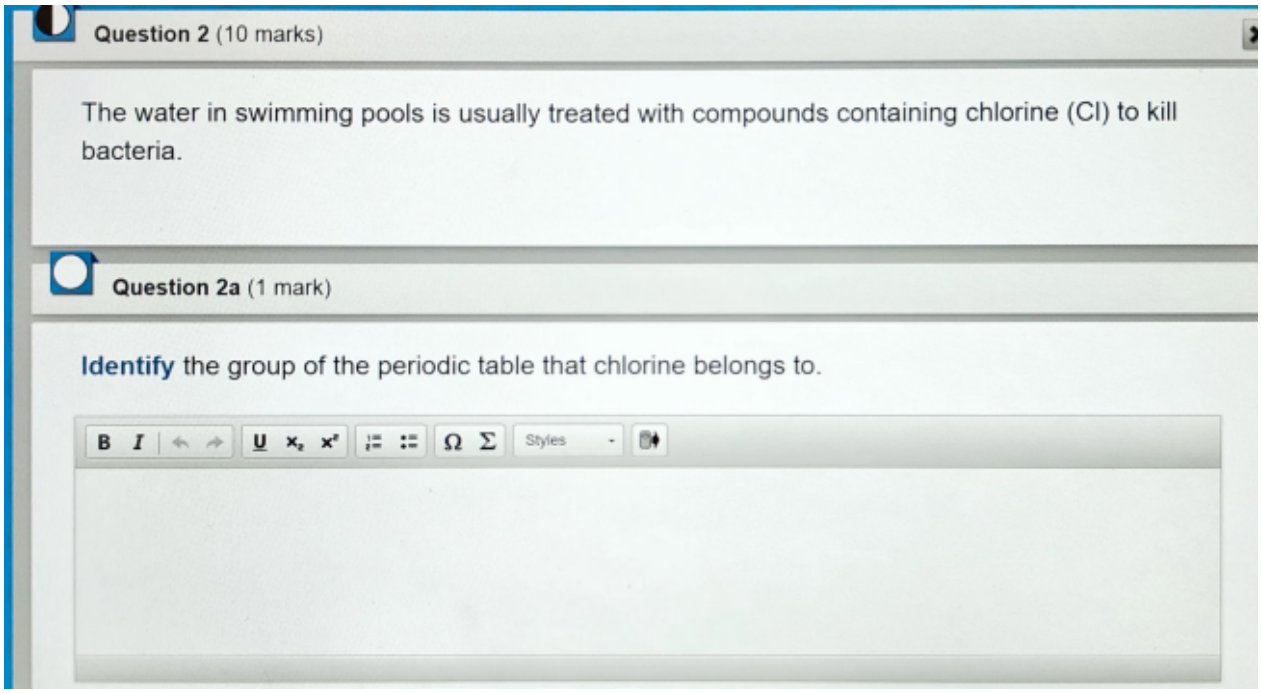





Use the graph to **identify** the time interval when the hyena is drinking water.

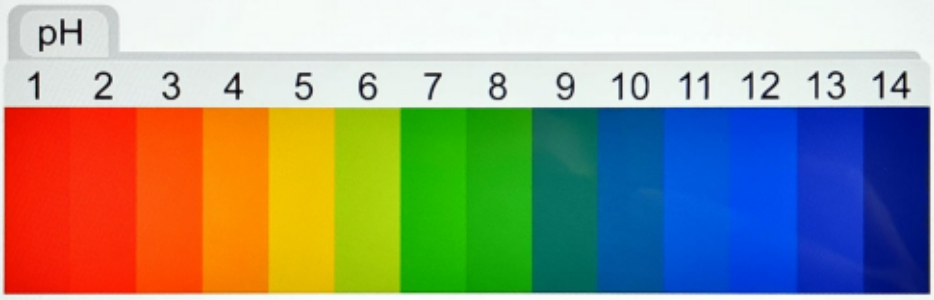
**Question 1e** (3 marks)

After 40 seconds, a lion approaches the hyena. Using the graph in part (d), **Calculate** the speed of the hyena after the lion approaches. Give your answer in km $h^{-1}$.


Question 2 (10 marks)
The water in swimming pools is usually treated with compounds containing chlorine (Cl) to kill bacteria.
Question 2a (1 mark)
Identify the group of the periodic table that chlorine belongs to.
Styles

**Question 2b** (1 mark)

When chlorine is added to the pool water, hypochlorous acid (HOCl) is formed. Hypochlorous acid is a weak acid. A sample of the hypochlorous acid was tested with a pH meter.

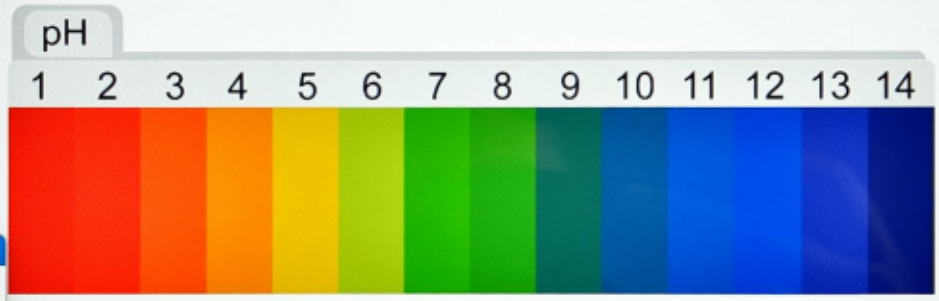



**Select** the pH you would expect this sample to have.

Select

**Question 2b** (1 mark)

When chlorine is added to the pool water, hypochlorous acid (HOCl) is formed. Hypochlorous acid is a weak acid. A sample of the hypochlorous acid was tested with a pH meter.



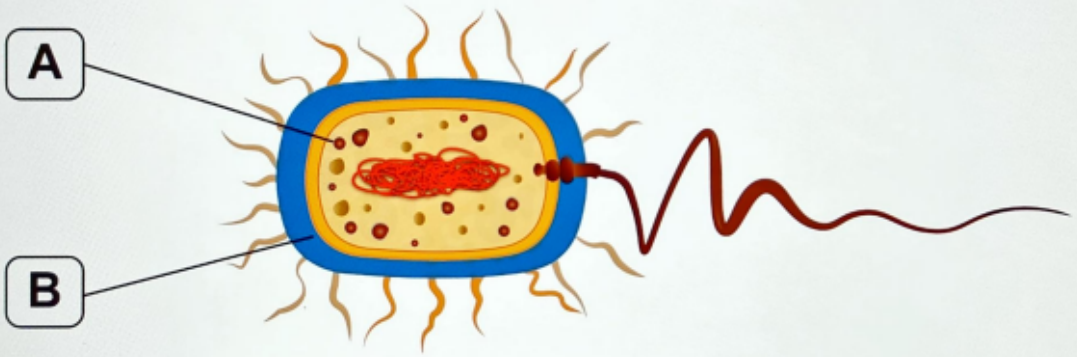

Select
pH 2
pH 6
pH 9
pH 14

...e pH you would expect this sample to have.

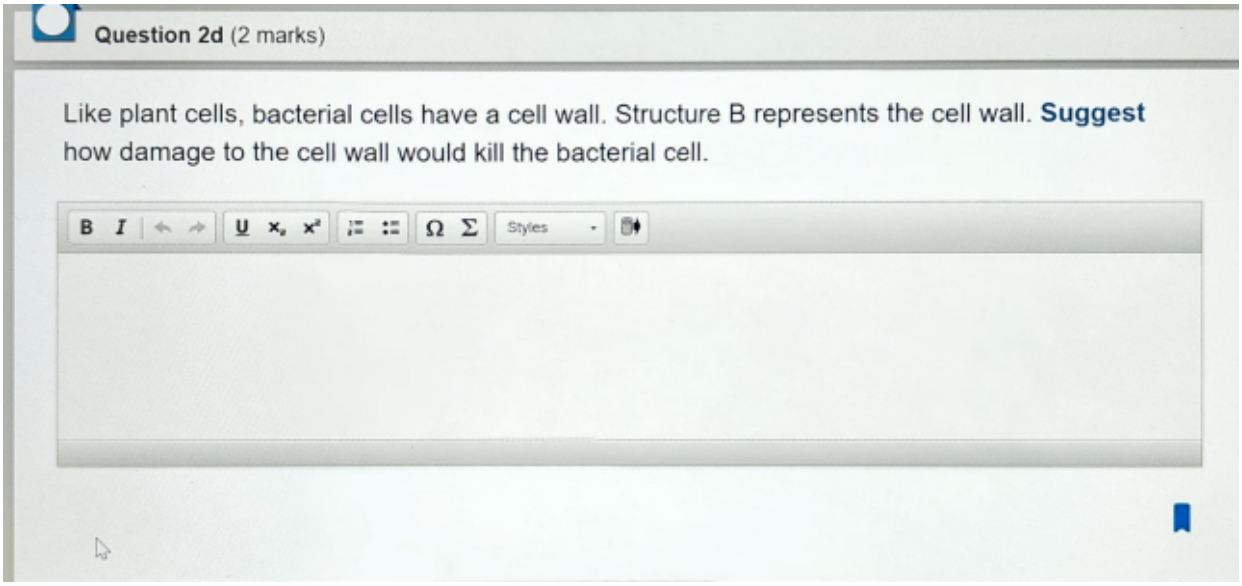
Select

**Question 2c** (1 mark)

The hypochlorous acid in the pool damages certain bacterial cell structures and disinfects the water. The structures damaged by the acid are shown in the diagram below.



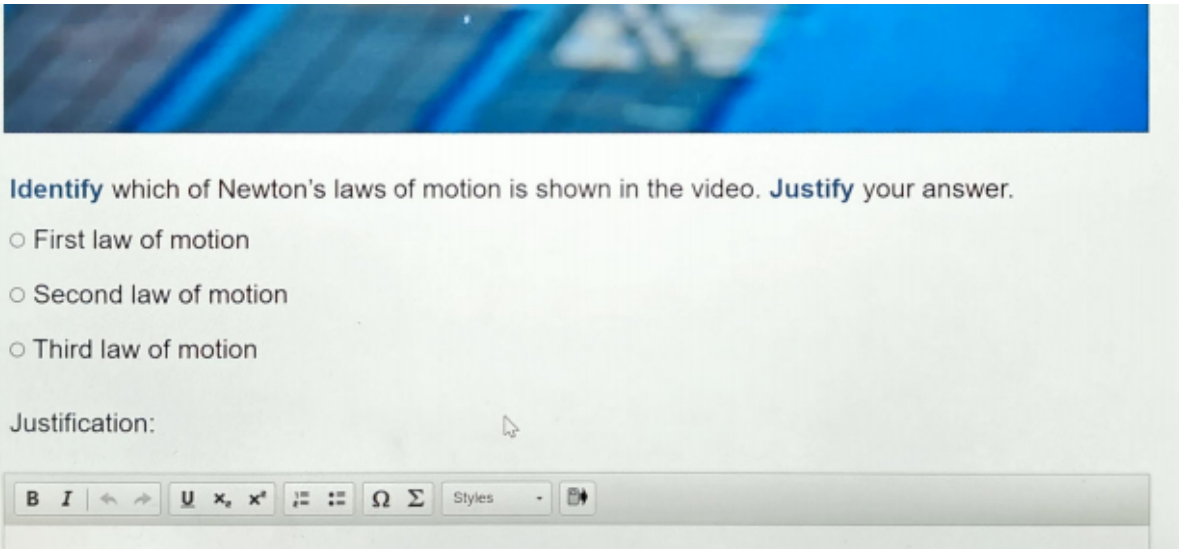

Structure A represents a ribosome. **State** the function of ribosomes.


Question 2d (2 marks)
Like plant cells, bacterial cells have a cell wall. Structure B represents the cell wall. Suggest how damage to the cell wall would kill the bacterial cell.
Styles

**Question 2e** (3 marks)

Once the water is properly treated, it is safe for swimming. A child uses a diving board to dive into the water.

**This video contains no audio**



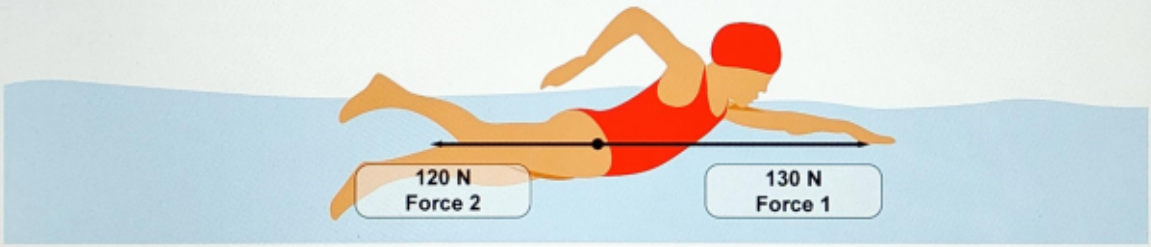
**Identify** which of Newton's laws of motion is shown in the video. **Justify** your answer.

- ○ First law of motion
- ○ Second law of motion
- ○ Third law of motion

Justification:

**Question 2f** (2 marks)

The horizontal forces acting on the child as they swim in the water are shown in the diagram below.




**Determine** the net force acting on the child as they swim.

**Question 3** (8 marks)

Energy-efficient devices operate using less energy than conventional devices.

**Question 3a** (2 marks)

Incandescent light bulbs and light-emitting diode (LED) light bulbs are two types of light bulb. These bulbs have different efficiencies. A comparison of the two bulbs is shown below.

| | Electrical energy input / J | Light energy output / J |
|---|---|---|
|  Incandescent light bulb | 100 | 10 |

**Question 3a** (2 marks)

Incandescent light bulbs and light-emitting diode (LED) light bulbs are two types of light bulb. These bulbs have different efficiencies. A comparison of the two bulbs is shown below.

| | Electrical energy input / J | Light energy output / J |
|---|---|---|
|  Incandescent light bulb | 100 | 10 |
|  LED light bulb | 100 | 75 |

Efficiency can be calculated using the following formula:

$$\text{efficiency} = \frac{\text{useful energy out}}{\text{total energy in}} \times 100$$

**Calculate** the efficiency of each light bulb.

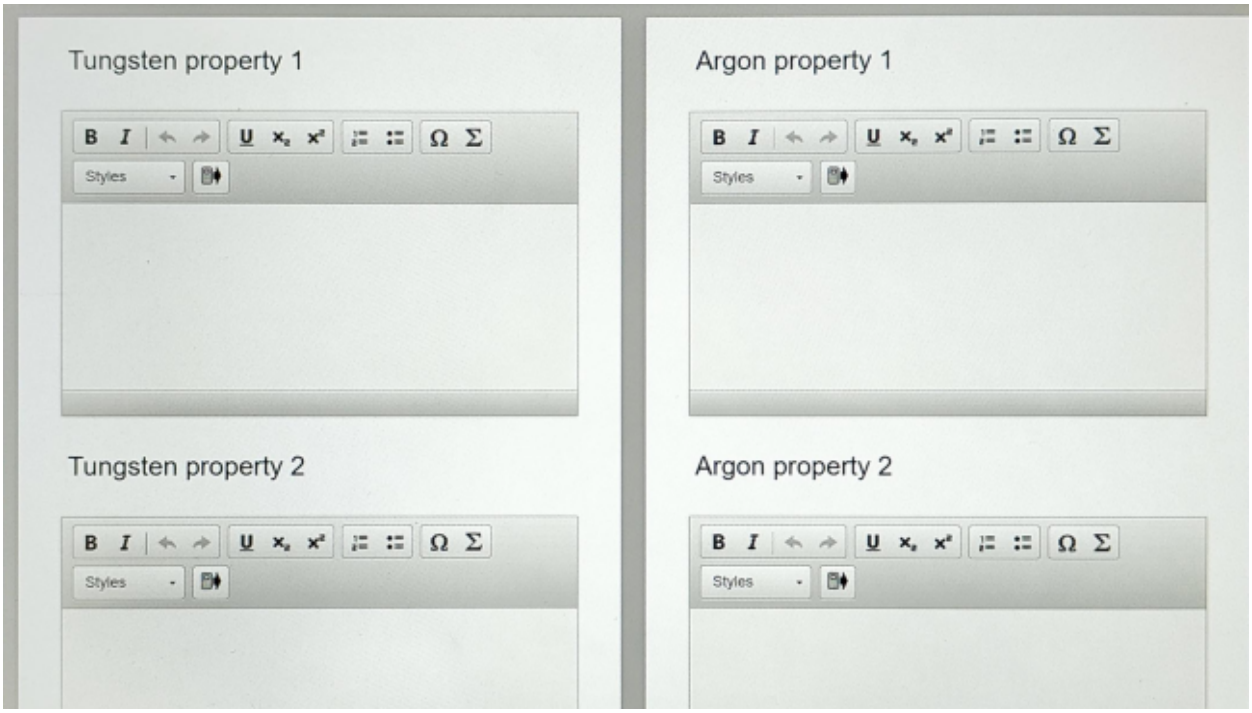
Efficiency of incandescent light bulb

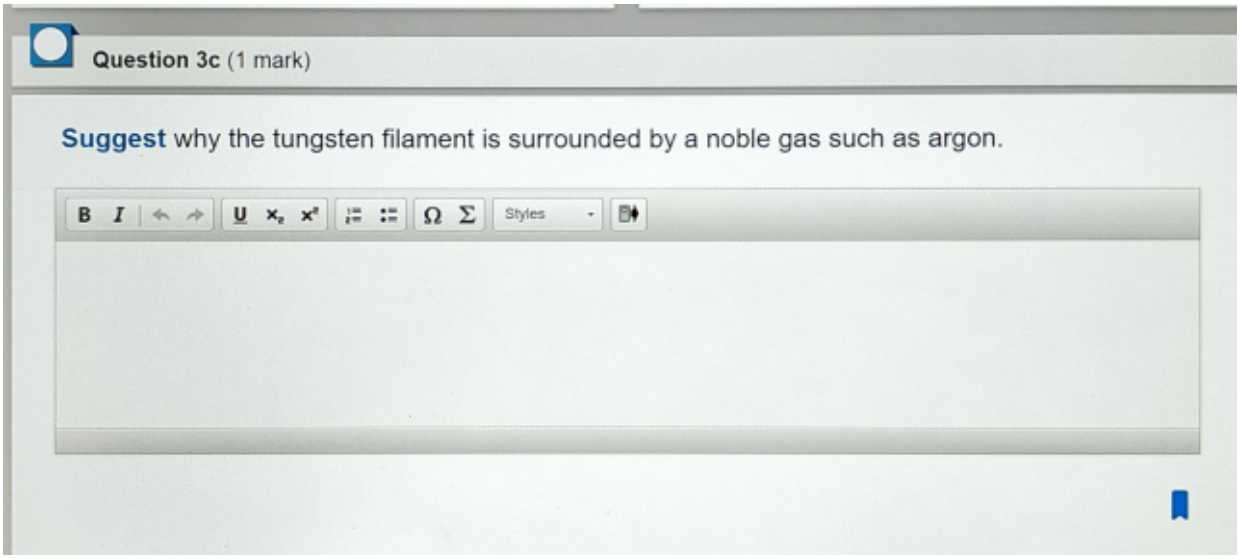
Efficiency of LED light bulb

**Question 3b** (2 marks)

The diagram below shows an incandescent bulb. Incandescent light bulbs work when electricity passes through the filament and heats it. The filament is made out of tungsten (chemical symbol W) and is surrounded by argon (Ar) gas.


**Describe** two differences in the **physical properties** of tungsten and argon.


Tungsten property 1
Styles
Argon property 1
Styles
Tungsten property 2
Styles
Argon property 2
Styles


Question 3c (1 mark)
Suggest why the tungsten filament is surrounded by a noble gas such as argon.
Styles

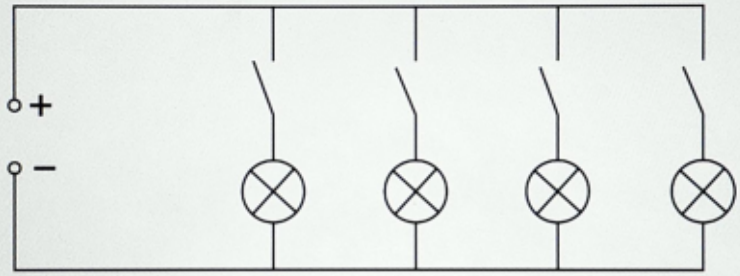
**Question 3d** (2 marks)

A light bulb lights up when an electric current passes through the filament. An electric current is the flow of electrons. Electrons are one of the particles found in an atom. Use the table below to **summarize** the properties of the different particles found in an atom.

| | Charge | Location |
|---|---|---|
| Protons | Positive | Select |
| Neutrons | Select | Select |
| Electrons | Select | Select |

**Question 3e** (1 mark)

The diagram below shows part of the lighting circuit in a home.




**Suggest** why the light bulbs in the circuit are connected in parallel.

**Question 4** (16 marks)

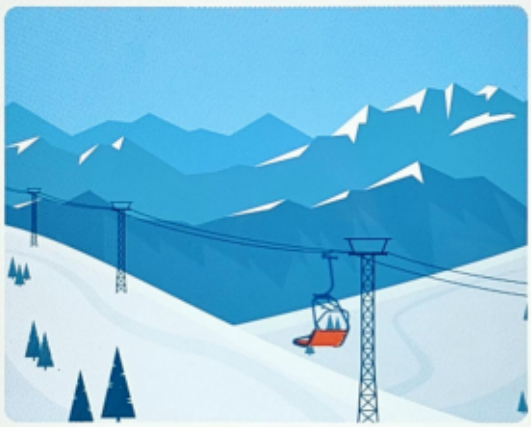
Skiing is a winter sport that involves travelling over snow. Usually, the person who wants to ski takes the ski lift to the top of a snow slope before they ski down the slope.

**Question 4a** (2 marks)

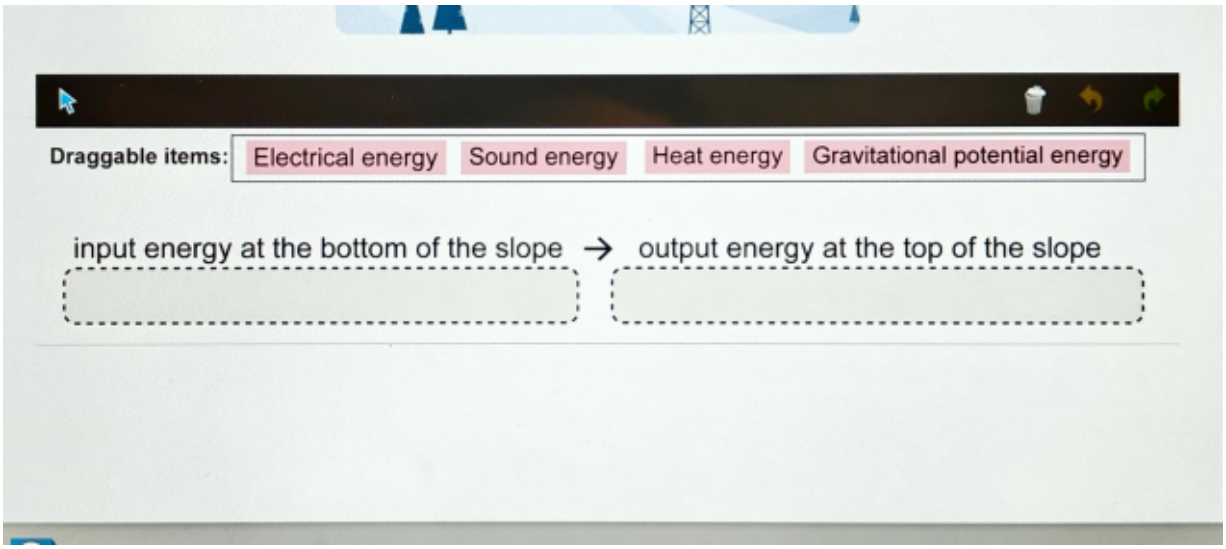
**Identify** the energy transfer in the ski lift shown below.

**Question 4a** (2 marks)

**Identify** the energy transfer in the ski lift shown below.



Draggable items: Electrical energy | Sound energy | Heat energy | Gravitational potential energy

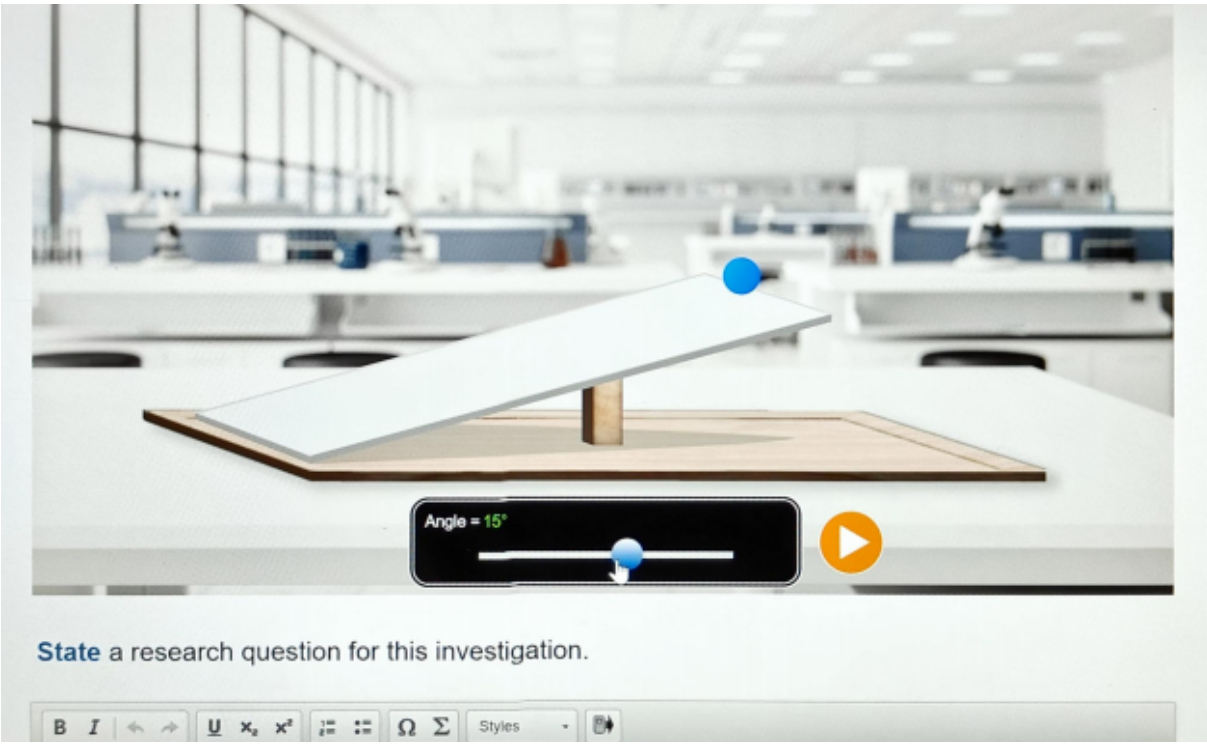

Draggable items:
Electrical energy
Sound energy
Heat energy
Gravitational potential energy
input energy at the bottom of the slope
output energy at the top of the slope

**Question 4b** (1 mark)

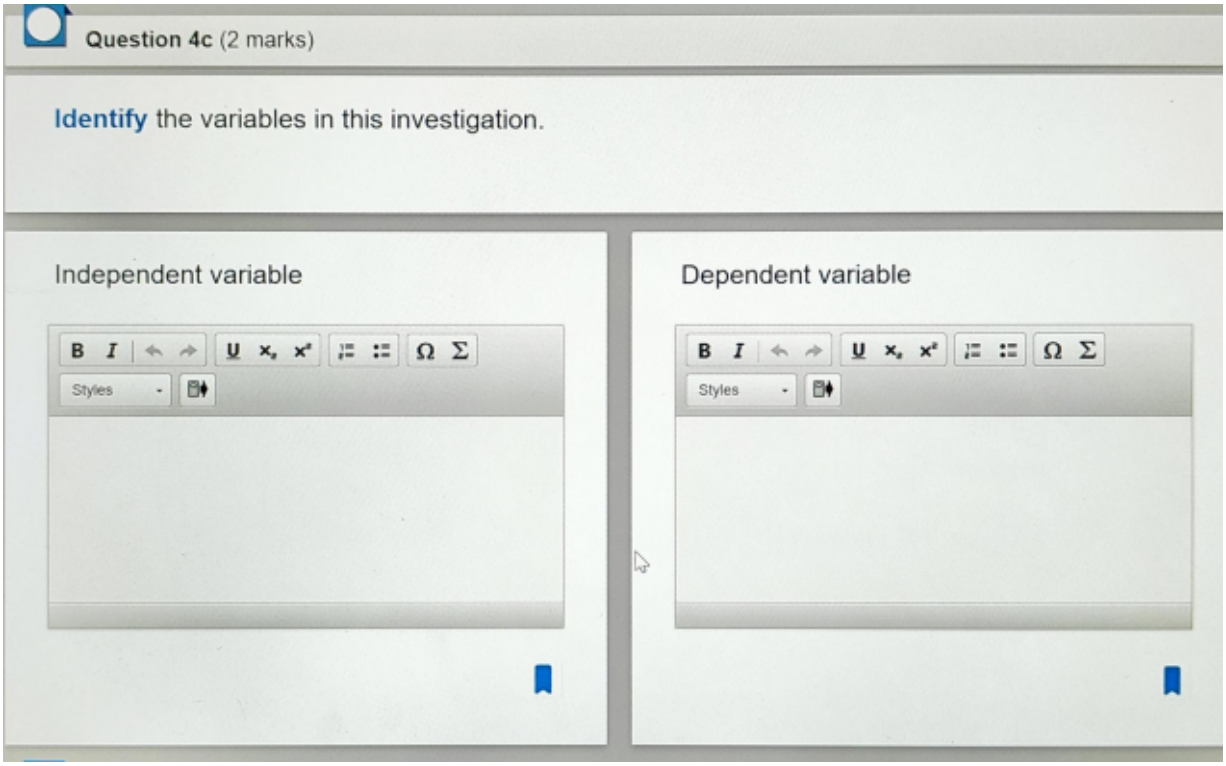
A student wanted to investigate the effect of changing the angle of the snow slope on the kinetic energy of the skier at the bottom. The student sets up a model as shown in the simulation below.

**This media is interactive**

**Diagram not to scale**




**State** a research question for this investigation.


Question 4c (2 marks)
Identify the variables in this investigation.
Independent variable
Styles
Dependent variable
Styles

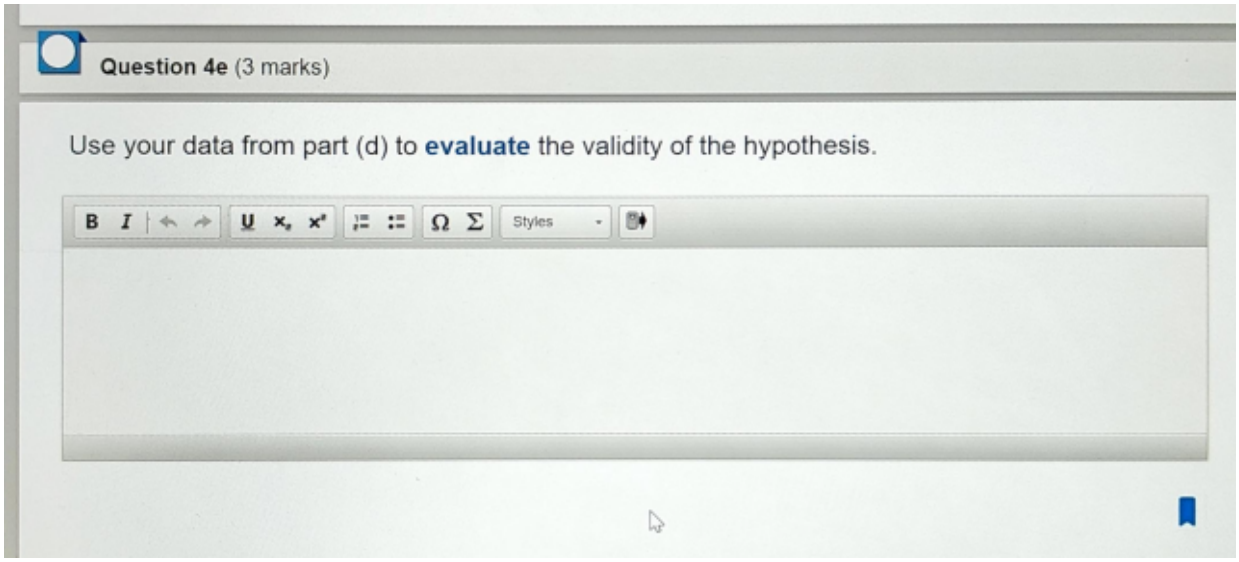
**Question 4d** (4 marks)

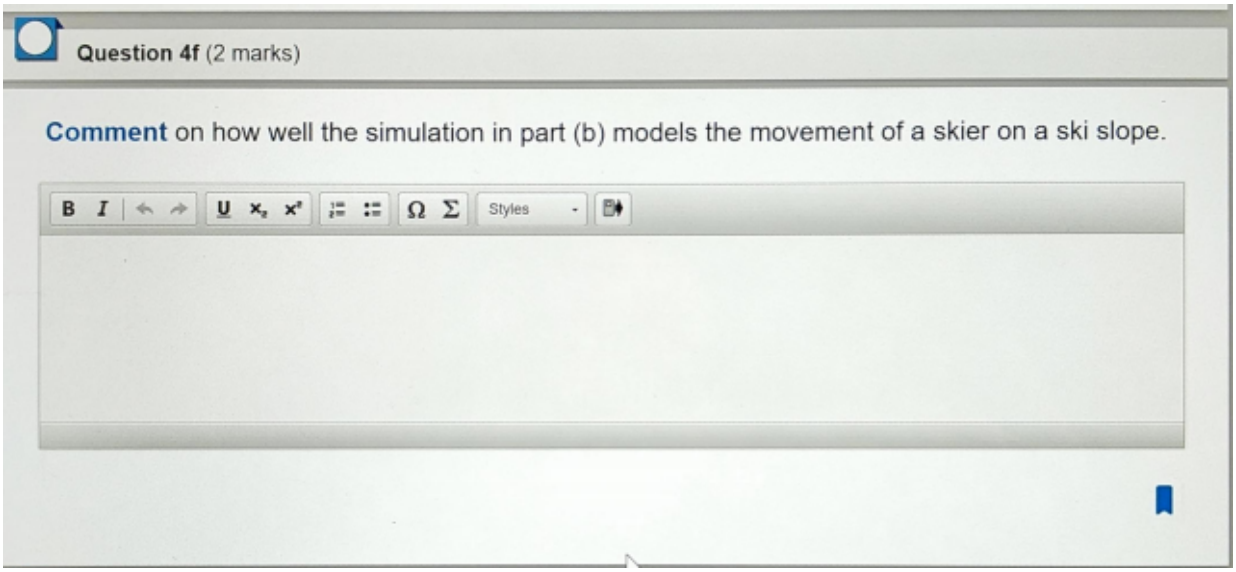
The student hypothesized:

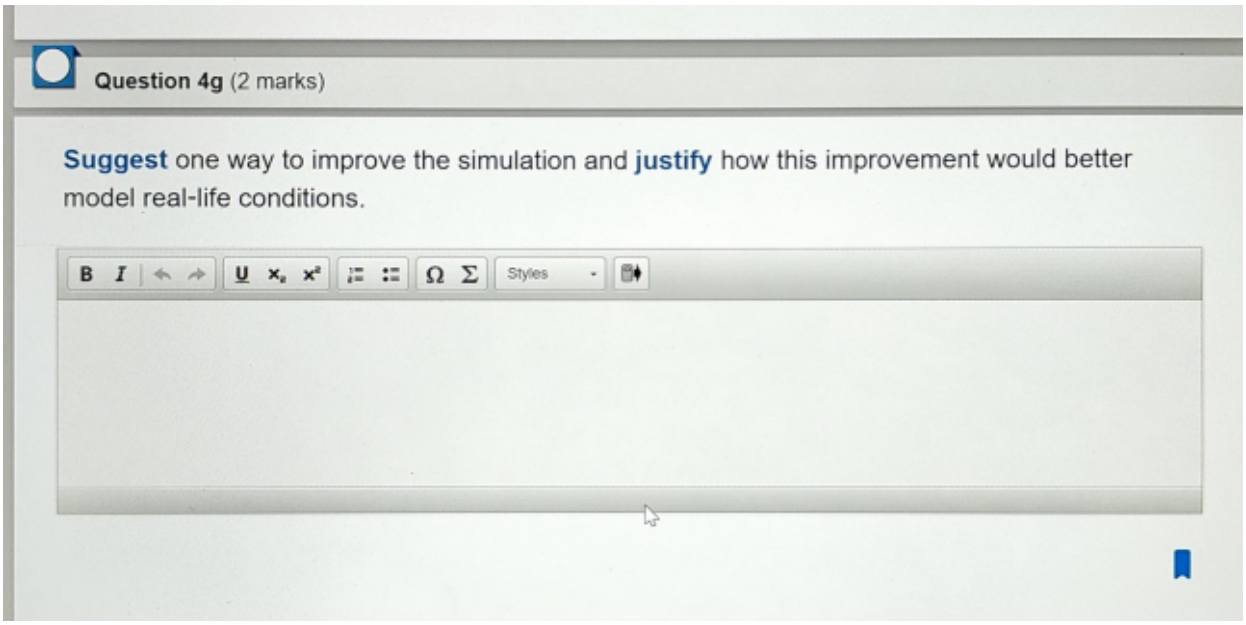
> If the angle increases, then the kinetic energy at the bottom decreases, because energy is conserved.

Use the simulation in part (b) to collect data for one trial to test this hypothesis. **Present** your data in a table.


Reset

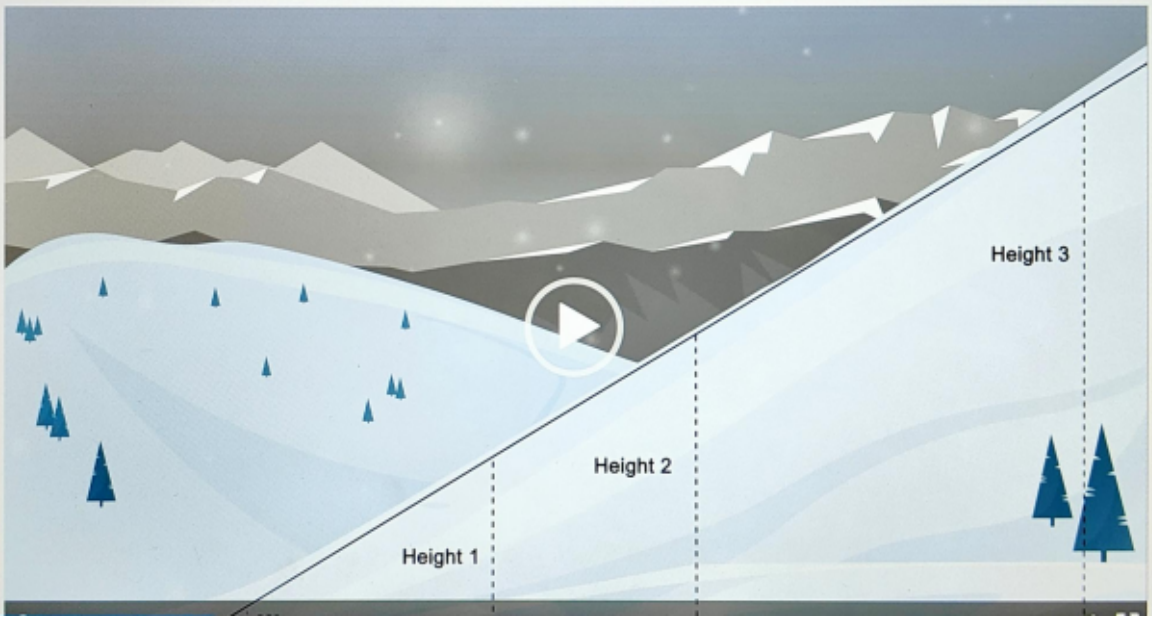

Question 4e (3 marks)
Use your data from part (d) to evaluate the validity of the hypothesis.
Styles


Question 4f (2 marks)
Comment on how well the simulation in part (b) models the movement of a skier on a ski slope.
Styles


Question 4g (2 marks)
Suggest one way to improve the simulation and justify how this improvement would better model real-life conditions.
Styles

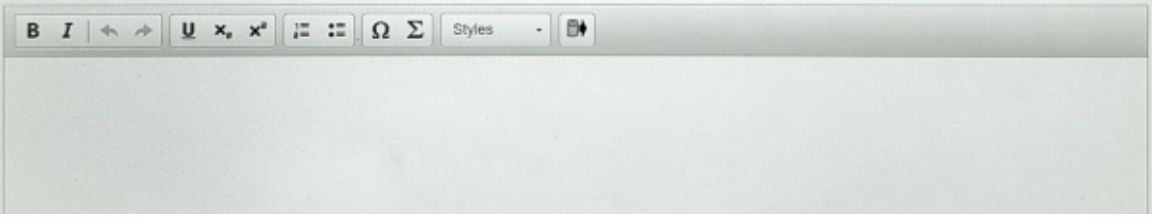
**Question 5** (15 marks)

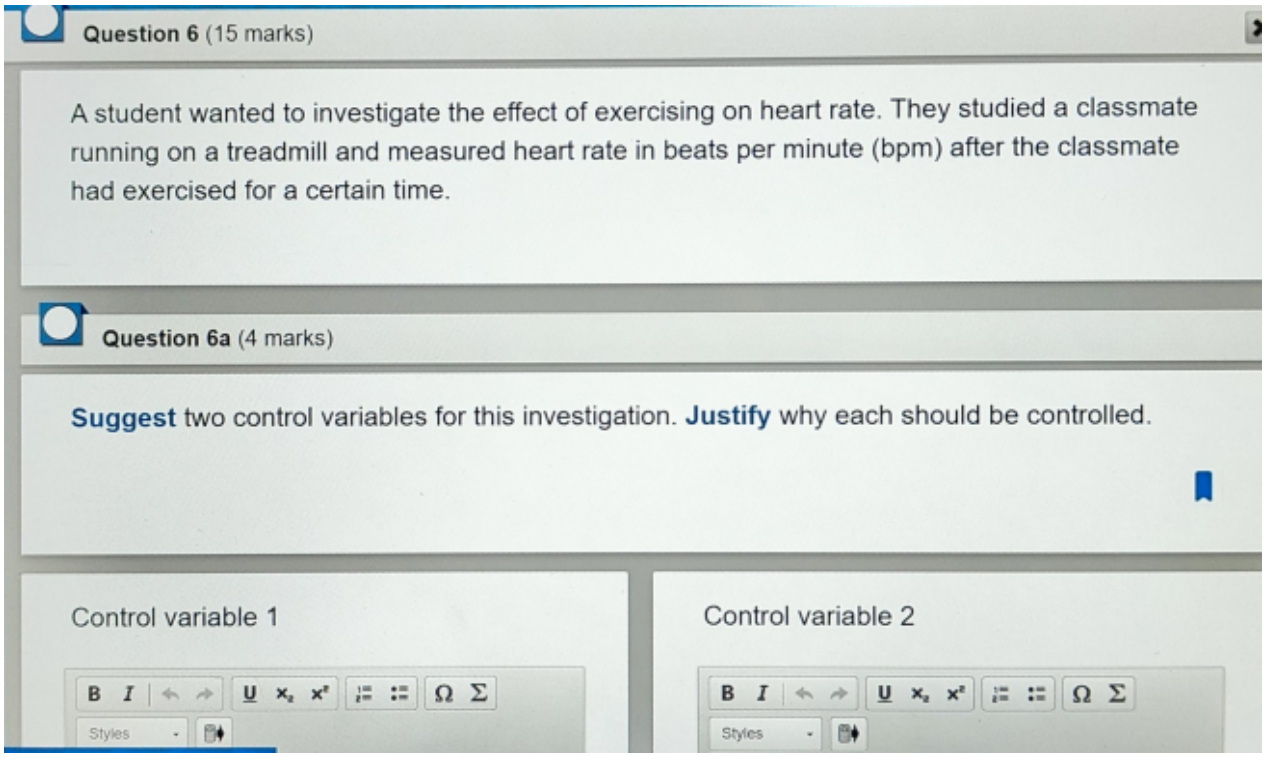
Another student wanted to investigate the effect of initial height on a snowboarder's speed at the bottom of a slope, as shown in the animation below.

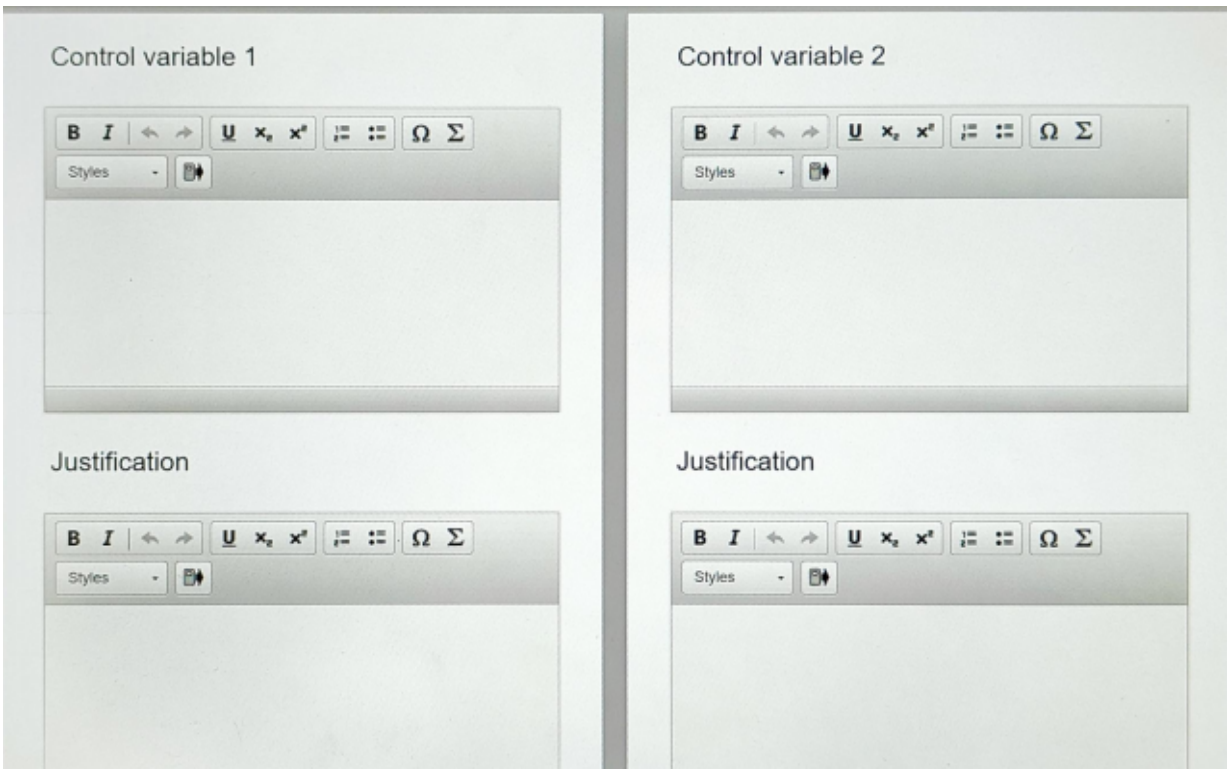


Use the animation above to **design** a method to investigate the effect of initial height on a snowboarder's speed at the bottom of the slope. You are provided with a speedometer, a 2m plastic ramp to model the snow slope and a small trolley to model the snowboard. In your answer, you should include:

- a research question
- the independent variable, dependent variable and two control variables
- how the independent variable will be manipulated to collect sufficient data
- any additional equipment you will require
- a description of your method.




Question 6 (15 marks)
A student wanted to investigate the effect of exercising on heart rate. They studied a classmate running on a treadmill and measured heart rate in beats per minute (bpm) after the classmate had exercised for a certain time.
Question 6a (4 marks)
Suggest two control variables for this investigation. Justify why each should be controlled.
Control variable 1
Styles
Control variable 2
Styles


Control variable 1
Styles
Justification
Styles
Control variable 2
Styles
Justification
Styles

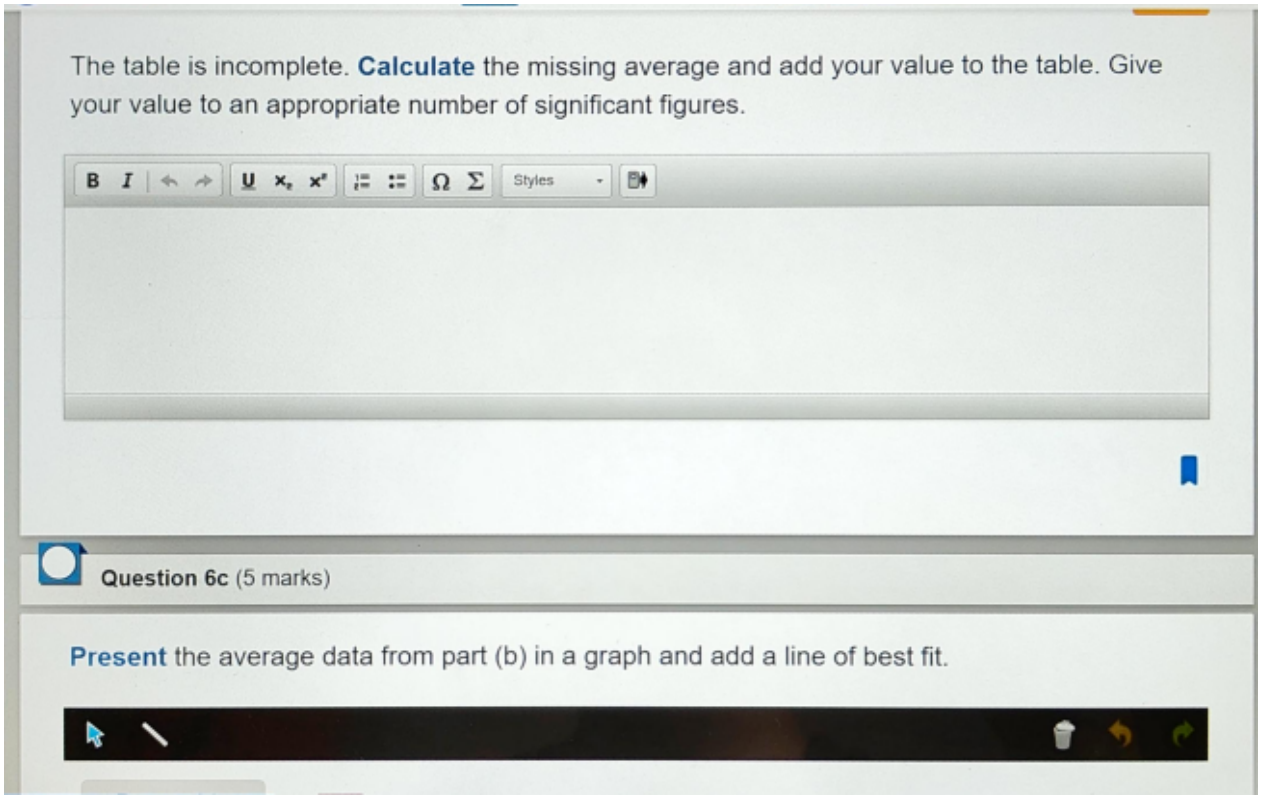
**Question 6b** (2 marks)

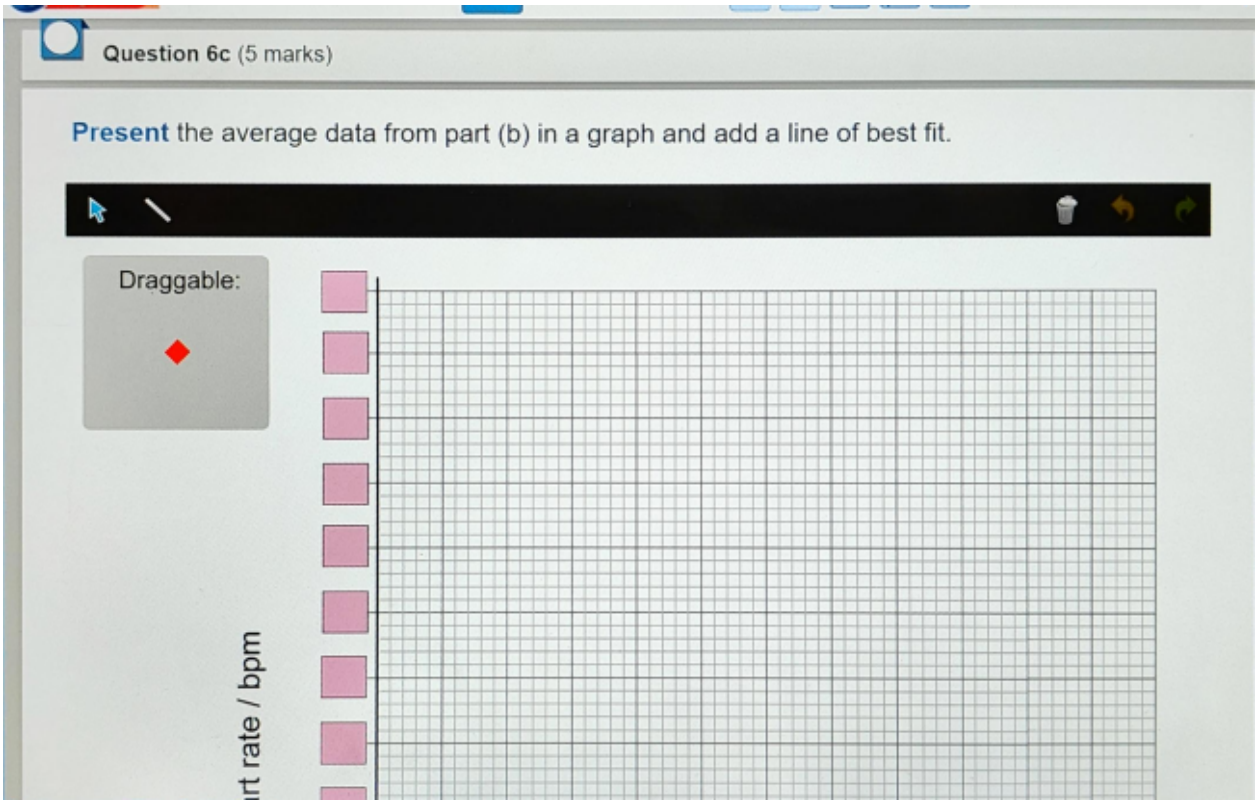
The student collected data and presented it in the table below.

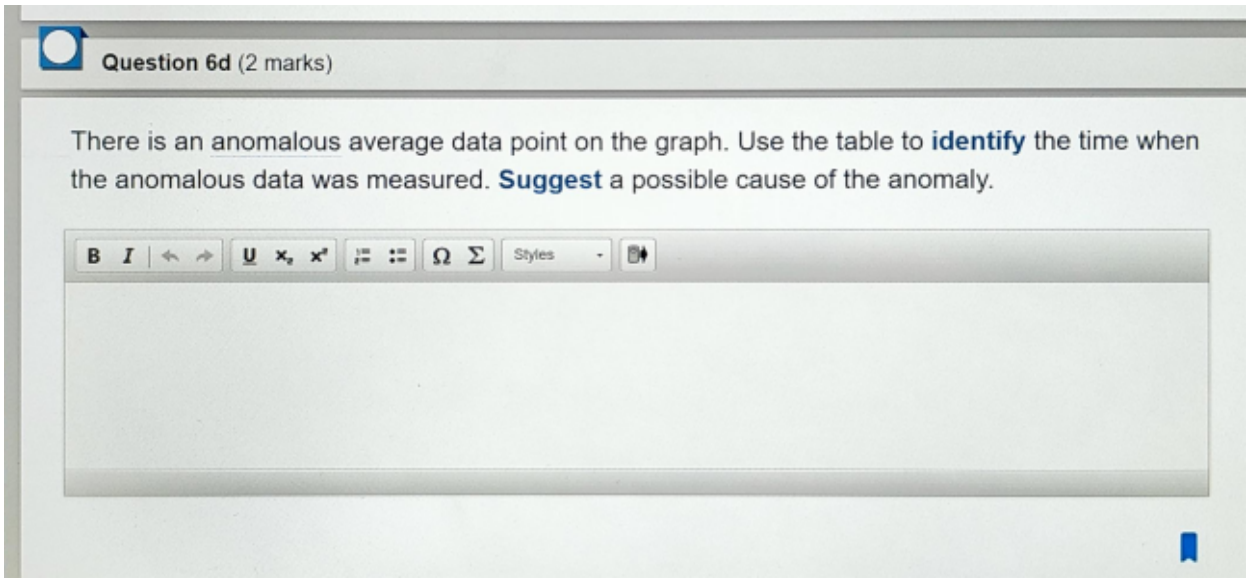
| Exercise time / s | Heart rate / bpm | | | |
|---|---|---|---|---|
| | Trial 1 | Trial 2 | Trial 3 | Average |
| 10 | 76 | 78 | 76 | 77 |
| 30 | 78 | 82 | 81 | 80 |
| 60 | 82 | 84 | 87 | 84 |
| 80 | 86 | 85 | 89 | 87 |
| 100 | 88 | 92 | 93 | 91 |
| 120 | 94 | 97 | 100 | 97 |
| 150 | 105 | 85 | 109 | 100 |
| 180 | 112 | 115 | 120 | 116 |
| 210 | 125 | 128 | 127 | 127 |
| 230 | 127 | 133 | 135 | |

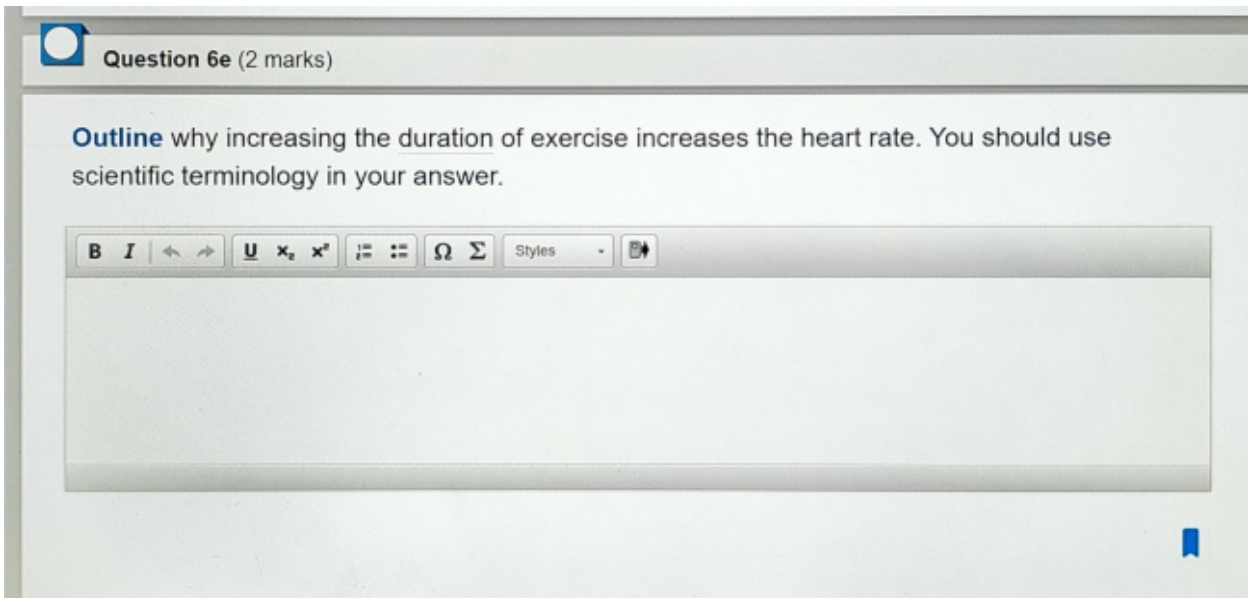
Reset

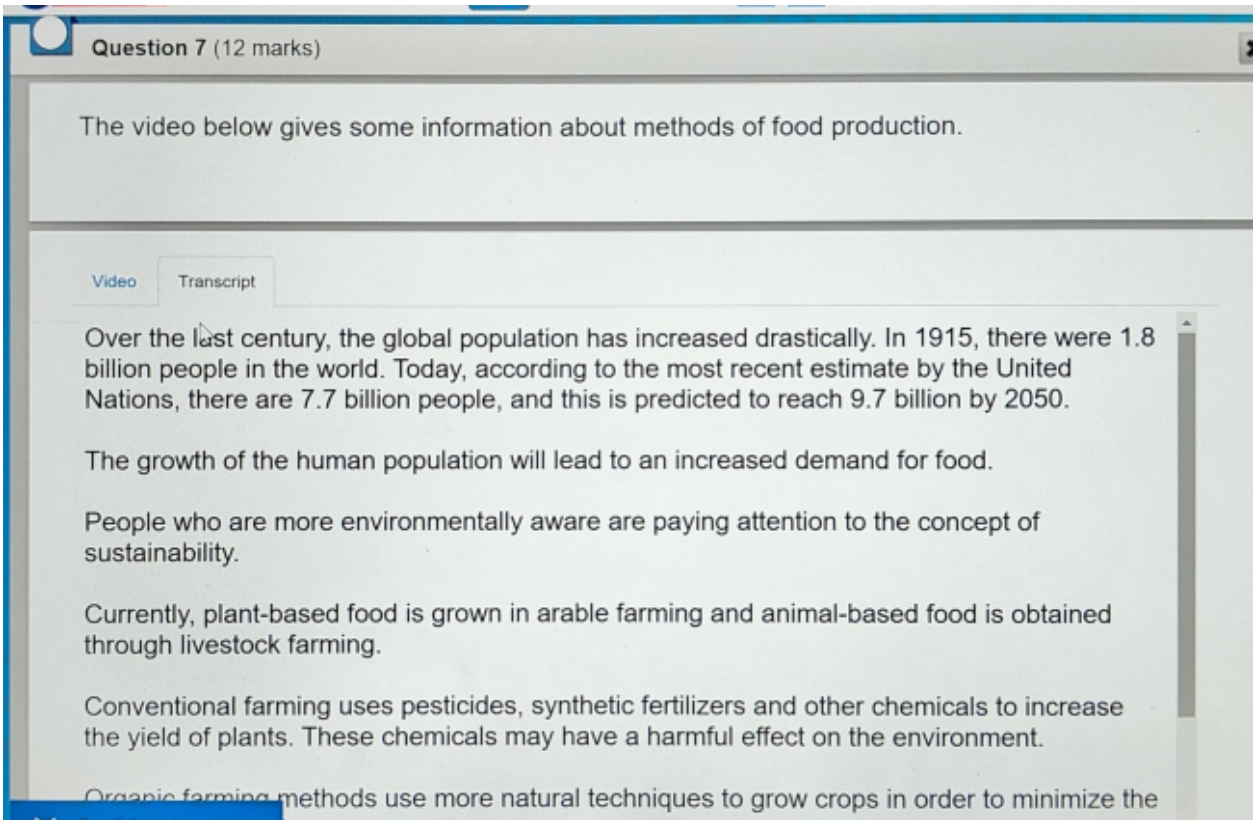
The table is incomplete. **Calculate** the missing average and add your value to the table. Give your value to an appropriate number of significant figures.

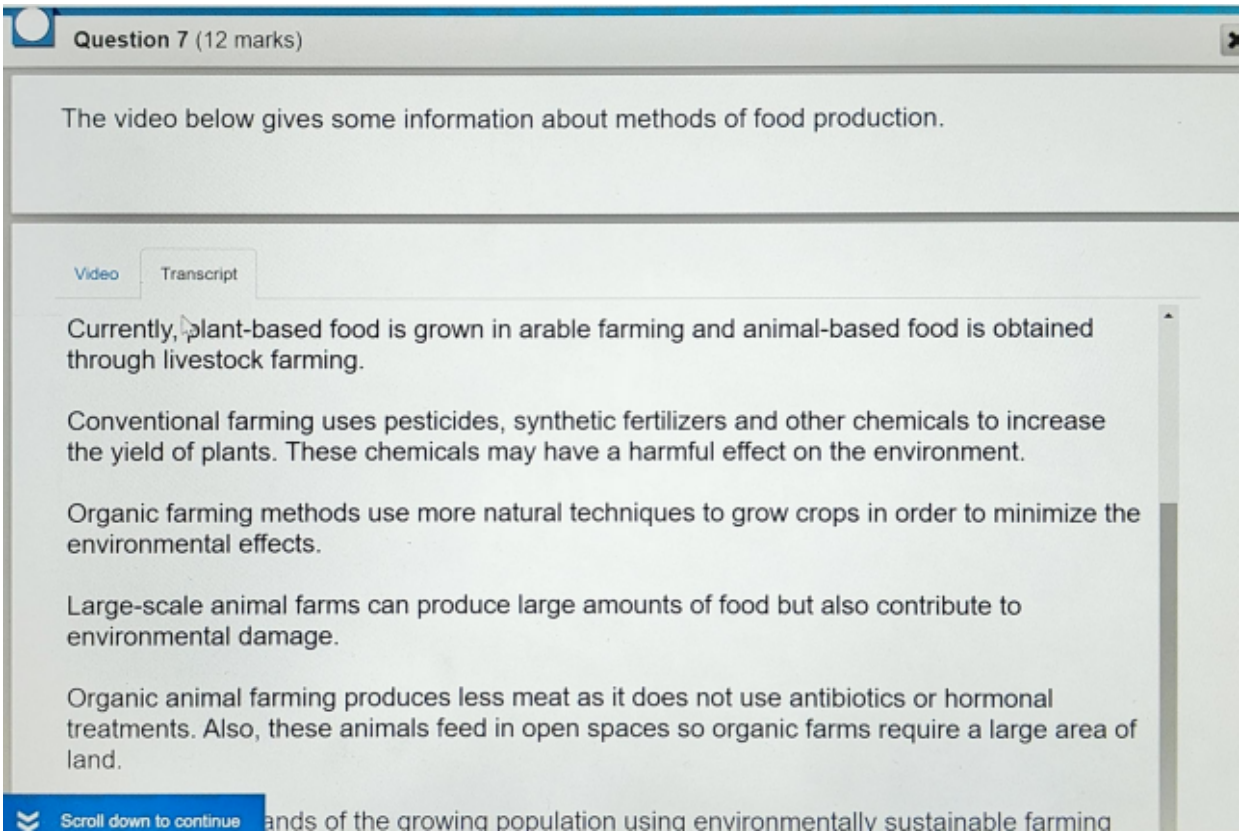

The table is incomplete. Calculate the missing average and add your value to the table. Give your value to an appropriate number of significant figures.
Styles
Question 6c (5 marks)
Present the average data from part (b) in a graph and add a line of best fit.


Question 6c (5 marks)
Present the average data from part (b) in a graph and add a line of best fit.
Draggable:
rt rate / bpm


Question 6d (2 marks)
There is an anomalous average data point on the graph. Use the table to identify the time when the anomalous data was measured. Suggest a possible cause of the anomaly.
Styles


Question 6e (2 marks)
Outline why increasing the duration of exercise increases the heart rate. You should use scientific terminology in your answer.
Styles


Question 7 (12 marks)
The video below gives some information about methods of food production.
Video
Transcript
Over the last century, the global population has increased drastically. In 1915, there were 1.8 billion people in the world. Today, according to the most recent estimate by the United Nations, there are 7.7 billion people, and this is predicted to reach 9.7 billion by 2050.
The growth of the human population will lead to an increased demand for food.
People who are more environmentally aware are paying attention to the concept of sustainability.
Currently, plant-based food is grown in arable farming and animal-based food is obtained through livestock farming.
Conventional farming uses pesticides, synthetic fertilizers and other chemicals to increase the yield of plants. These chemicals may have a harmful effect on the environment.
Organic farming methods use more natural techniques to grow crops in order to minimize the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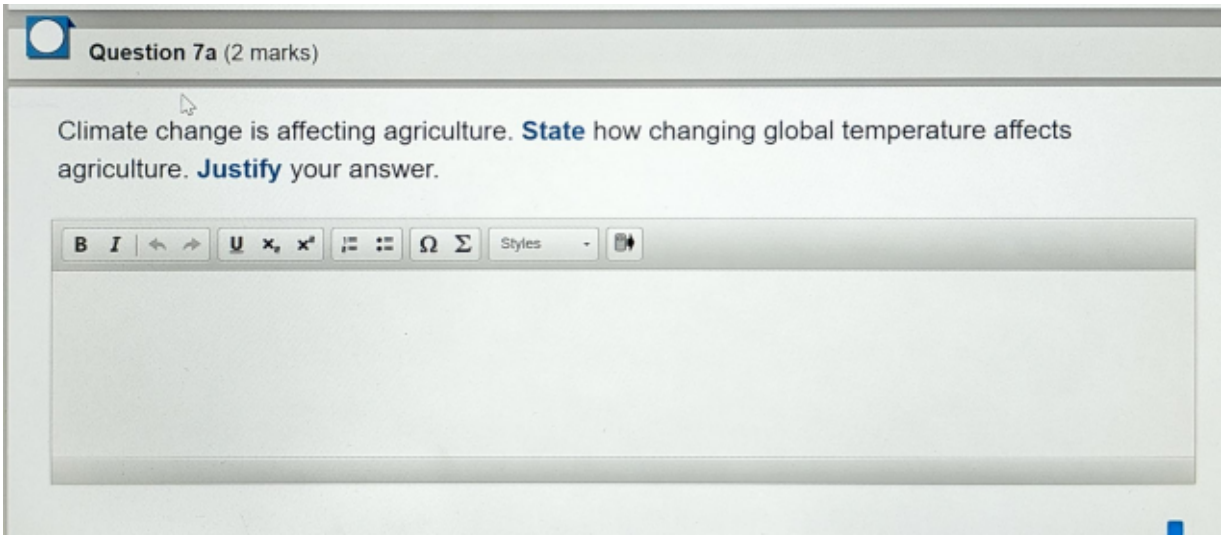
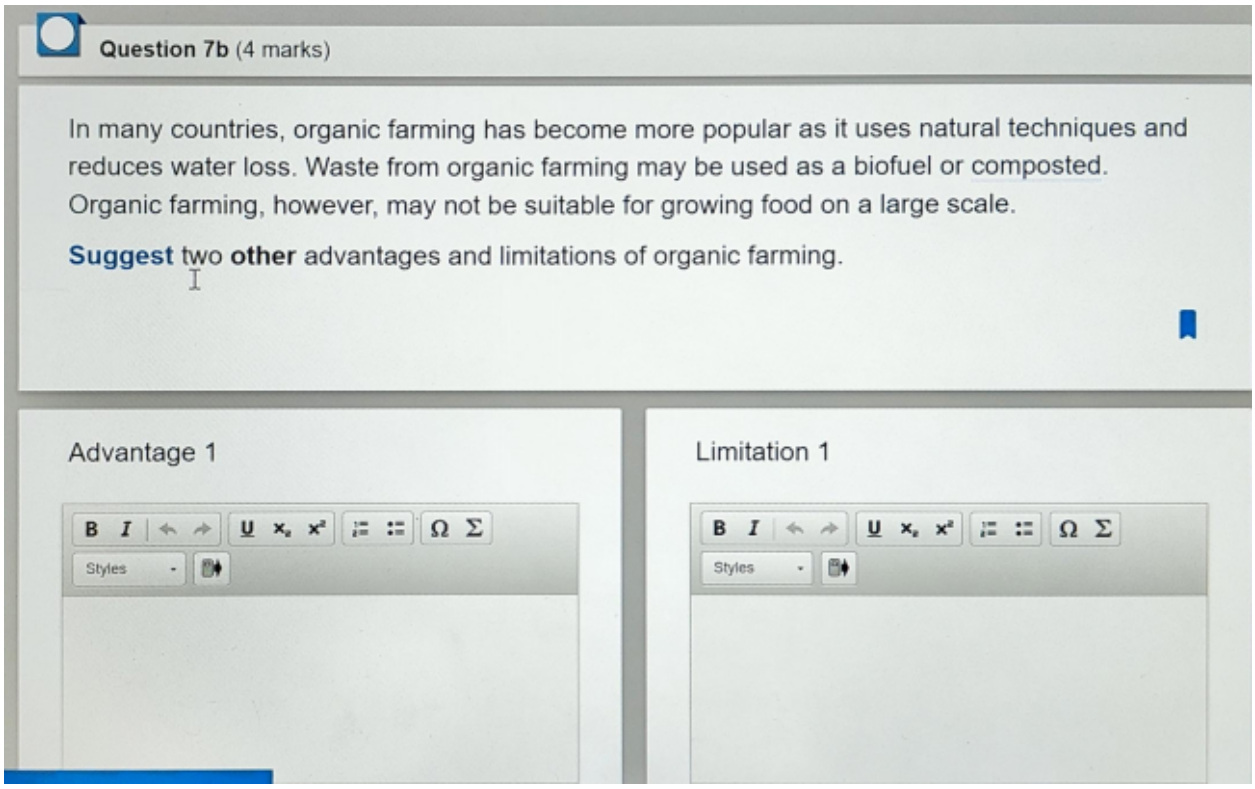
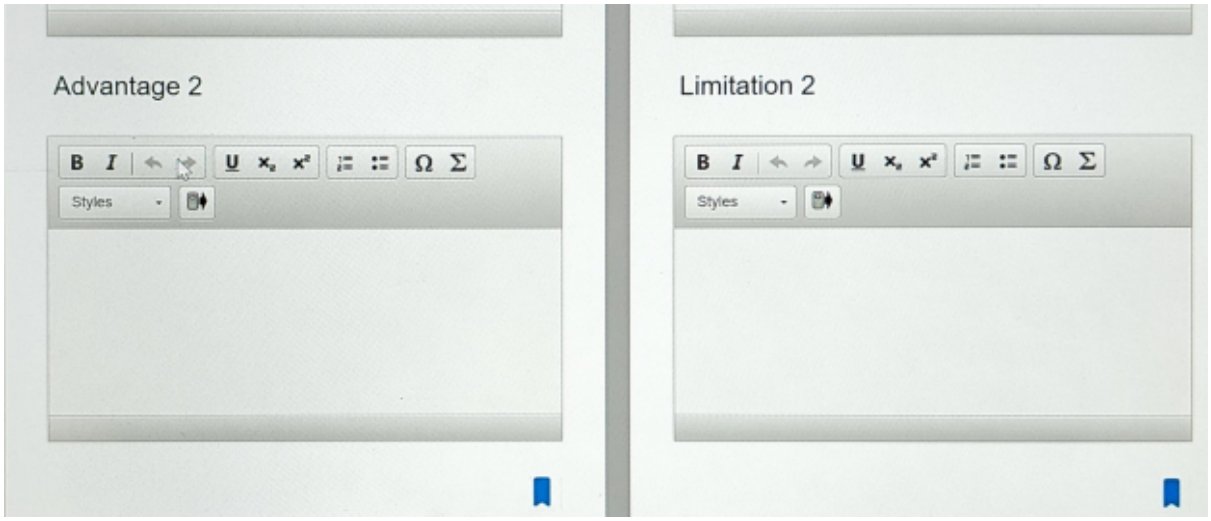
Organic farming methods use more natural techniques to grow crops in order to minimize the environmental effects.
Large-scale animal farms can produce large amounts of food but also contribute to environmental damage.
Organic animal farming produces less meat as it does not use antibiotics or hormonal treatments. Also, these animals feed in open spaces so organic farms require a large area of land.
Scroll down to continue
ands of the growing population using environmentally sustainable farming

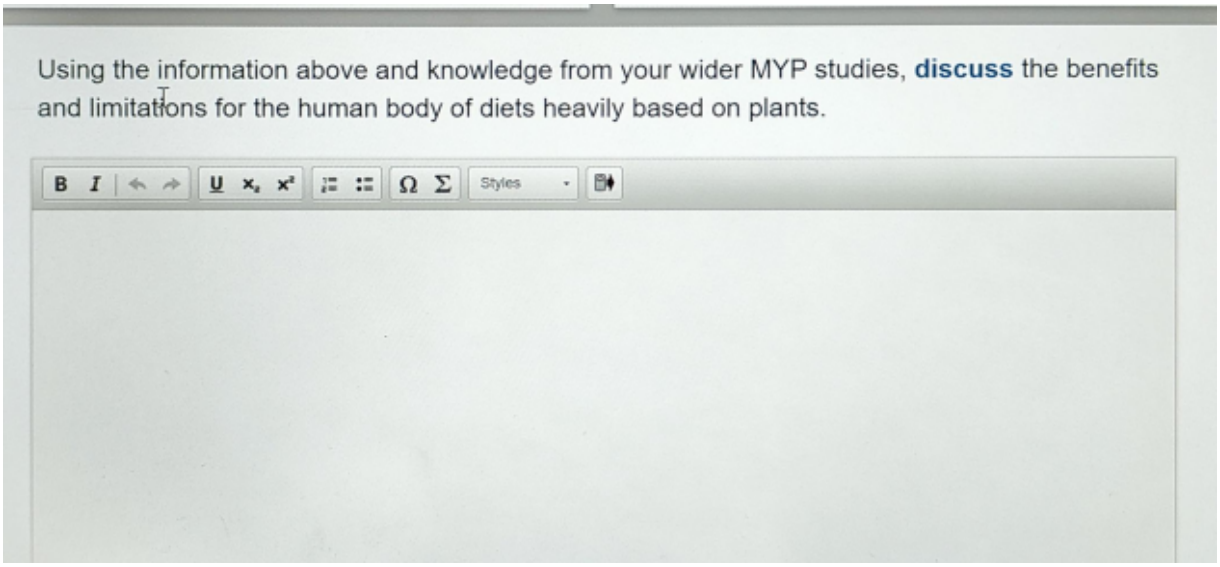

Question 7a (2 marks)
Climate change is affecting agriculture. State how changing global temperature affects agriculture. Justify your answer.
Styles


Question 7b (4 marks)
In many countries, organic farming has become more popular as it uses natural techniques and reduces water loss. Waste from organic farming may be used as a biofuel or composted. Organic farming, however, may not be suitable for growing food on a large scale.
Suggest two other advantages and limitations of organic farming.
Advantage 1
Styles
Limitation 1
Styles


Advantage 2
Styles
Limitation 2
Styles

**Question 7c** (6 marks)

The Food and Agriculture Organization (FAO) defines sustainable diets as diets with low environmental impacts. These diets ensure healthy food supplies for present and future generations. The FAO suggests that diets heavily based on plants are more sustainable than diets rich in animal products.

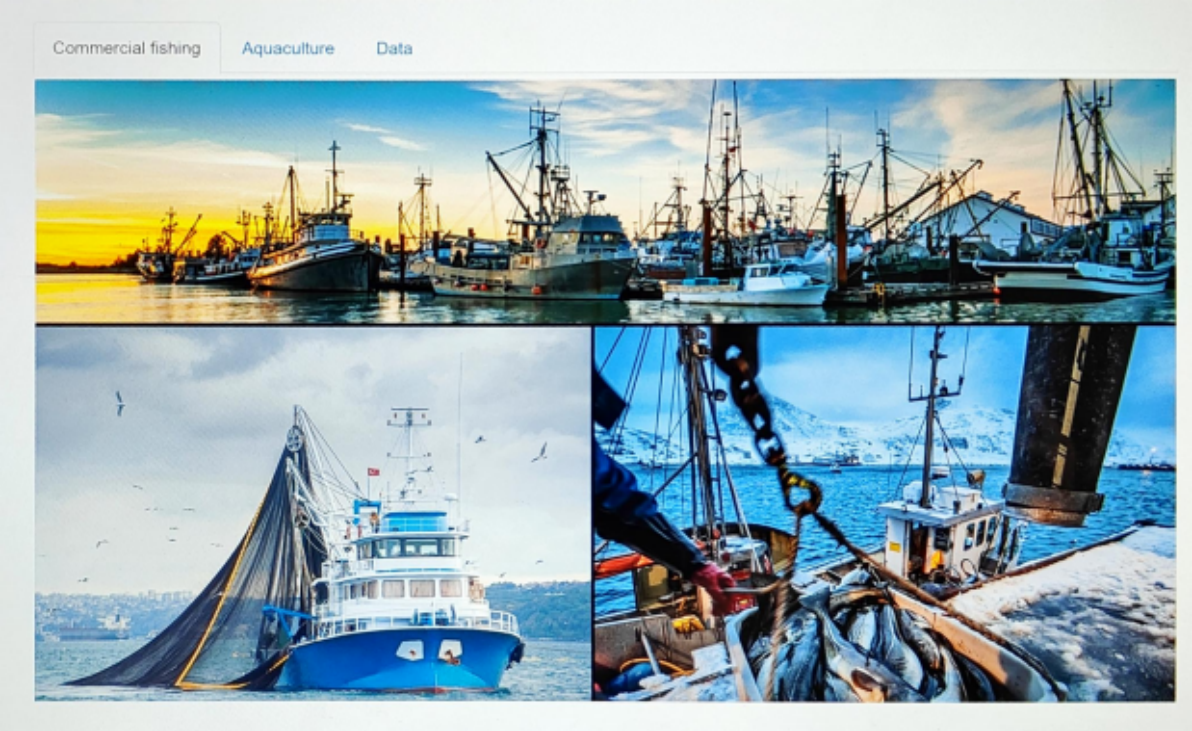

Using the information above and knowledge from your wider MYP studies, discuss the benefits and limitations for the human body of diets heavily based on plants.
Styles

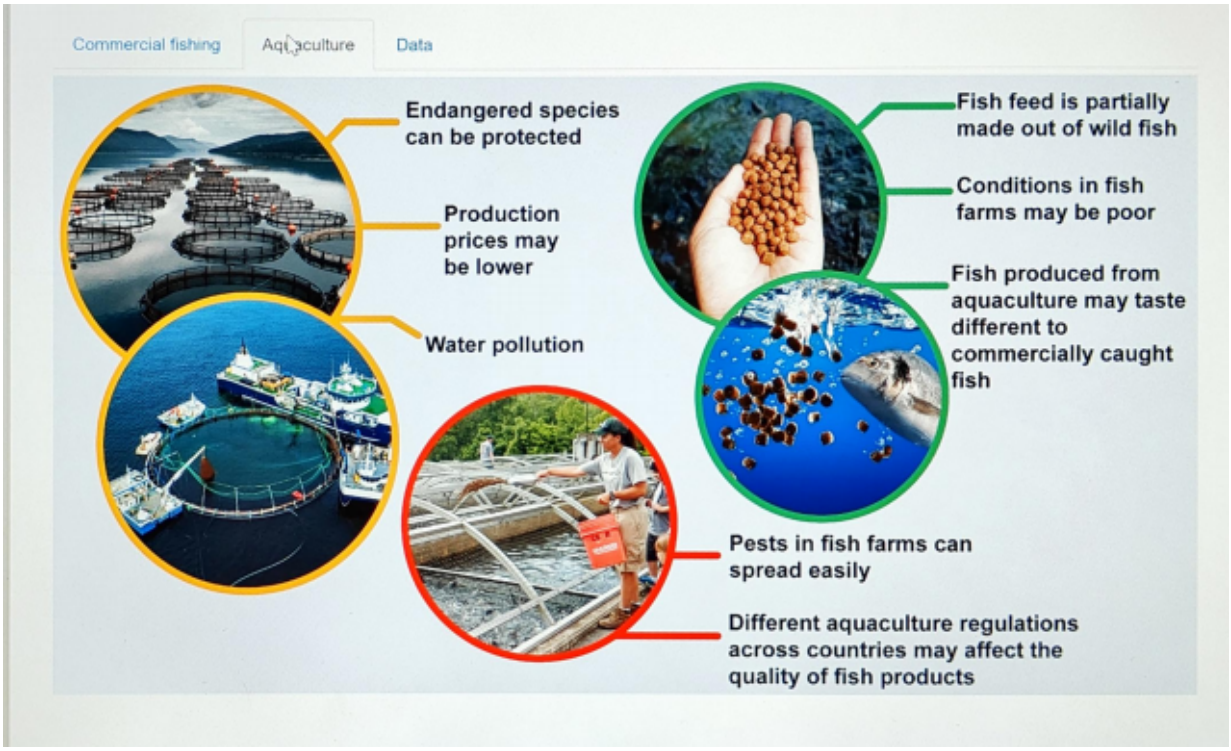
**Question 8** (16 marks)

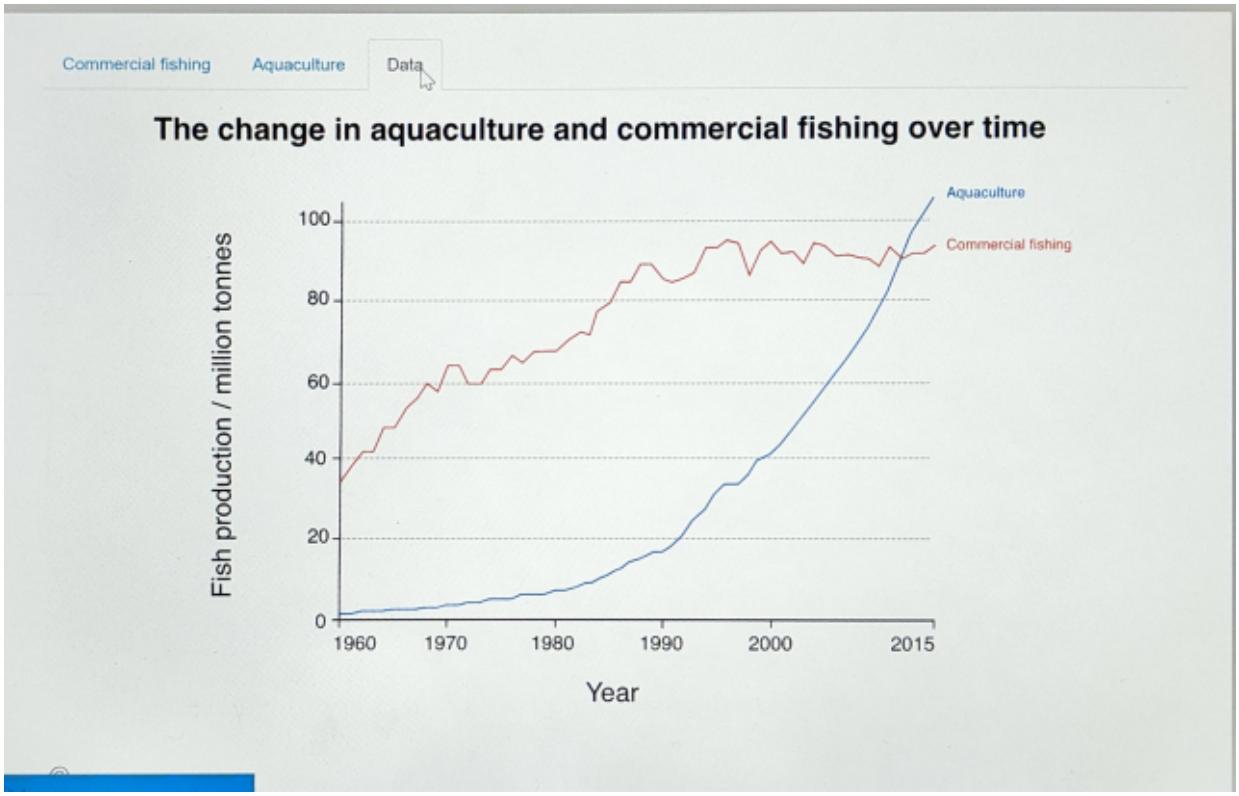
In commercial fishing, fish are caught from their natural habitats such as lakes, oceans and rivers on a large scale. From 1970 onwards, aquaculture techniques have been used more widely. Aquaculture is the farming of fish in controlled environments.

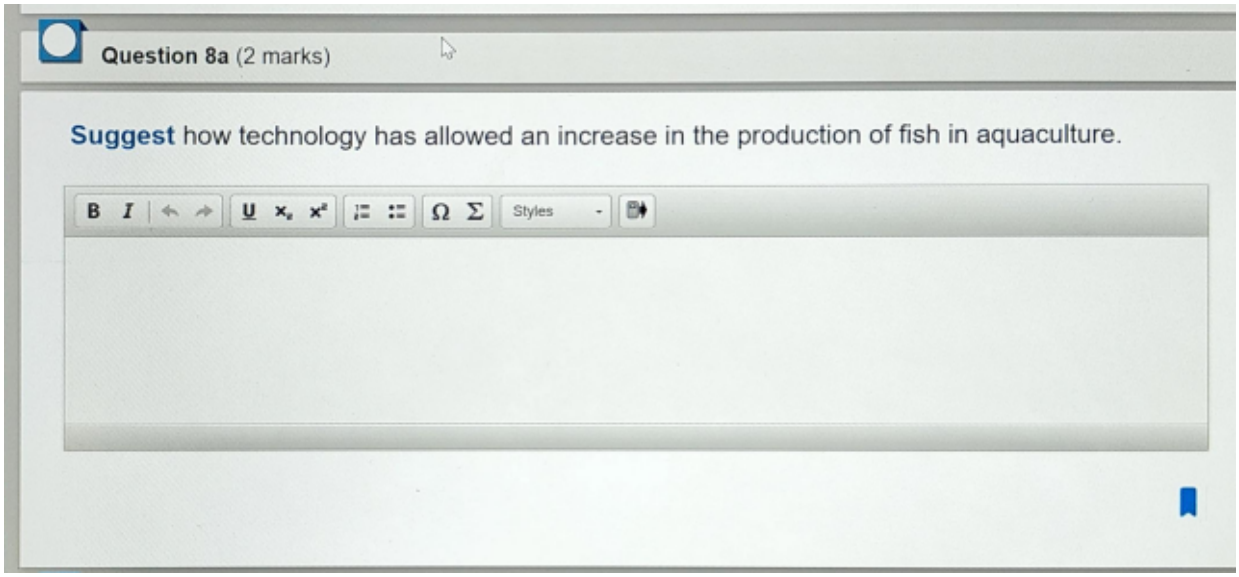
Aquaculture can be in land-based systems in tanks, or in enclosed areas of lakes and oceans. There are many species currently farmed around the world, which include salmon, trout, tuna and tilapia.

Aquaculture can produce large quantities of farmed fish. Farmed fish are grown from egg to harvest in a controlled environment. Farmed fish are given hormones to increase their breeding rates. The fish are also fed diets designed to maximize their growth. These methods have increased the production of farmed fish very rapidly, as have technologies such as monitoring equipment and sensors. Aquaculture now produces over 100 million tonnes of fish per year, while commercial fishing production has remained constant at around 90–95 million tonnes for the past 30 years.


Commercial fishing
Aquaculture
Data


Commercial fishing
Aquaculture
Data
Endangered species can be protected
Production prices may be lower
Water pollution
Fish feed is partially made out of wild fish
Conditions in fish farms may be poor
Fish produced from aquaculture may taste different to commercially caught fish
Pests in fish farms can spread easily
Different aquaculture regulations across countries may affect the quality of fish products


Commercial fishing
Aquaculture
Data
The change in aquaculture and commercial fishing over time
Fish production / million tonnes
100
80
60
40
20
0
1960
1970
1980
1990
2000
2015
Year
Aquaculture
Commercial fishing


Question 8a (2 marks)
Suggest how technology has allowed an increase in the production of fish in aquaculture.
Styles

**Question 8b** (14 marks)

Using the information provided and knowledge from your MYP studies, **discuss** and **evaluate** the impact of aquaculture to solve the problem of feeding the growing human population. In your answer, you should include:

- a discussion of how aquaculture would impact quality and quantity of food supplies
- the positive and negative environmental impacts of aquaculture
- the positive and negative economic impacts of aquaculture
- a concluding appraisal justifying your opinion on the use of aquaculture compared to commercial fishing.