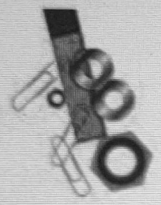
Question 1 (10 marks)



Knowing and understanding

This task (questions 1 to 3) addresses the key concept of **change** and focuses on **criterion A** (Knowing and understanding). In this task, you will look at different examples of change in physics.

Magnets can be used to induce a current in a wire.

Question 2 (9 marks)

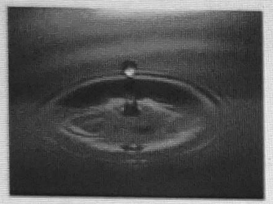
Dry ski slopes are an example of artificial landscapes built by humans.

Question 3 (9 marks)

Different types of heat transfer should be considered when building a dry ski slope.

Scroll down to continue

Question 4 (19 marks)



Investigation skills

This task (questions 4 to 6) addresses the key concept of **relationships** and focuses on **criterion B** (Inquiring and designing) and **criterion C** (Processing and evaluating).

Some of the earliest clocks used water.

Question 5 (13 marks)

Investigating how the time measured by a water clock is related to the volume of the water.

Question 6 (16 marks)

Investigating how the time measured by a water clock is related to the height of the water.

Scroll down to continue

Question 7 (10 marks)

Applying science

The global context is **orientation in space and time** with a focus on **natural and human landscapes and resources.** This task (questions 7 and 8) addresses the key concept of **systems** and assesses **criterion D** (Reflecting on the impacts of science).

Population growth and increased industrialization have led to increased demand for electrical energy in China.

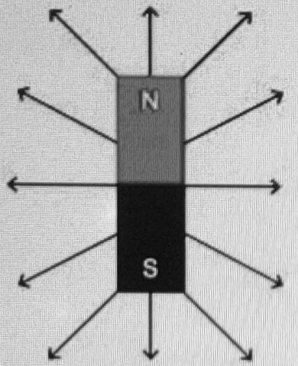
Question 8 (14 marks)

The world's largest hydropower project was built to meet increased demand for electrical energy.

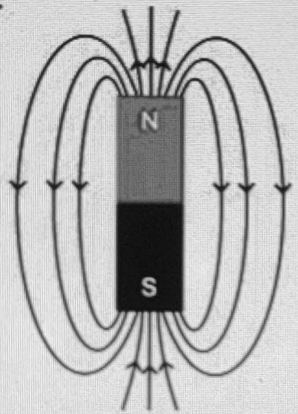
Question 1a (1 mark)

Select the diagram that correctly shows the magnetic field lines around a bar magnet.

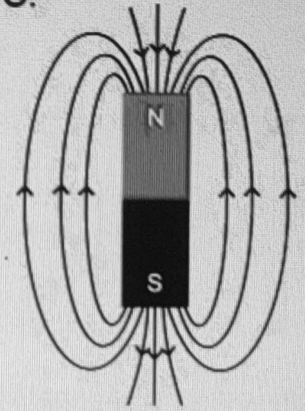
A.



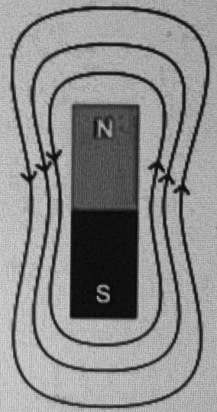
B.



C.



D.



©

Select

Select
A
B
C
D

Question 1b (2 marks)

Question 1b (2 marks)

Faraday performed an experiment in which he moved the bar magnet through the coil of wire. He noticed at certain times that there was an induced current flowing in the coil of wire. He noted the following observations:

- the induced current only flowed for a short time
- if the magnet was entering the coil, the current would flow in the opposite direction compared to when the magnet was leaving the coil
- the current was greater when the number of turns on the coils was increased.

Suggest two additional ways that the size of the current could be increased.

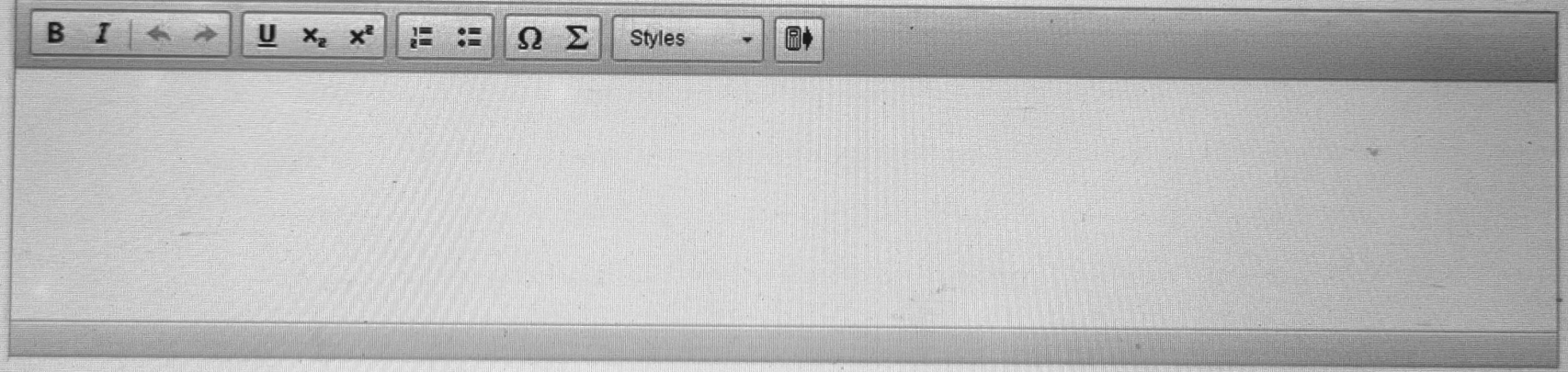
1.

2.

Scroll down to continue

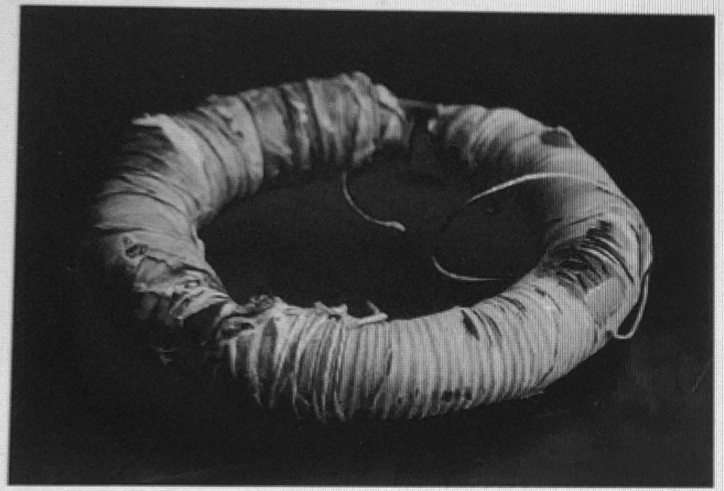
Question 1c (1 mark)

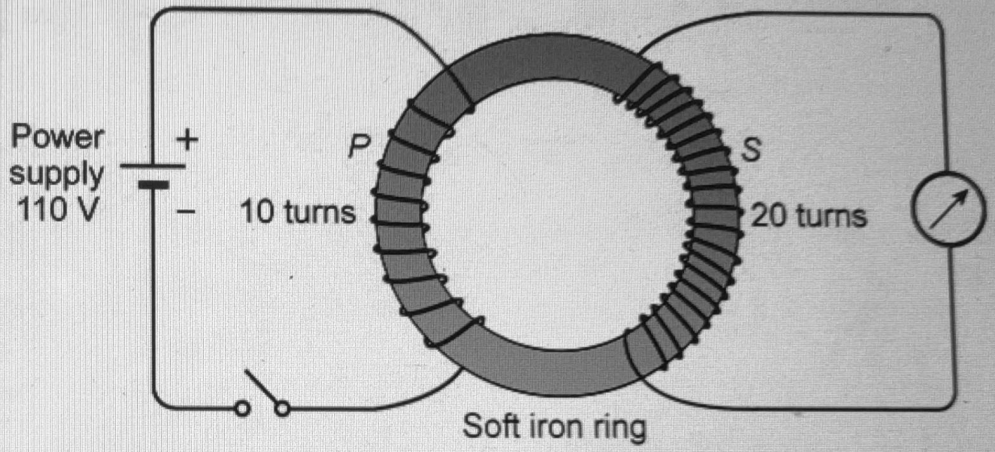
The bar magnet is turned so that the south pole enters the coil first. **Predict** the change on the induced current.



Question 1d (2 marks)

In another experiment, Faraday found that a current could be induced in a coil of wire near to a coil carrying an electric current. This led to the development of a device called a transformer.





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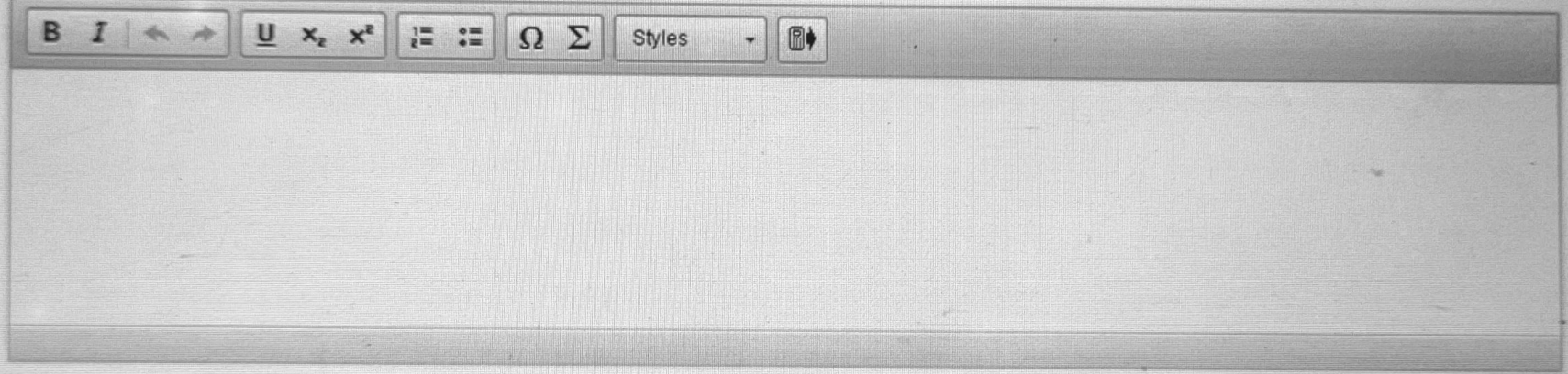
Assume that the transformer is 100 % efficient and **calculate** the value of the voltage on the secondary coil.

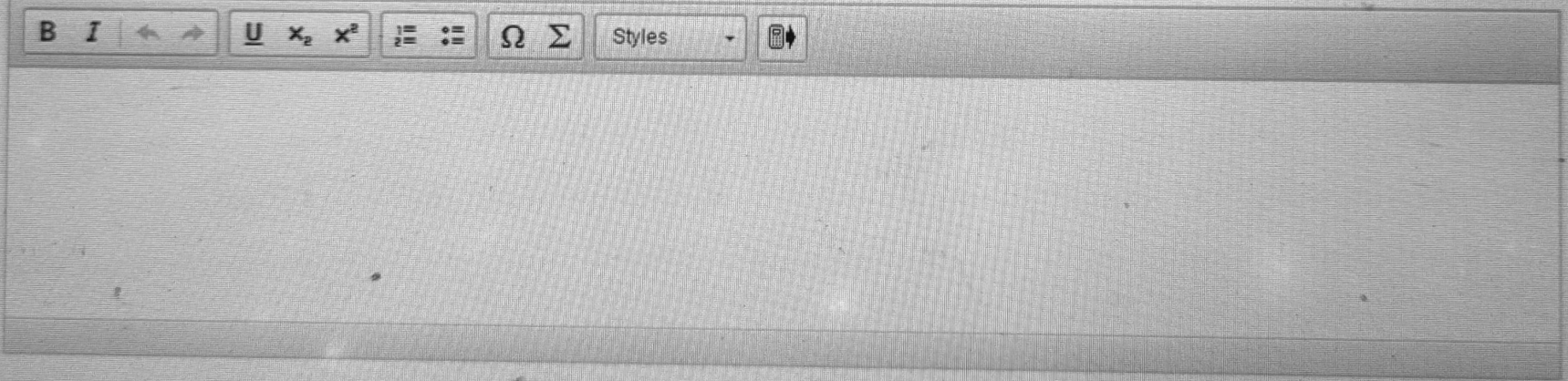


Question 1e (2 marks)

The following data is taken from a real transformer which is not 100 % efficient.

Primary coil	Secondary coil
24 V	12 V
2.50 A	4.75 A

Calculate the efficiency of this transformer.



Scroll down to continue

Question 1f (2 marks)

Faraday performed this experiment using direct current. **Suggest** why modern transformers use alternating current.

B I U x_a x^a Ω Σ Styles

Scroll down to continue

Question 2 (9 marks)

Skiing requires conditions that humans have tried to reproduce when building artificial landscapes. Dry slopes and indoor snow slopes are examples of these artificial landscapes.

©

Question 2a (3 marks)

Different variables are relevant to studying skiing. **Select** the most appropriate description for each variable.

Draggable:

- Energy transformed per unit time
- Speed in a particular direction
- Amount of energy that can be transformed by a force
- Energy stored due to the position of an object
- Energy due to the motion of an object

Velocity	
Kinetic energy	
Power	

Question 2b (1 mark)

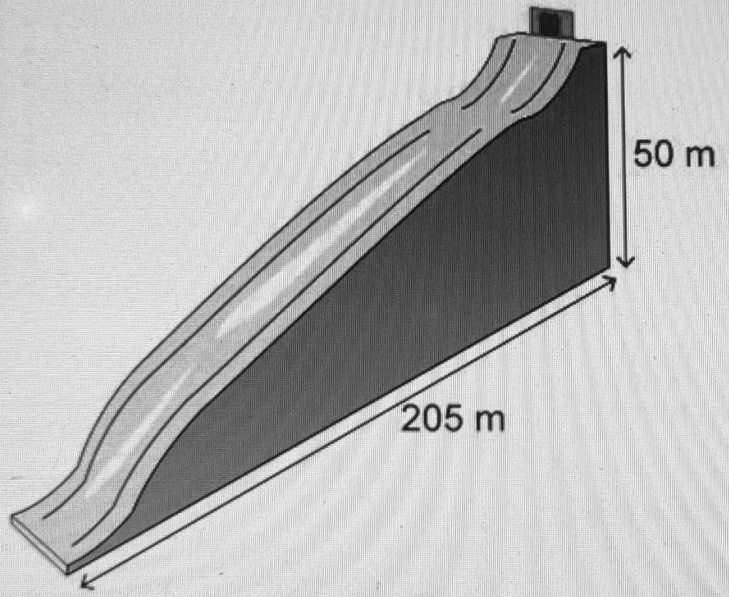
Ski facilities use lifts to take users uphill. **Select** the type of energy that a skier gains when taken uphill.

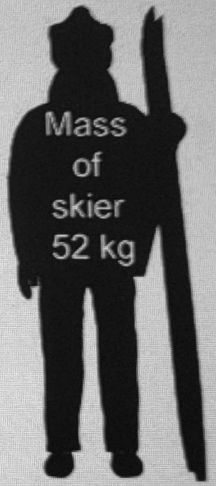
Select

- Select
- Nuclear
- Elastic potential
- Thermal
- Gravitational potential

Question 2c (3 marks)

Calculate the size of the energy in part (b) using the diagram. Give your answer in kilojoules (kJ) and assume the gravitational field strength is 10 ms^{-2}.





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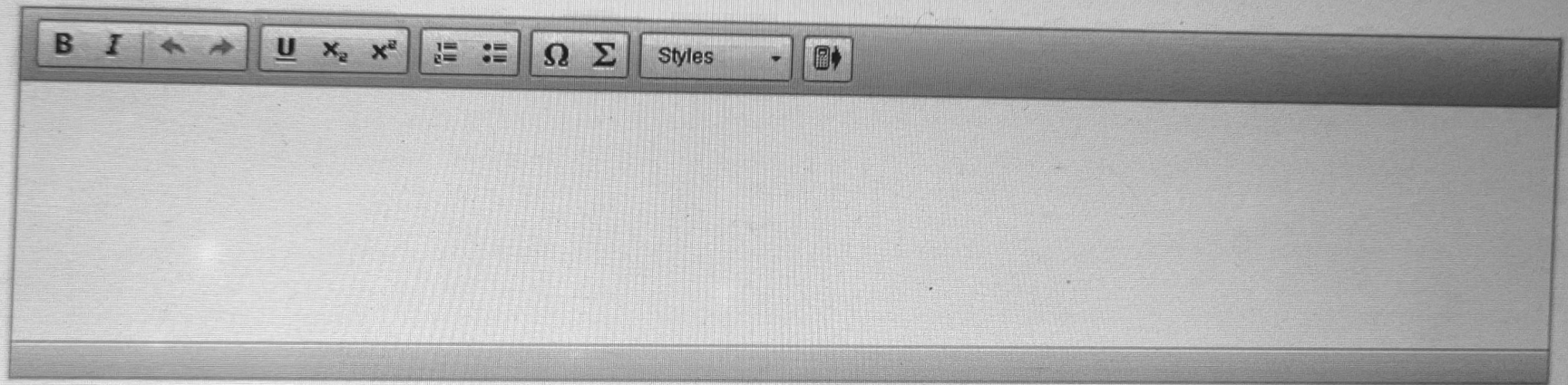
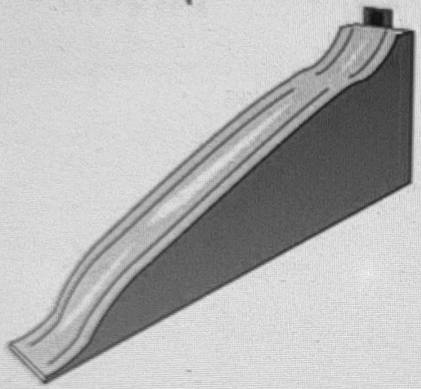

B I
U
Ω Σ
Styles

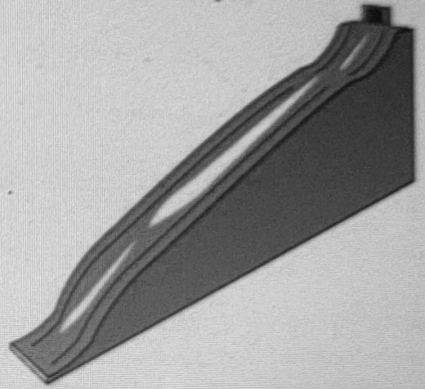
Question 2d (1 mark)

Tests to compare the behaviour of a "real" snow slope (A) and an indoor ski slope (B) show that a snow slope is 40 % efficient. This means that 40 % of the energy of the skier at the top is converted to kinetic energy at the base of the slope.

A: Real snow slope



B: Indoor ski slope



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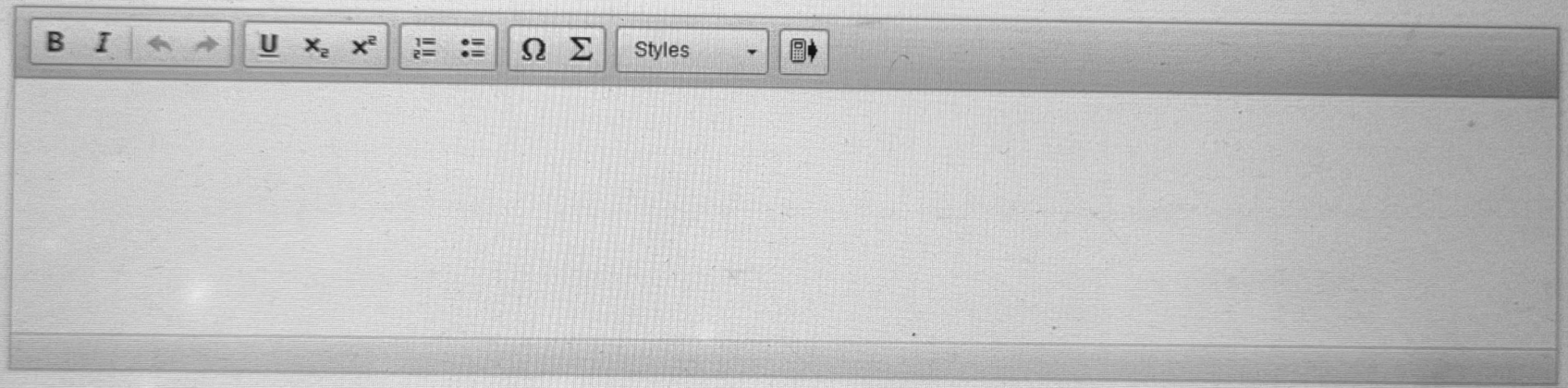
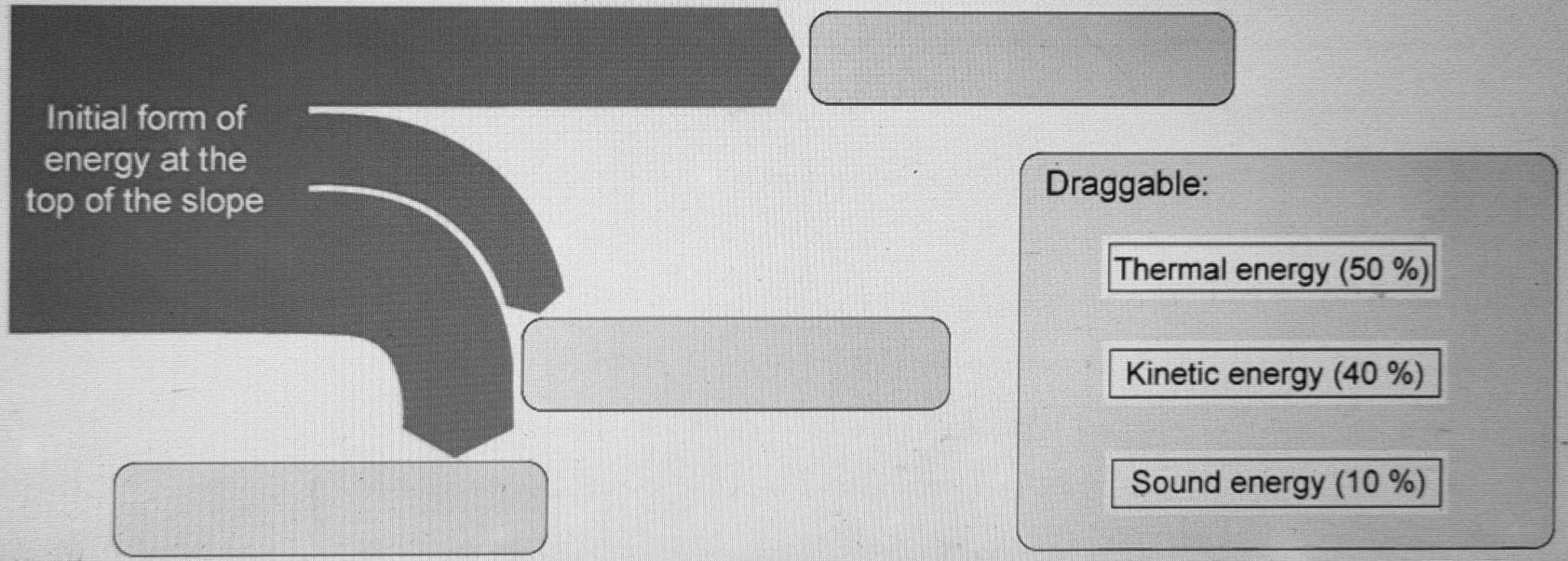
State the force responsible for the 60 % energy loss.



Question 2e (1 mark)

Select the forms of energy outputs involved in the motion of a skier who starts from rest at the top of the slope and reaches the base.



Scroll down to continue

Question 3 (9 marks)

In addition to the efficiency of indoor snow slopes, environmental conditions such as temperature need to be reproduced.

Question 3a (1 mark)

In the design of the cooling system for an indoor snow slope, a decision must be made about the position of the air cooling units. The air cooling units are positioned at the top of the building.

Select the type of heat transfer relevant to this situation.

Select
- Select
- Conduction
- Convection
- Induction
- Radiation

(3 marks)

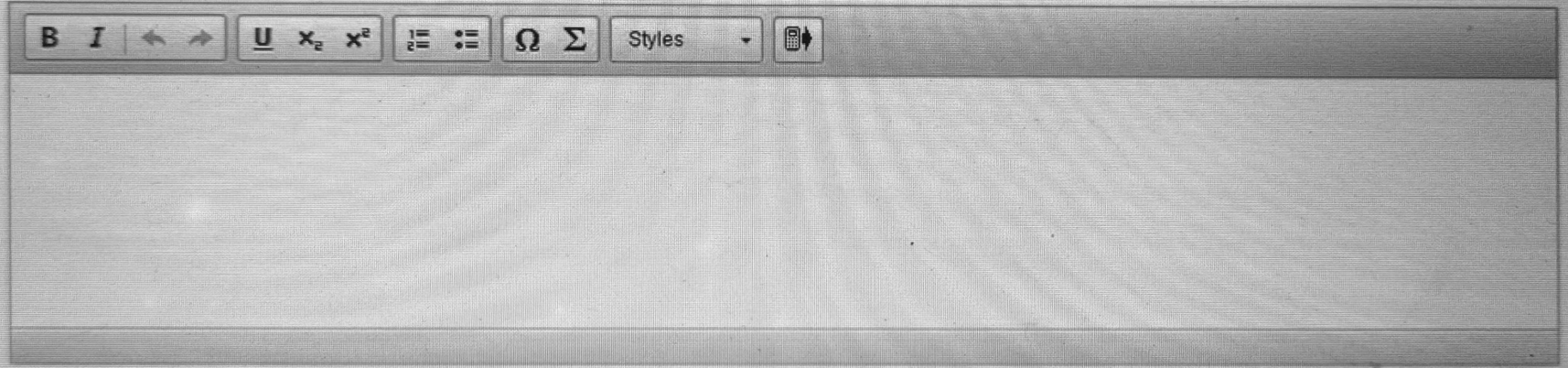
Describe why the air cooling units are positioned at the top of the building. Use scientific terminology in your answer.

B I U x_2 x^2 Ω Σ Styles

Scroll down to continue

Question 3b (3 marks)

Describe why the air cooling units are positioned at the top of the building. Use scientific terminology in your answer.



Question 3c (3 marks)

One type of cooling unit is based on the principle of cooling by evaporation. Dry air is passed over the surface of a liquid. As the dry air passes over the liquid, the liquid cools down.

Suggest an explanation for this process.

Question 3d (2 marks)

State and **justify** the colour that you would paint the outside of the building containing an indoor ski slope to reduce the effects of heating by sunlight.

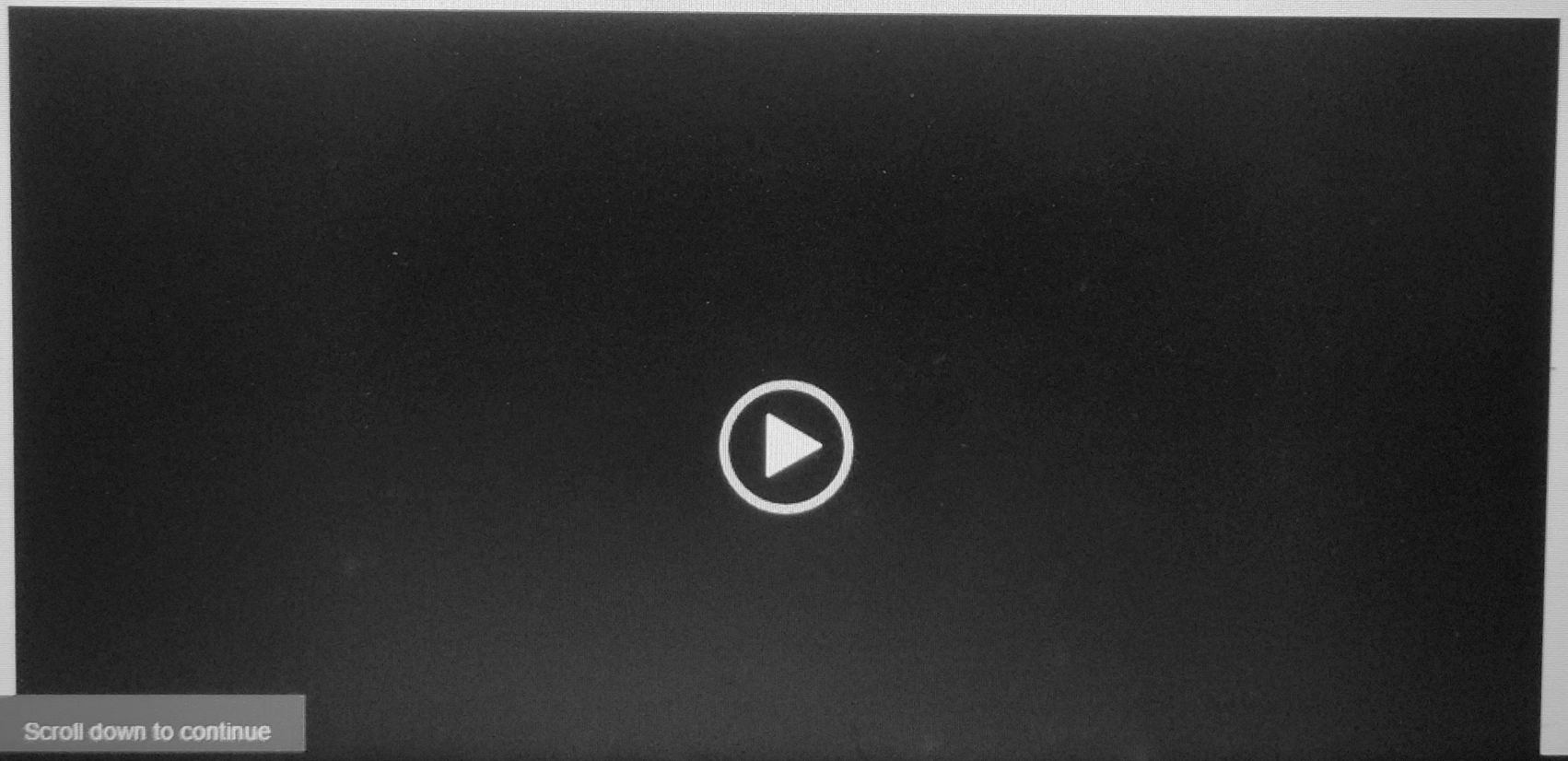
B I U x_2 x^2 Ω Σ Styles

Question 4 (19 marks)

Question 4a (1 mark)

Video | Video script

Watch the following short animation about water clocks.



Scroll down to continue

Video | Video script

Water clocks are amongst the world's oldest timing devices. They use the flow of water to measure the passing of time.

Throughout history, many designs have been developed incorporating mechanical dials to record time. However, in their simplest form these designs are grouped into two types: inflow and outflow.

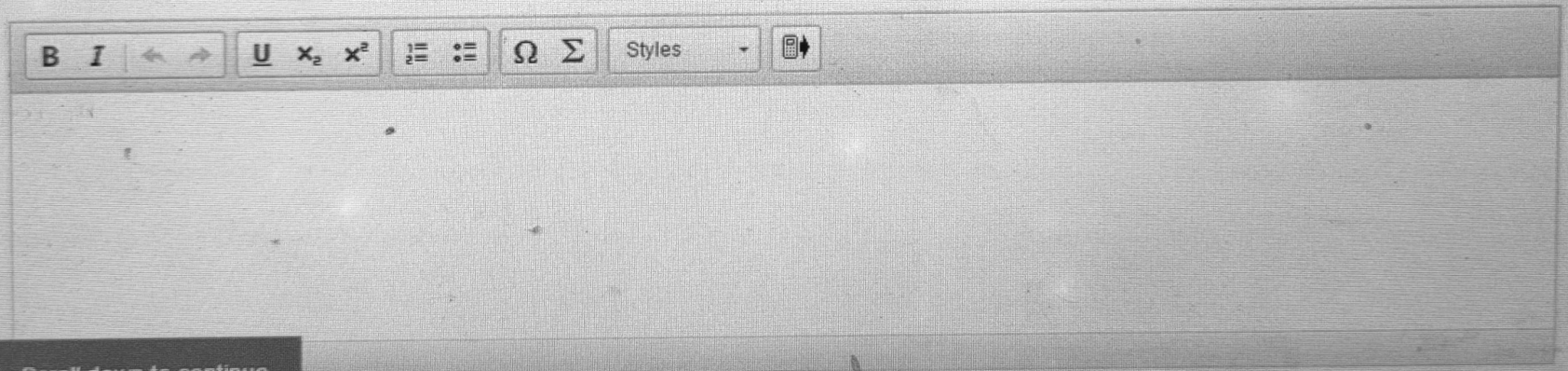
An inflow water clock uses a constant flow of water into a fixed container. The time is recorded either when the water reaches the top of the container or against a scale as the water rises.

An outflow water clock uses a prefilled container of water. As the water drains out of the container the time is recorded either when the water has finished draining and the container is empty, or against a scale as the water falls.

In the video, you will have seen that one type of water clock is known as an inflow water clock. This clock measures time as water flows from a hole at the bottom of a container of water. Time is measured as this flow of water fills up a second container.

You have been asked to investigate how the area of the hole from which the water flows affects the time it takes to fill the second container.

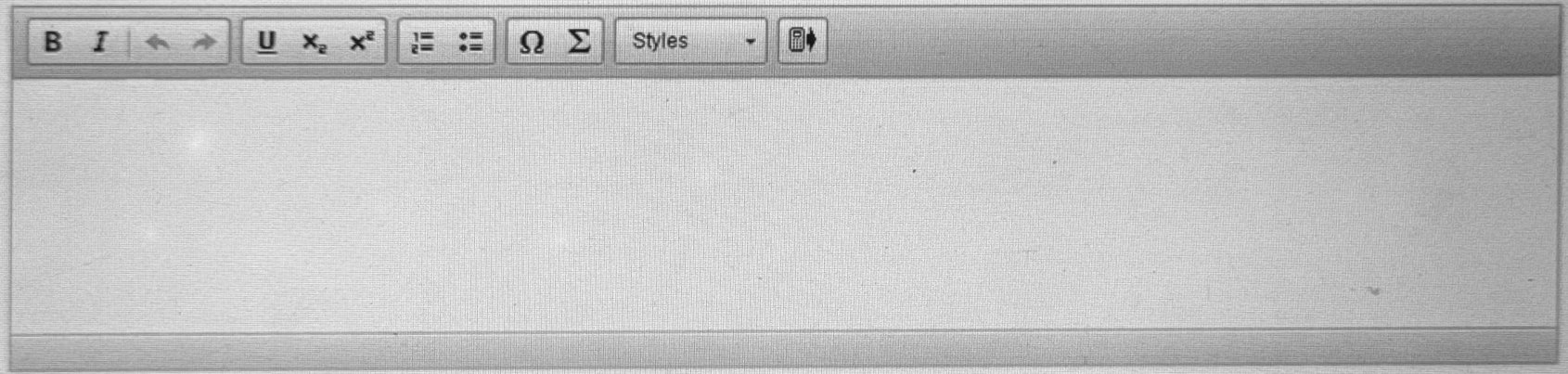
State the question that could be answered in this scientific investigation.



Scroll down to continue

Question 4b (3 marks)

Formulate and **explain** the hypothesis that this question would test.



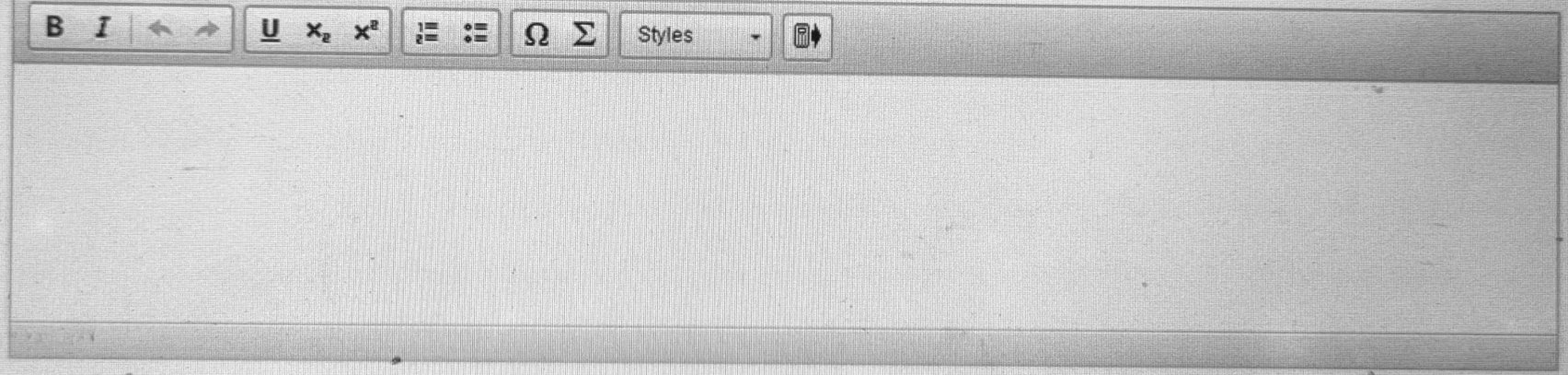
Question 4c (3 marks)

Below is a list of variables for this experiment. **Select** the appropriate description for each of the variables used.

Independent Variable	Dependent Variable	Control Variable	
☐	☐	☐	Type of liquid
☐	☐	☐	Area of the out-flow tube
☐	☐	☐	Time it takes for the second container to fill
☐	☐	☐	Volume of second container
☐	☐	☐	Viscosity of the liquid

Question 4d (2 marks)

Identify two pieces of measuring equipment you would need to perform this experiment.



Question 4e (3 marks)

Describe the data you will collect.

B I U x_2 x^2 Ω Σ Styles

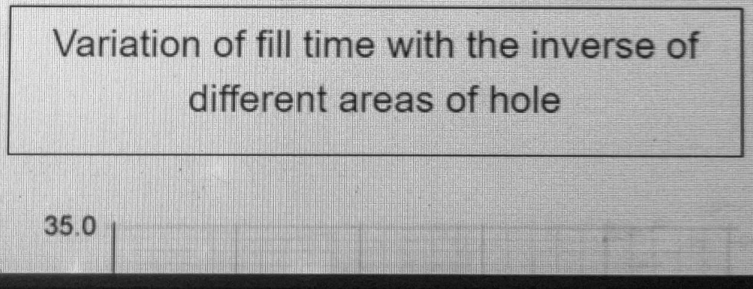
Question 4f (1 mark)

The whole class collected their data and presented it using the following two graphs.

Suggest an appropriate title for the first graph.

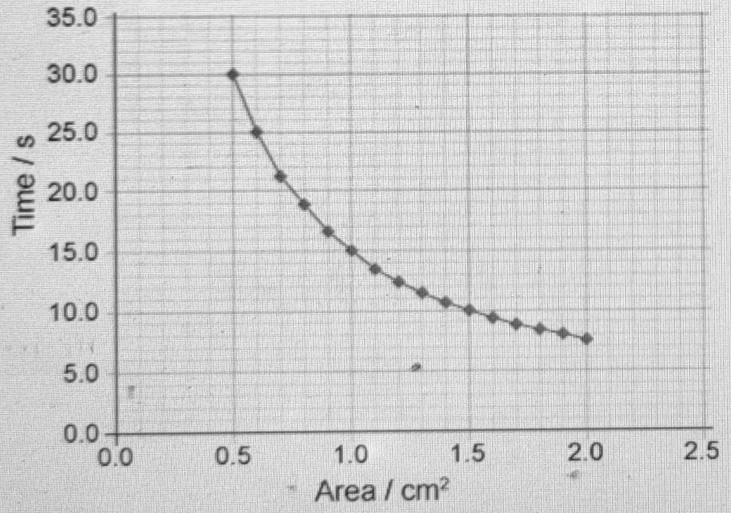
Graph 1

Graph 2



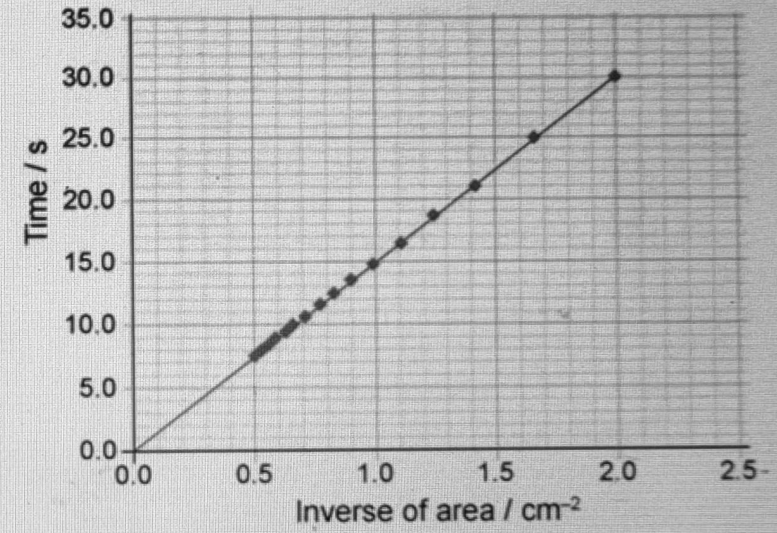
Scroll down to continue

Graph 1



Graph 2

Variation of fill time with the inverse of different areas of hole



Scroll down to continue

Question 4g (2 marks)

Describe the relationship between the fill time and the area shown in the second graph.

B I U x_2 x^2 Ω Σ

Styles

Question 4h (2 marks)

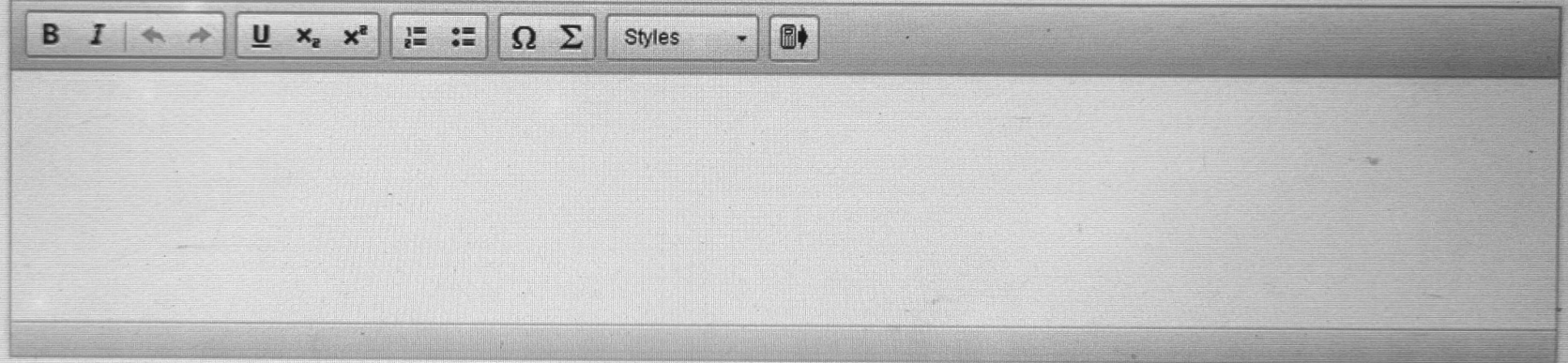
Find the constant of the proportionality from the graph.

B I U x_2 x^2 Ω Σ

Styles

Question 4i (2 marks)

Use your value from part (h) to **calculate** the area needed for a fill time of 90 seconds.



Question 5 (13 marks)

Another student decides to continue the investigation of inflow water clocks. She makes the following prediction: "If the volume of the container being filled increases, then the time measured will be longer."

Design an investigation that she could use to test this prediction. In your plan, you must include:

- the independent, dependent and two control variables
- the equipment you will use
- your method for manipulating the variables to collect sufficient data.

Scroll down to continue

Question 6 (16 marks)

A student decides to investigate the effect that the initial height of water in a tube has on the time taken for the tube to empty.

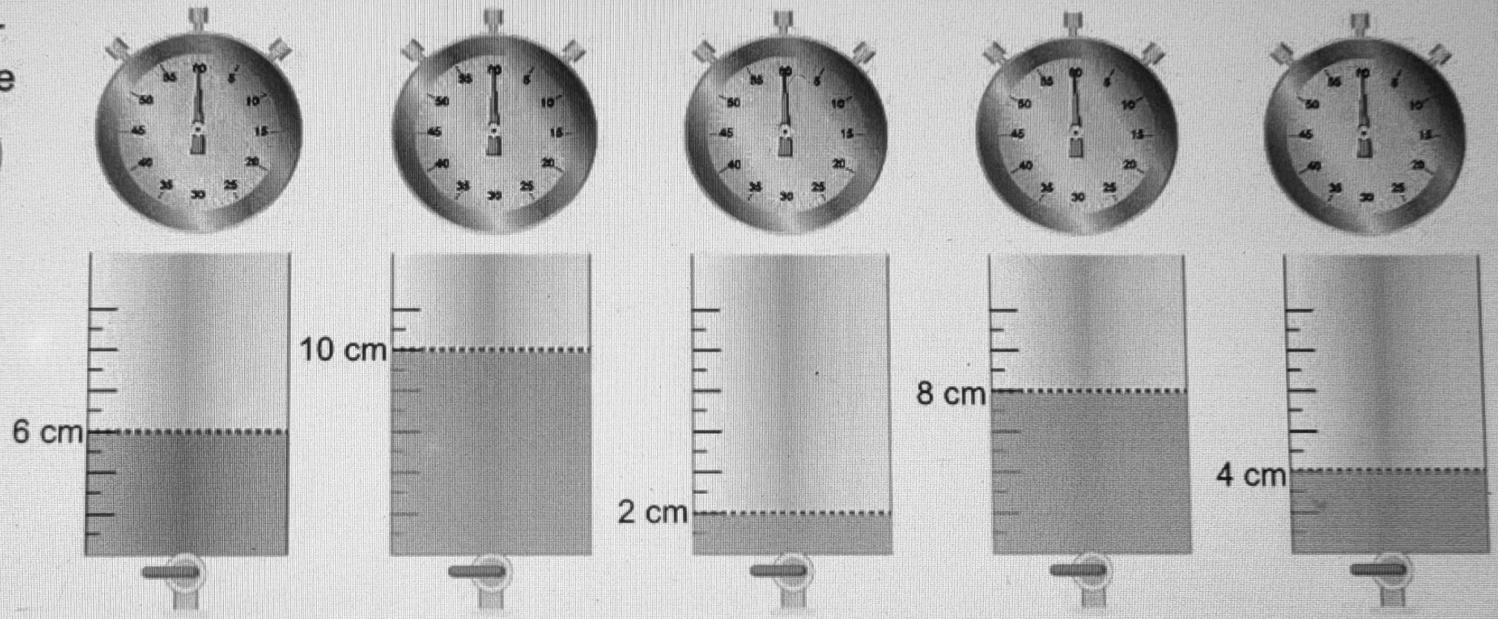
He adds water to five tubes, fitted with a tap at the bottom, at different heights and allows the water to drain out.

Question 6a (2 marks)

Water simulation | Final time 8 cm

Water release

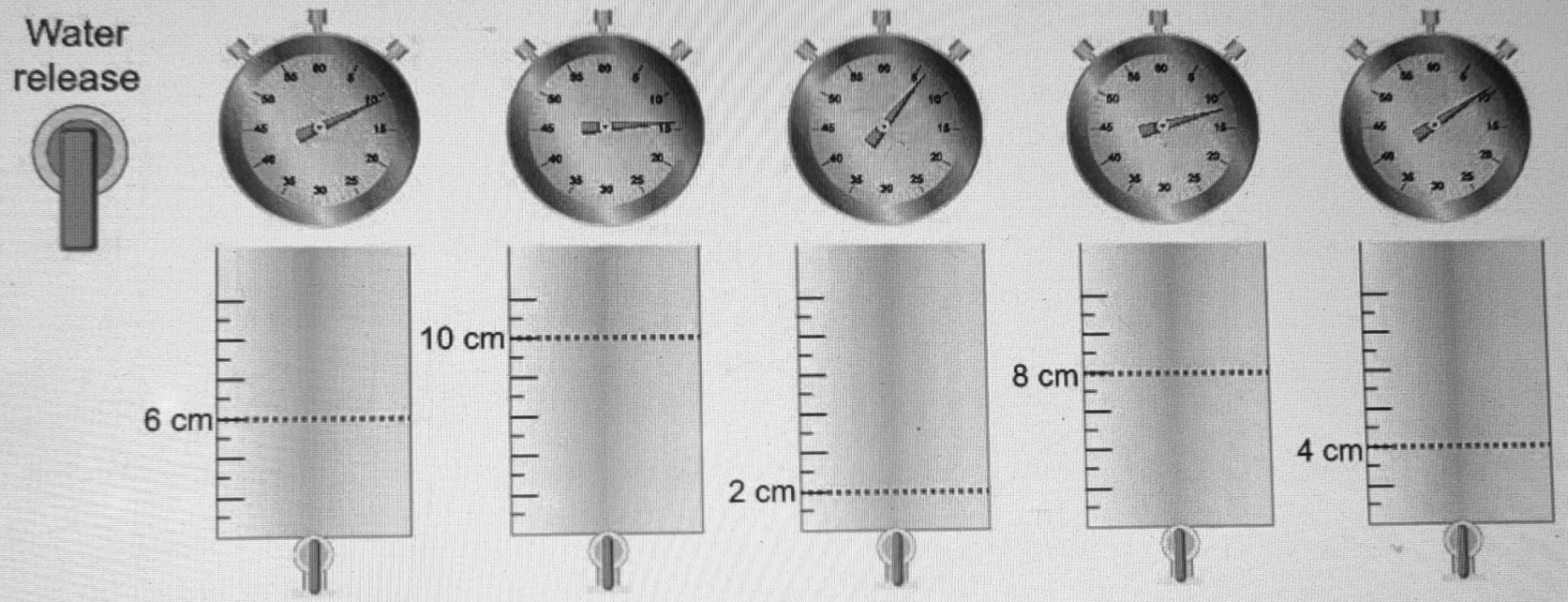
Start



0.0 s	0.0 s	0.0 s	?	0.0 s

Reset

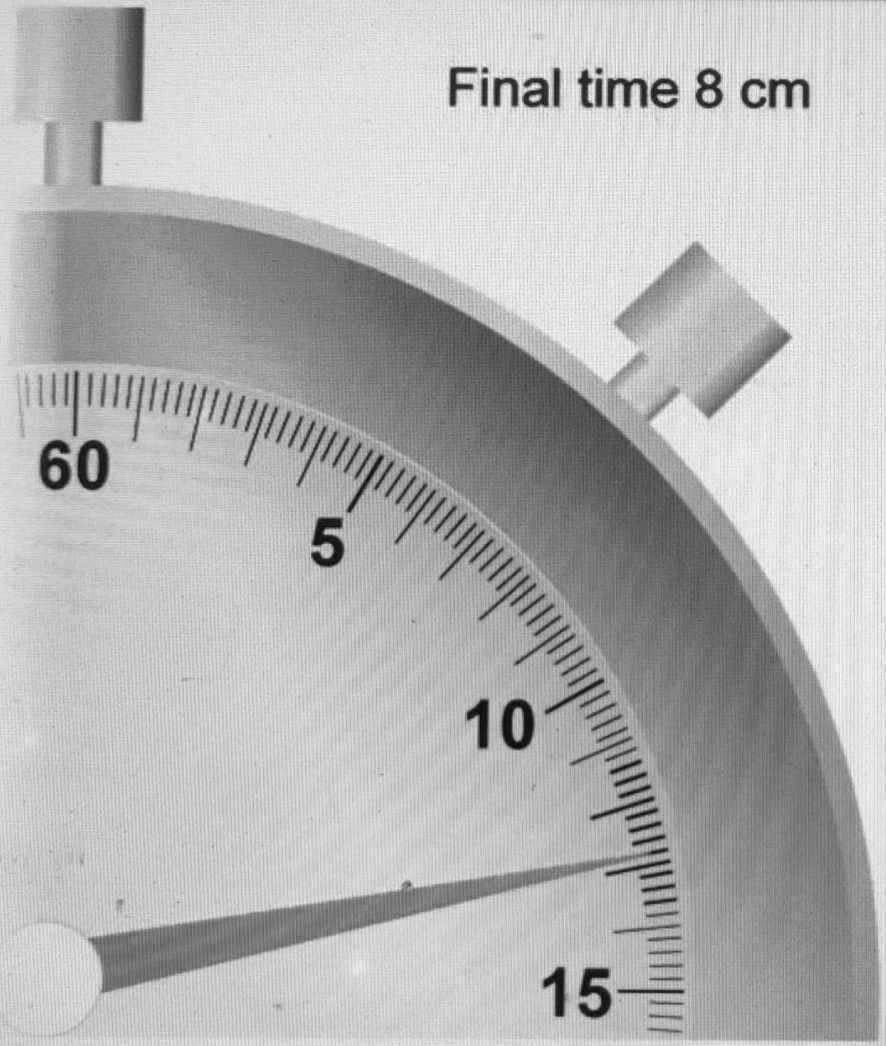
Water simulation | Final time 8 cm



Final time 6 cm	Final time 10 cm	Final time 2 cm	Final time 8 cm	Final time 4 cm
11.1 s	14.3 s	6.4 s	?	9.0 s

Reset

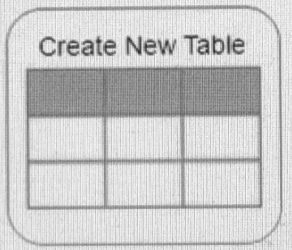
Water simulation | Final time 8 cm



The time for the fourth tube of water was not recorded by the student. **Measure** the time shown in the picture.

Question 6b (4 marks)

Organize and **present** the data from the water clocks into a suitable table. You should include the result from part (a) in your answer.



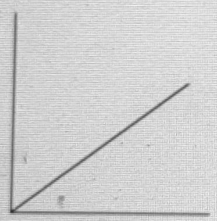
Reset

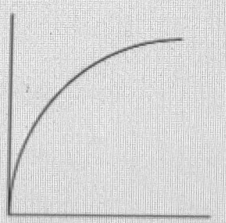
Question 6c (1 mark)

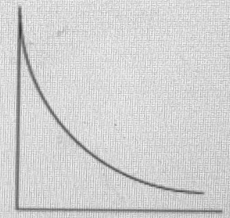
Before starting the experiment, the student writes the following hypothesis:

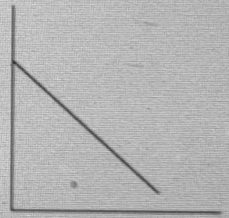
"If the height of the water in the tube doubles, there will be twice as much water, so the time taken to empty the tube will be proportional to the height of the water."

If the results of the experiment support the hypothesis, **select** the most appropriate graph that would represent the data.

A. 

B. 

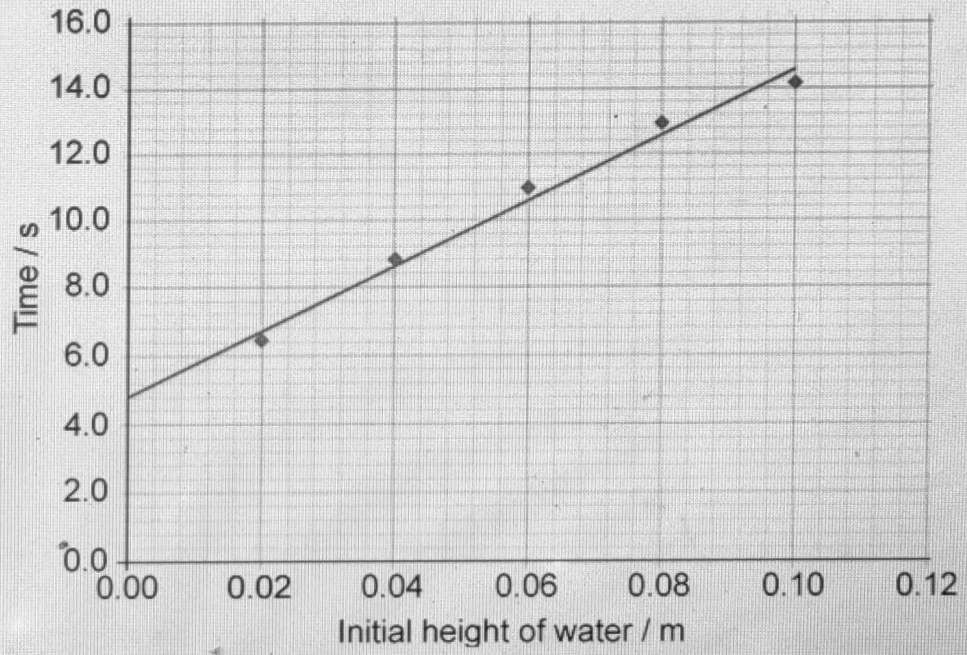
C. 

D. 

Question 6d (2 marks)

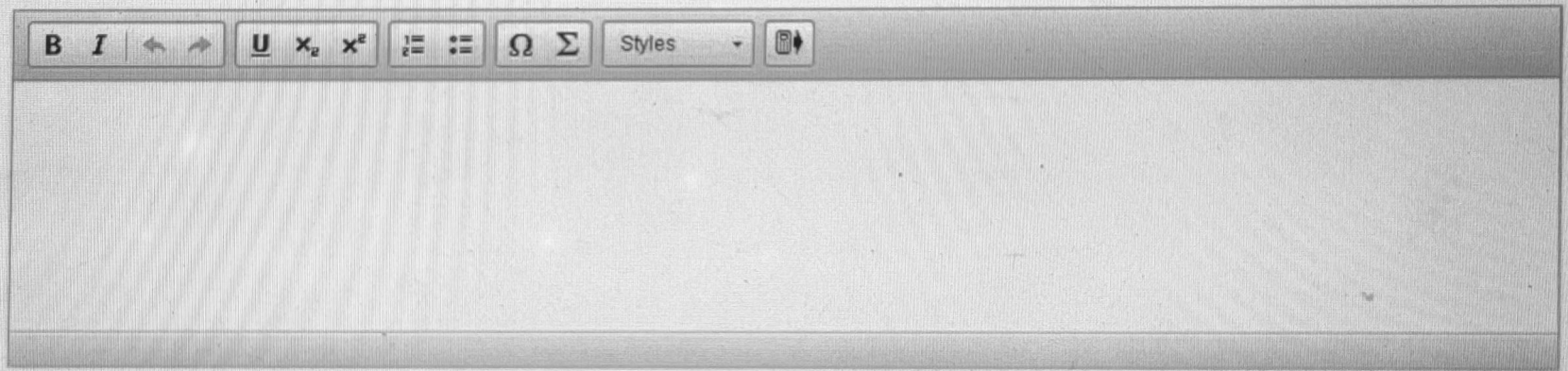
Once the student has completed the experiment, the results produce the following graph:

Variation of time to empty the water tube with initial height of water in the tube



When comparing the graph of the experiment to the hypothesis, the student declares that his results support the hypothesis made.

Use the graph to **outline** one reason why the student is incorrect to draw that conclusion.

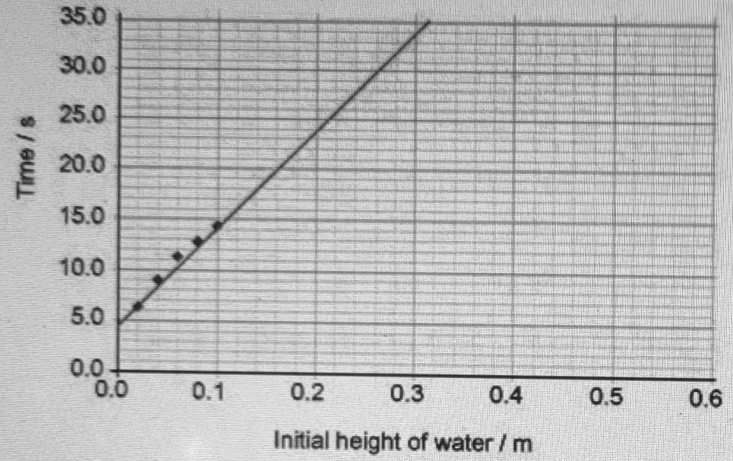


Question 6e (3 marks)

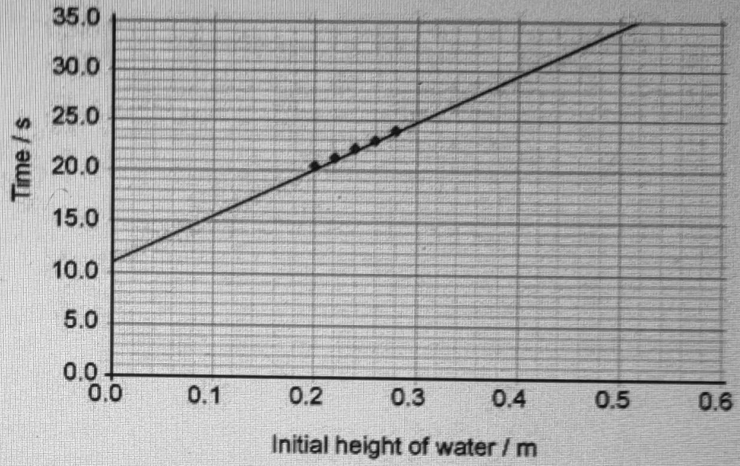
Three more students completed the experiment. The data is shown in the graphs below:

Variation of time to empty the water tube with initial height of water in the tube

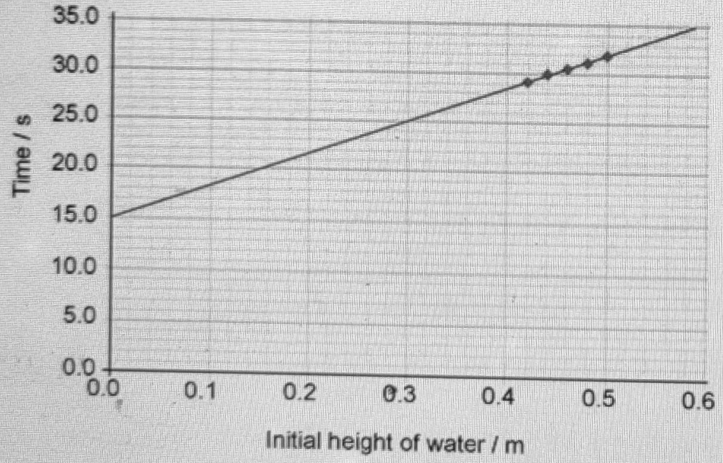
Data from method A



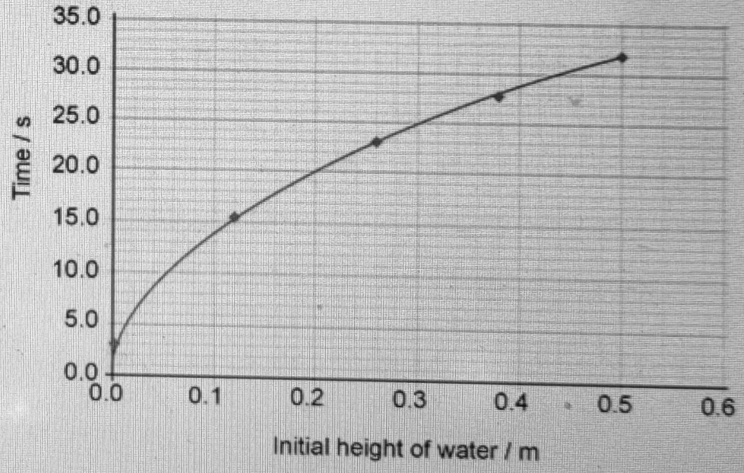
Data from method B



Data from method C



Data from method D



Use the graphs above to **evaluate** the method with the greatest validity.

B I U x_2 x^2 Ω Σ Styles

Question 6f (1 mark)

Suggest an alternative independent variable to extend this investigation into water clocks.

B I U x_2 x^2 Ω Σ Styles

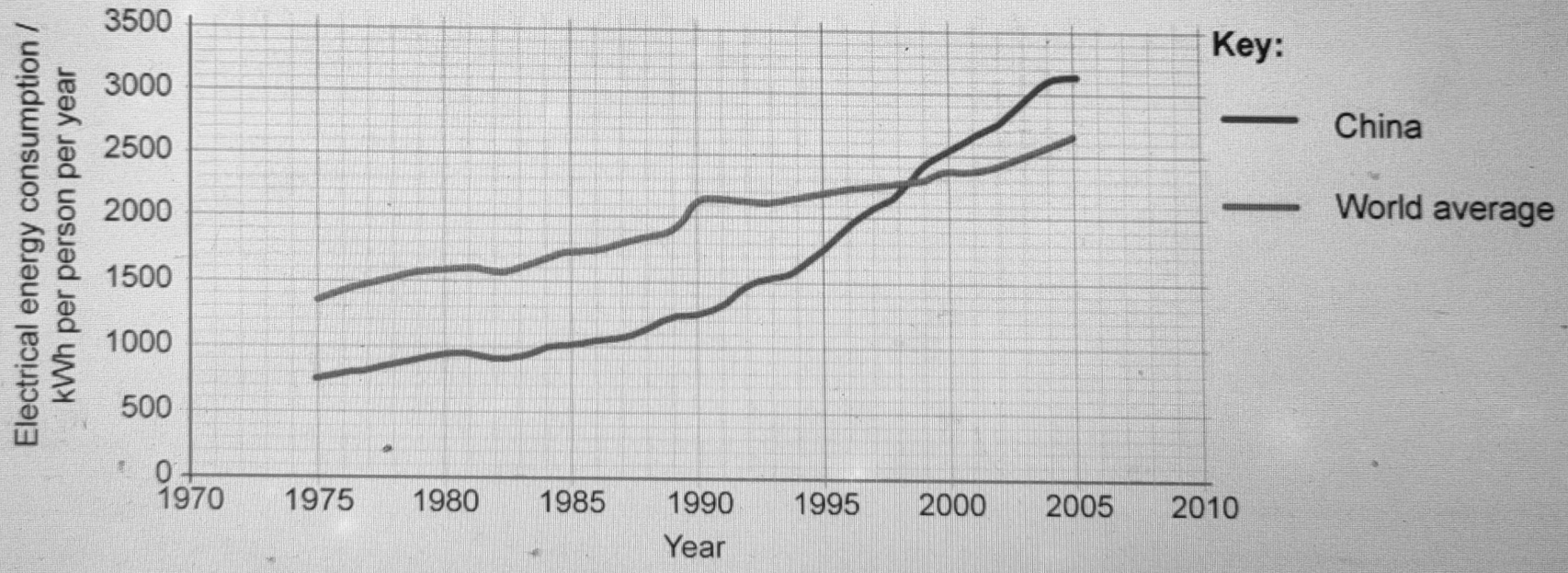
Question 6g (3 marks)

Formulate and **explain** a hypothesis that the extension would test.

Question 7 (10 marks)

Towards the end of the 20th century, China was faced with a significant increase in the demand for electricity.

Electrical energy consumption between 1975 and 2005 – China compared to the world average



The graph above shows the electrical energy consumption in kWh per person in China compared to the world average for the years 1975 to 2005.

Question 7a (2 marks)

Use the graph above to **outline** how China's electrical energy consumption per person changed over the 30-year period shown by comparison with the world average.

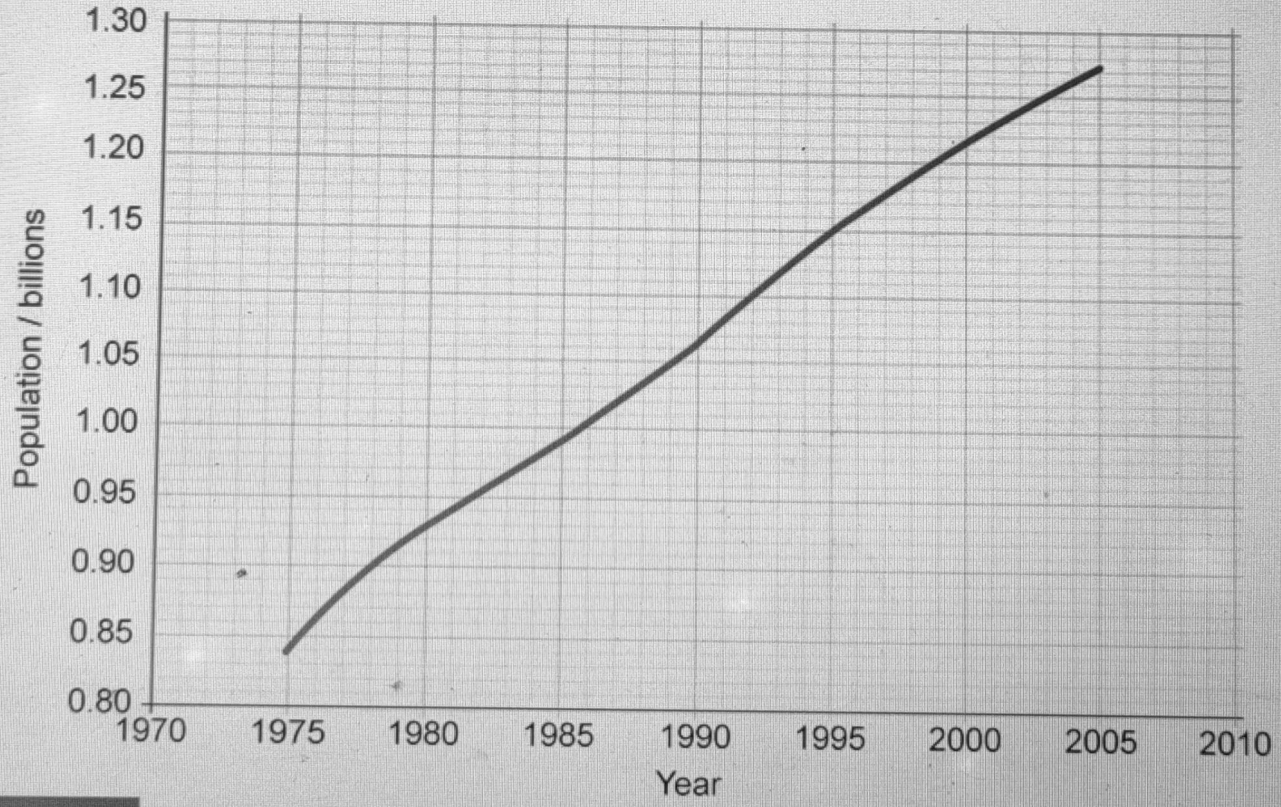
Question 7b (1 mark)

Suggest a possible reason for the trend you described in part (a).

Question 7c (2 marks)

The graph below shows the population of China during the same time period as the graph in part (a).

Population of China between 1975 and 2005



Scroll down to continue

Year

(c)

The total number of units of electrical energy consumed in China in 1975 was 6.24×10^{11} kWh.

Using appropriate data from the graphs, **calculate** the total electrical energy consumed in China in 2005. Show your working clearly. Give your answer in kWh.

B I U x_2 x^2 Ω Σ Styles

Question 7d (3 marks)

To meet this rising demand for electricity, China started looking for ways in which to supply the electricity its citizens needed without the need for fossil fuels.

State three environmental problems that are associated with using fossil fuels for the generation of electricity.

1.

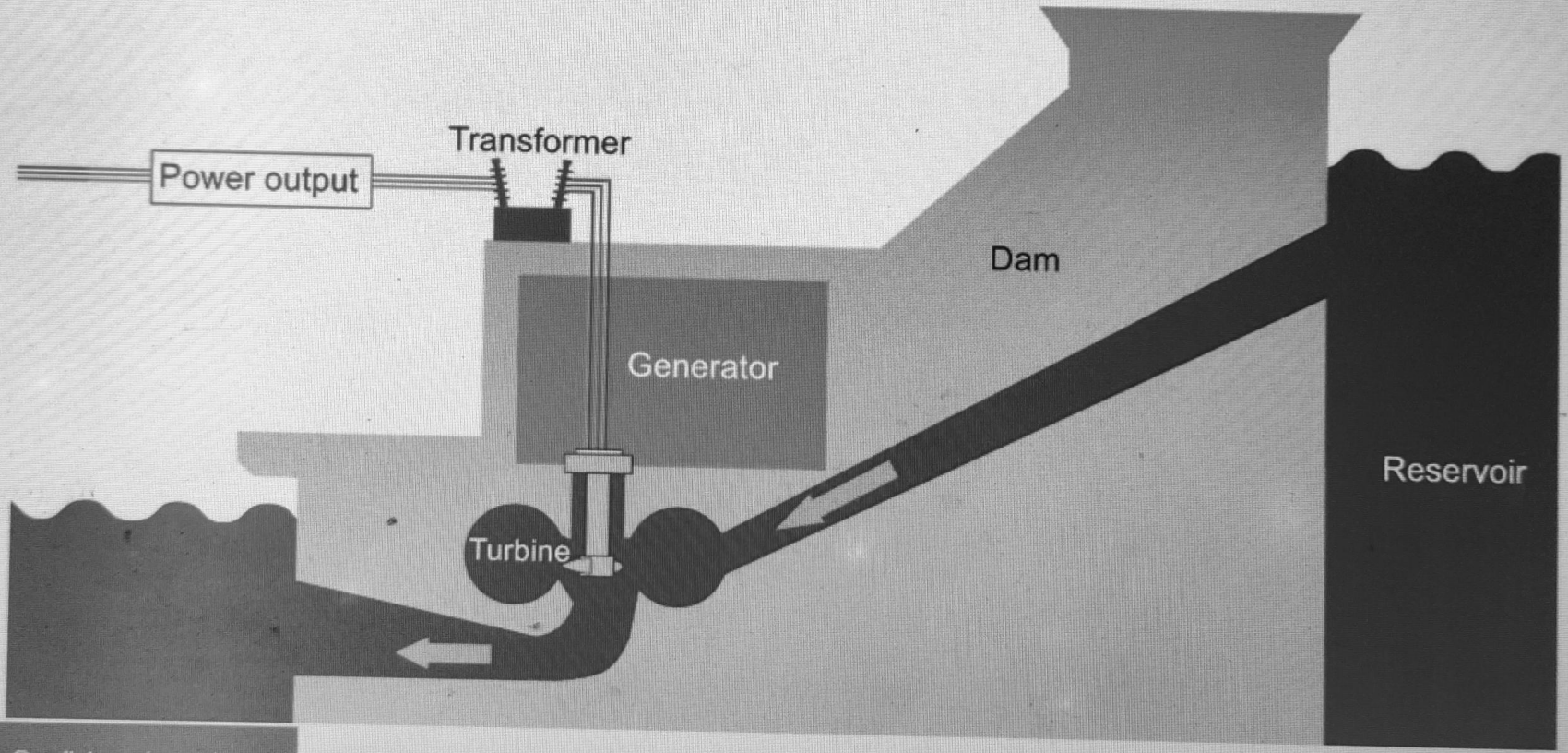
Scroll down to continue

2.

3.

Question 7e (2 marks)

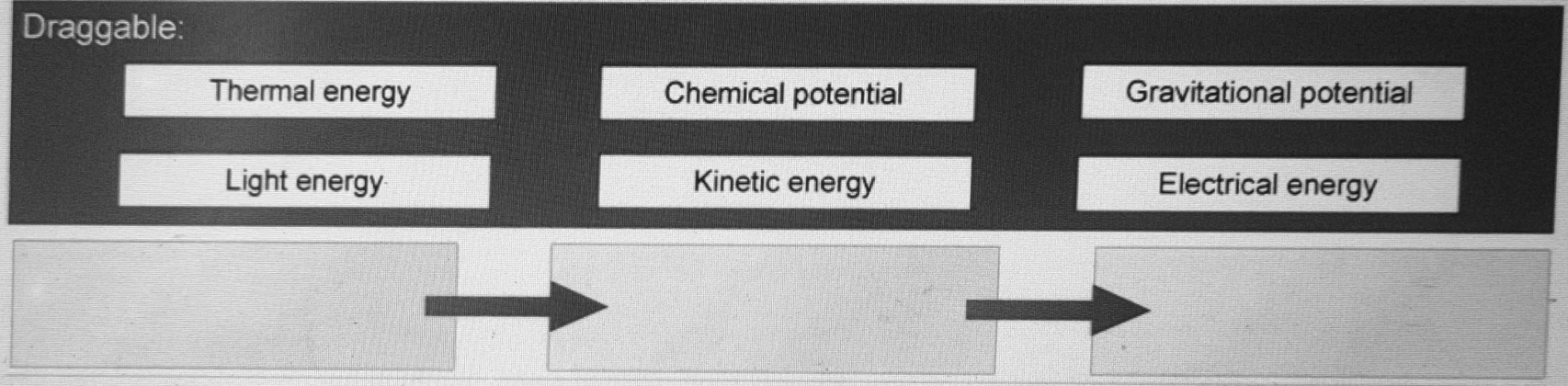
One alternative method for the generation of electricity is hydroelectric power. A typical hydroelectric facility is shown below.



Scroll down to continue

©

Drag and drop the energy forms shown below to **outline** the main energy transformations that take place in a hydroelectric power plant.

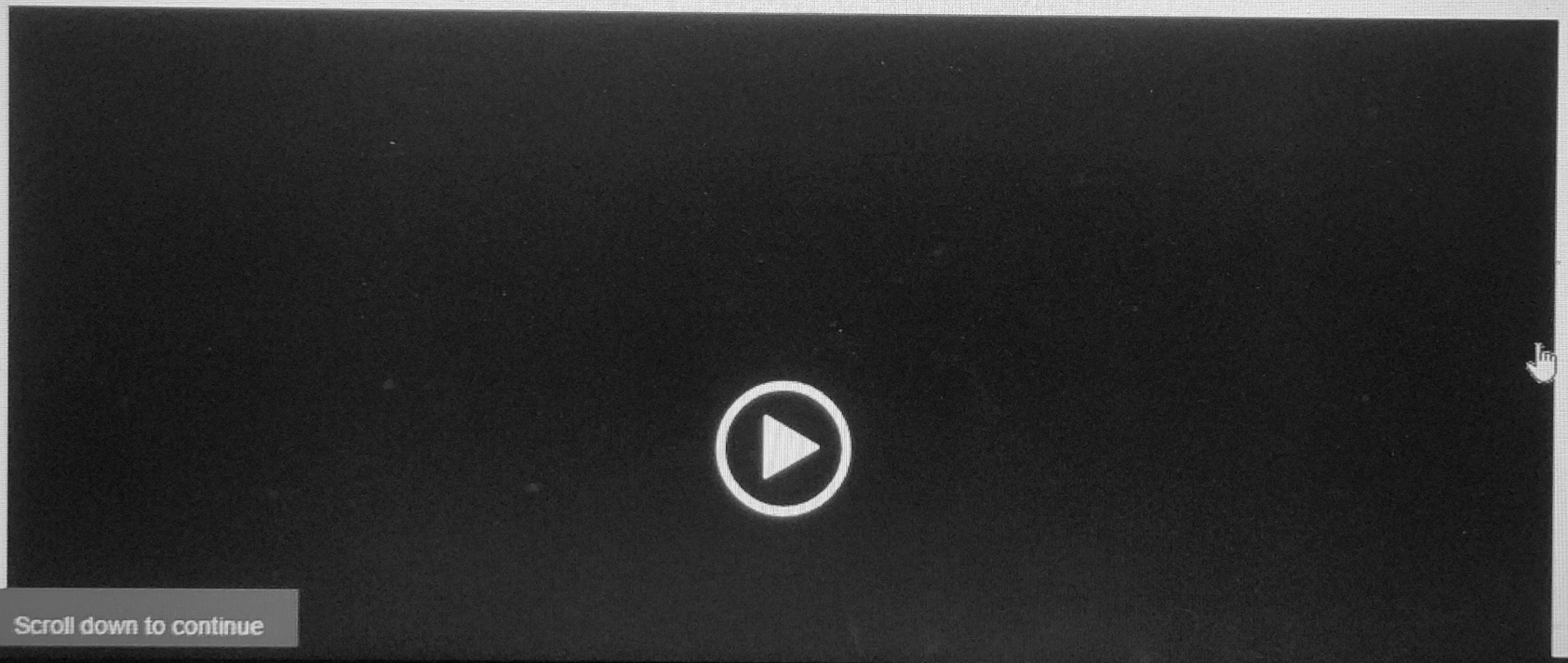


Question 8 (14 marks)

Video | Video script | Data

Towards the end of the 20th century, China planned the largest hydropower project the world had ever seen called the Three Gorges Dam. The dam, which was completed in 2006, remains one of the most controversial projects in modern times.

The video gives some information about the Three Gorges Dam.



Scroll down to continue

Video | Video script | Data

The Yangtze River is the longest river in Asia and the third longest river in the world.

The water levels of the Yangtze River have been recorded for over a thousand years.

Flooding has always been a problem along the Yangtze River. Chinese authorities estimated that 300,000 people were killed during floods in the last century.

The idea of constructing a dam on the Yangtze was first proposed by Sun Yat-sen, the founder of the Republic of China in 1919. He proposed that changing the natural landscape by building a dam would help to protect the local people from the river's frequent and fatal floods.

The Three Gorges Dam in China is the world's largest hydropower project. The dam is constructed on the Yangtze River in China's Hubei province and gained its name as Three Gorges; the Qutang, Wu Xia, and Xiling were flooded as a result of its construction.

Some sources estimate that 632 square kilometres of land were flooded when the dam was built. 1.2 million people were moved from 13 cities, 140 towns and 1350 villages as the reservoir was formed.

Construction of the 2.3 kilometre long and 185 metre high dam started in 1995 and was completed in 2006.

The water behind the dam is raised to a height of 175 metres above sea level and when the [illegible]tional, water rushes at high velocity through 34 turbines linked to electrical

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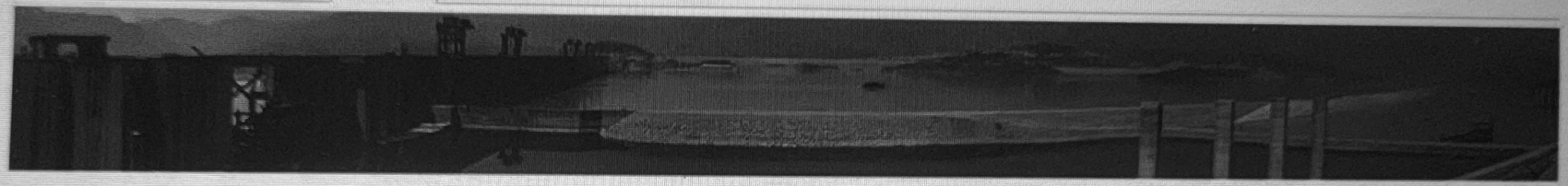
The water behind the dam is raised to a height of 175 metres above sea level and when the dam is fully operational, water rushes at high velocity through 34 turbines linked to electrical generators.

The total power producing capacity of the project is 22 500 megawatts. 31 million tonnes of coal would need to be burned per year to match the power output of the Three Gorges Dam. 31 million tonnes of coal would produce approximately 80 million tonnes of carbon dioxide.

Question 8 (14 marks)

Video | Video script | Data



©

31 million tonnes of coal would need to be burned per year to match the power output of The Three Gorges Dam; this would produce approximately **80 million tonnes** of CO_2.

40 million tonnes of concrete were used in the construction of the dam which released approximately **7 million tonnes** of CO_2.

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Chinese authorities estimated that **300,000** people were killed by flooding of the Yangtze River before the dam's construction in the last century.

The **34 generators** can produce **22 500 MW** power.

6000 species of plant live in the area, which is **20 percent** of all Chinese seed plants.

The dam is approximately **2300 m** long and **185 m** high.

39.3 km^3 of water in the reservoir which has a surface area of around **1045 km^2**.

177 unique fish species live in the Yangtze River.

97 significant landslides occurred in the first 4 months of 2010 due to erosion caused by high water levels behind the dam.

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In the first three years of use, the dam had collected an estimated **10 million tonnes of waste including plastic** preventing it from travelling further down the river.

Use the information from the three tabs above to answer the following question.

Considering the positive and negative impacts of the changes to the landscape, **discuss** and **evaluate** the environmental impact of the Three Gorges Dam hydropower project.

In your answer, you should include:

- the impacts on living and non-living things within the river
- the impacts on the wider surrounding natural landscape
- the impacts from a global perspective
- a concluding appraisal.