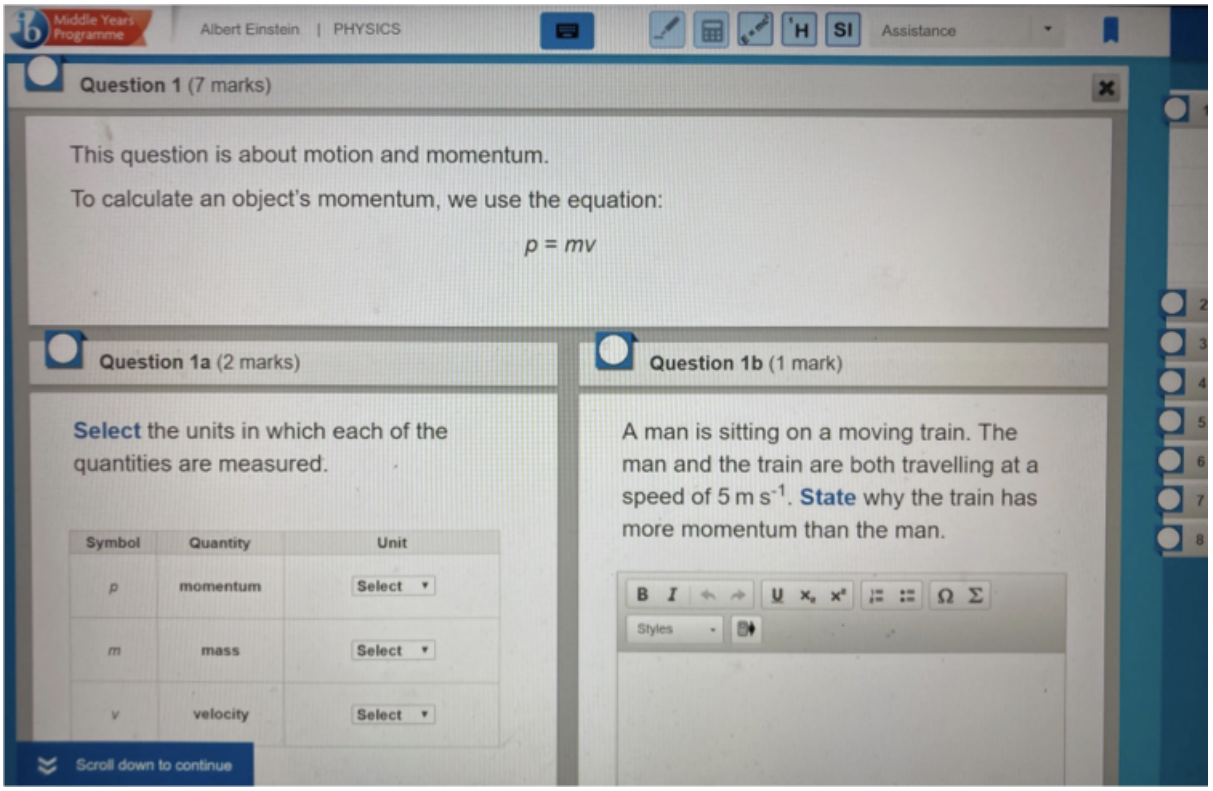
Middle Years Programme
Albert Einstein | PHYSICS
H
SI
Assistance
Question 1 (7 marks)
This question is about motion and momentum.
To calculate an object's momentum, we use the equation:
p = mv
Question 1a (2 marks)
Select the units in which each of the quantities are measured.
Symbol
Quantity
Unit
p
momentum
Select
m
mass
Select
v
velocity
Select
Scroll down to continue
Question 1b (1 mark)
A man is sitting on a moving train. The man and the train are both travelling at a speed of 5 m s-1. State why the train has more momentum than the man.
Styles

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Two children are sitting on the same moving train, one child places a ball on the floor and the other places a large bag on the floor.

This media contains no audio

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When the train comes to a complete stop, the ball rolls forward. Use Newton's Laws to **explain** why the ball moves forward after the train has stopped.

B I U x_2 x^2 Ω Σ Styles

Question 1d (1 mark)

The child's large bag does not move when the train comes to a complete stop. **Suggest** why the bag does not move.

B I U x_2 x^2 Ω Σ Styles

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Question 2 (7 marks)

Pollution in cities often causes smog which can be harmful when breathed in. Smog contains a mixture of polluting gases and dust particles.

Scroll down to continue

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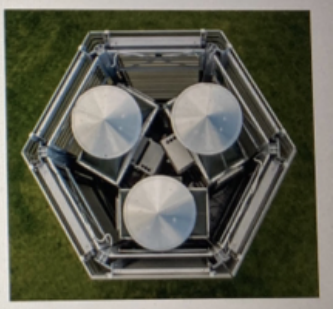
One solution recently installed in parks in the Netherlands and Beijing is a tower containing smog filters to clean the air in the park.



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Question 2a (3 marks)

The tower is estimated to require 1100 W of electrical power and is connected to an electrical supply of 220 V. **Calculate** the current flowing through the tower. You should give the appropriate unit with your answer.

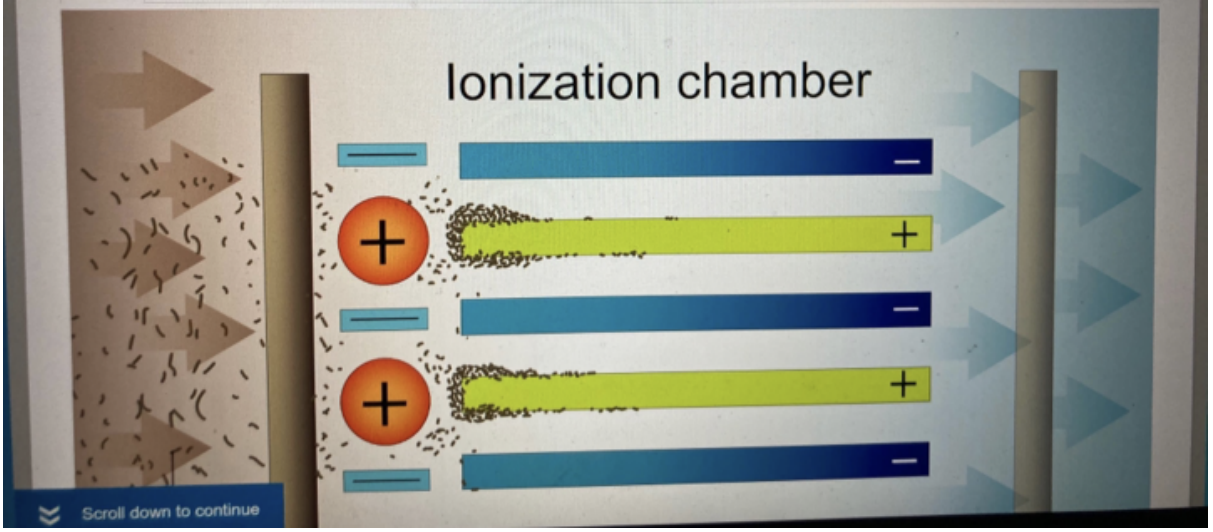
B I U x_2 x^2 Ω Σ Styles

The smog filter is an example of a type of filter which uses ionization to remove particles from the air.

Scroll down to continue

The smog filter is an example of a type of filter which uses ionization to remove particles from the air.

Video Script



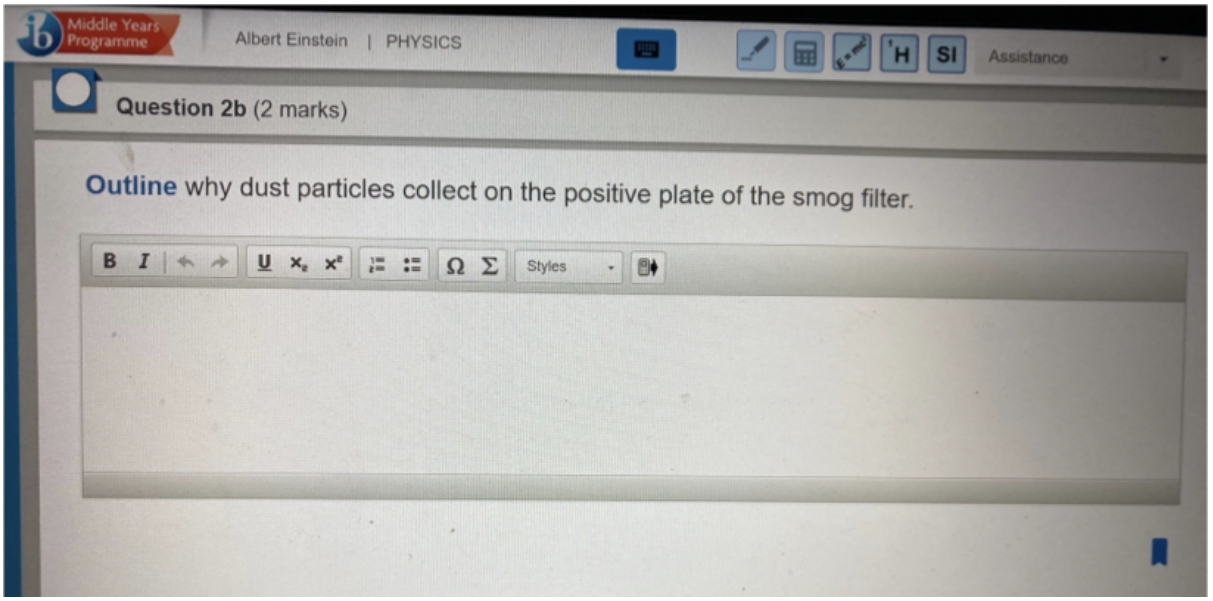
Video Script

Air containing dust particles without charge enters the filter and passes through an ionisation chamber.

Inside the ionization chamber electrons pass between two electrodes where they collide with the dust particles in the air; this causes the particles to become charged.

The air now moves past long, charged “collection” plates and the charged particles attach to the plates.

The clean air moves out of the other side of the filter.


Middle Years Programme
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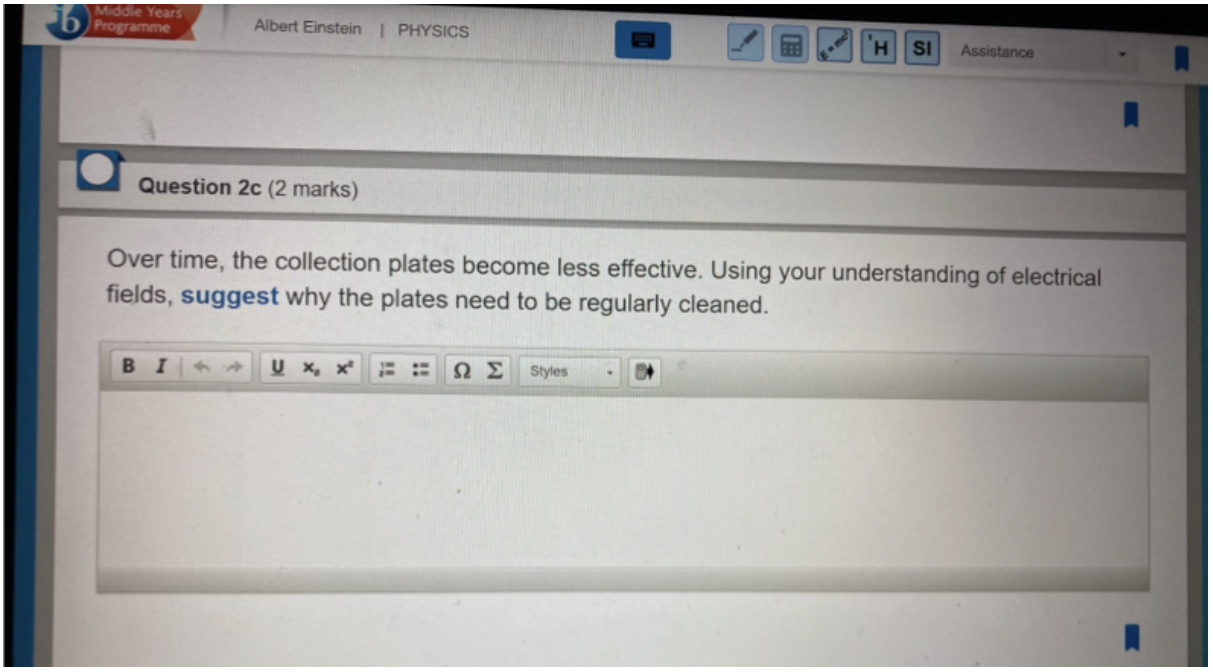
H
SI
Assistance
Question 2b (2 marks)
Outline why dust particles collect on the positive plate of the smog filter.
Styles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Question 2c (2 marks)
Over time, the collection plates become less effective. Using your understanding of electrical fields, suggest why the plates need to be regularly cleaned.
Styles

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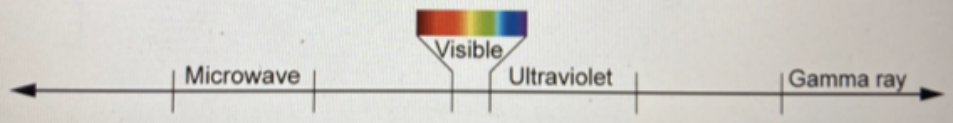
Question 3 (10 marks)

Question 3a (1 mark)

Radio waves form a section of the electromagnetic spectrum. Drag and drop the labels to **classify** the missing sections in the spectrum.

Draggable: X-rays | Infra-red | Radio



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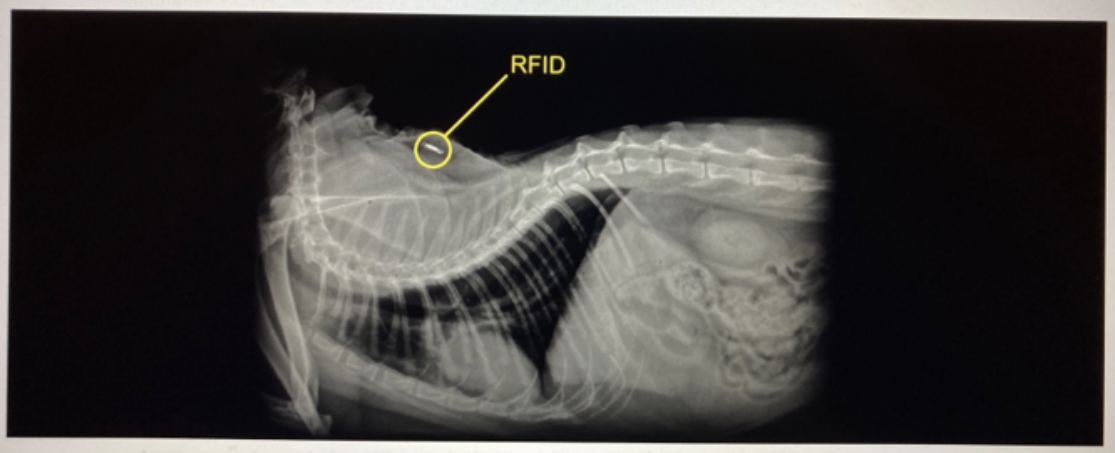
Question 3b (1 mark)

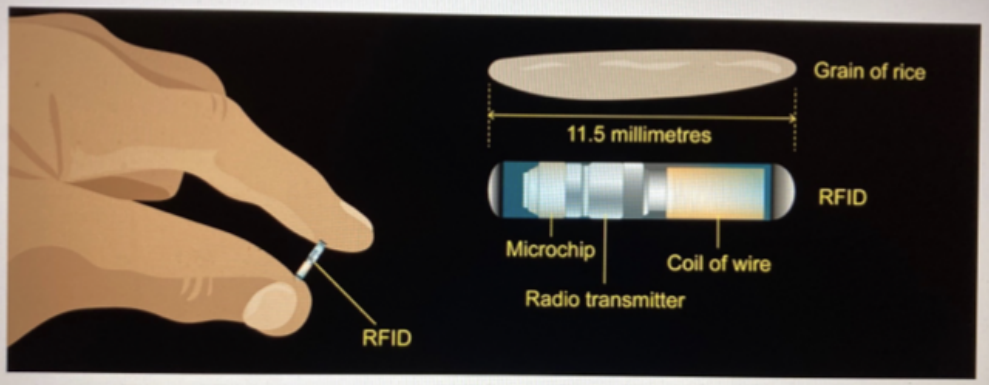
RFIDs (radio-frequency identification devices) are now used in many ways to help track products and store information. RFIDs can be placed under the skin of animals to store information regarding their owners. The information stored on the RFID is transmitted to a hand-held scanner using radio waves. This image shows an RFID inside a cat.



Scroll down to continue

s of a wire coil, a radio transmitter and a microchip to store information

The RFID consists of a wire coil, a radio transmitter and a microchip to store information.



The RFID transmits information using radio waves. Infra-red waves can also be used to transmit information, **suggest** one advantage of using radio waves instead of infra-red waves inside

Scroll down to continue

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The RFID transmits information using radio waves. Infra-red waves can also be used to transmit information, **suggest** one advantage of using radio waves instead of infra-red waves inside animals.

Styles

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Question 3c (3 marks)

The frequency of the radio waves is 134 000 Hz and their wavelength is 2238 m. **Calculate** the speed of radio waves. Give your answer in scientific notation.

B I U x_2 x^2 Ω Σ Styles

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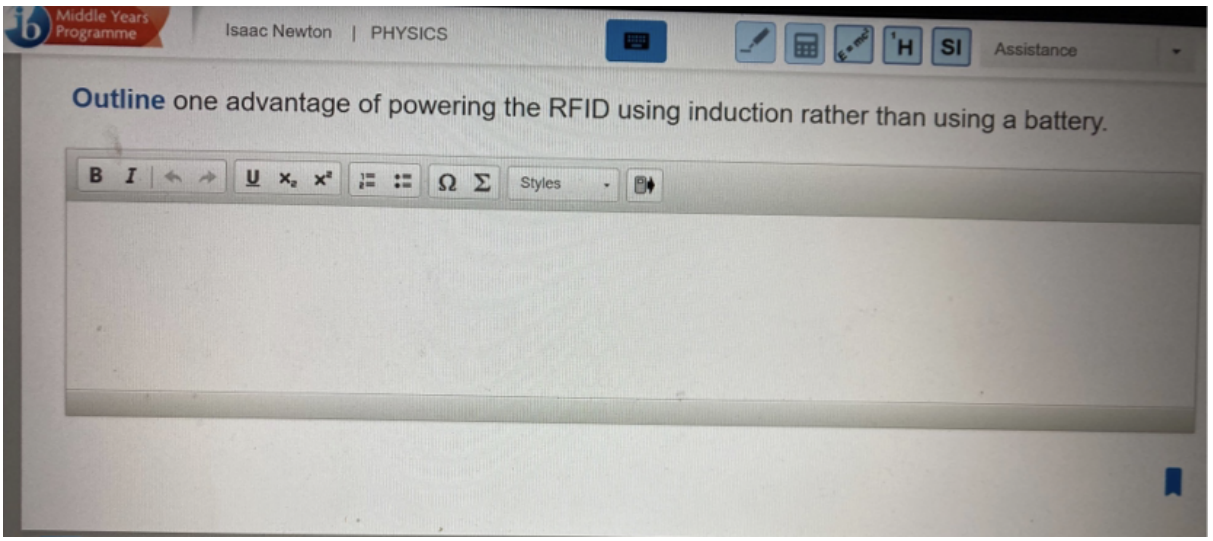
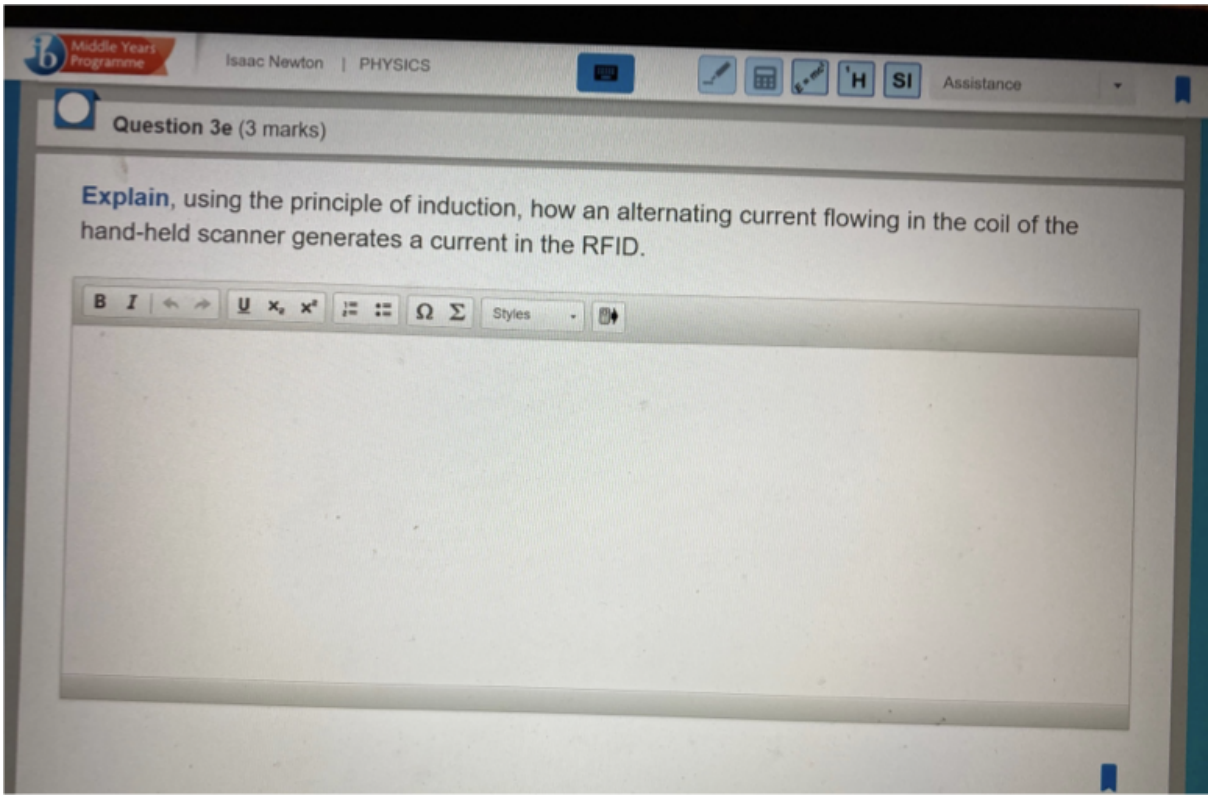
Question 3d (2 marks)

The wire coil in the scanner carries an alternating current, inside the RFID there is also a coil of wire. When the two coils act together they behave like a transformer, inducing a current in the RFID coil.

Scroll down to continue


Middle Years Programme
Isaac Newton | PHYSICS
Assistance
Outline one advantage of powering the RFID using induction rather than using a battery.
Styles


Middle Years Programme
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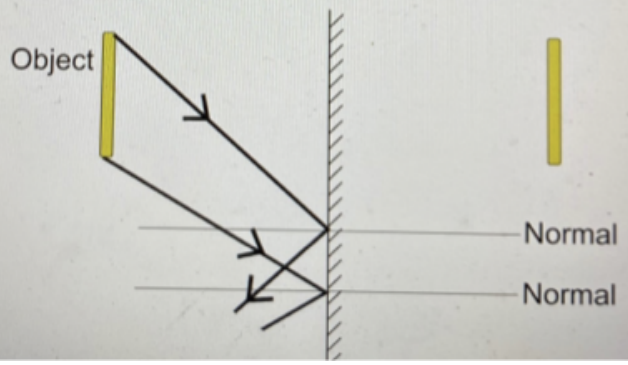
Assistance
Question 3e (3 marks)
Explain, using the principle of induction, how an alternating current flowing in the coil of the hand-held scanner generates a current in the RFID.
Styles

Question 4 (13 marks)

An object placed in front of a mirror produces an image due to the reflection of light waves from the surface of the mirror. The video below explains the physics of reflection and how more than one mirror can produce several images of the same object.

Video Script



Scroll down to continue

Video Script

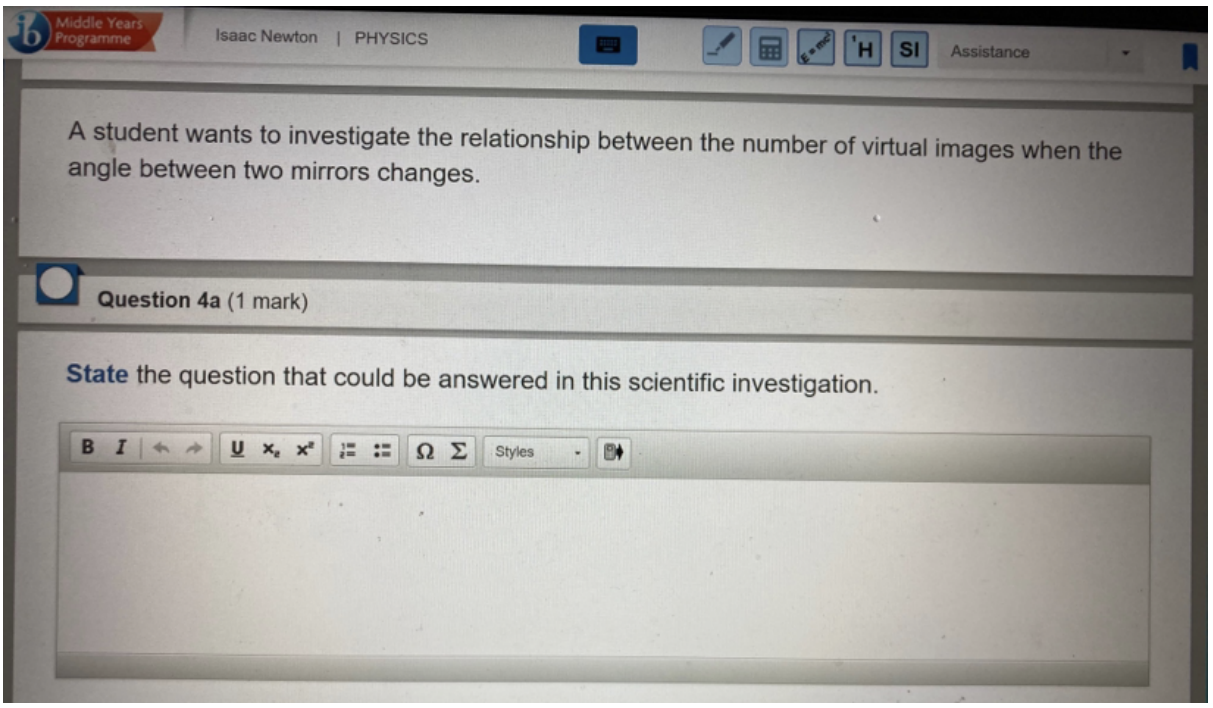
When light hits a mirror, the rays are reflected in a manner that is consistent with the law of reflection.

When these rays are observed, a virtual image is produced. The image appears as if the original object is in a position behind the mirror.

This happens because our mind is trained to believe that light travels in straight lines. The brain effectively places an image at the end of the virtual rays.

The situation with two mirrors is more complicated. Multiple reflections of light lead to multiple images being observed. When two mirrors are placed together in contact along one side, the number of images varies depending on the angle between the mirrors. In the picture shown here, there are three virtual images of the original object.

In this picture there are seven virtual images. The only thing that has changed between these two situations is the angle between the mirrors.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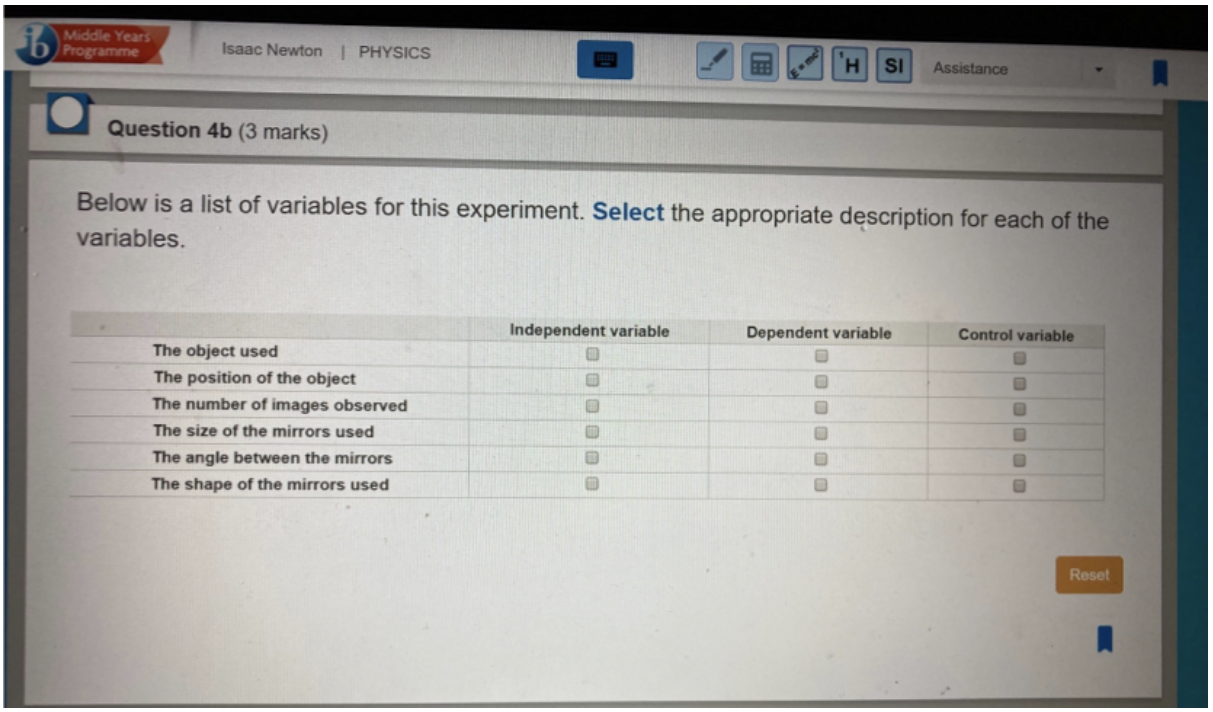
Assistance
A student wants to investigate the relationship between the number of virtual images when the angle between two mirrors changes.
Question 4a (1 mark)
State the question that could be answered in this scientific investigation.
Styles


Middle Years Programme
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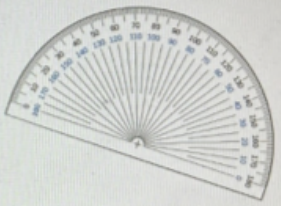
Assistance
Question 4b (3 marks)
Below is a list of variables for this experiment. Select the appropriate description for each of the variables.
Independent variable
Dependent variable
Control variable
The object used
The position of the object
The number of images observed
The size of the mirrors used
The angle between the mirrors
The shape of the mirrors used
Reset

Question 4c (1 mark)

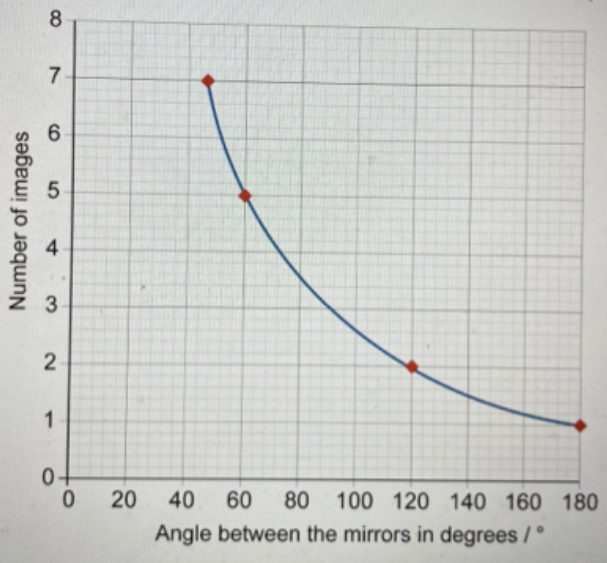
Identify the measuring equipment that would be needed for this experiment.

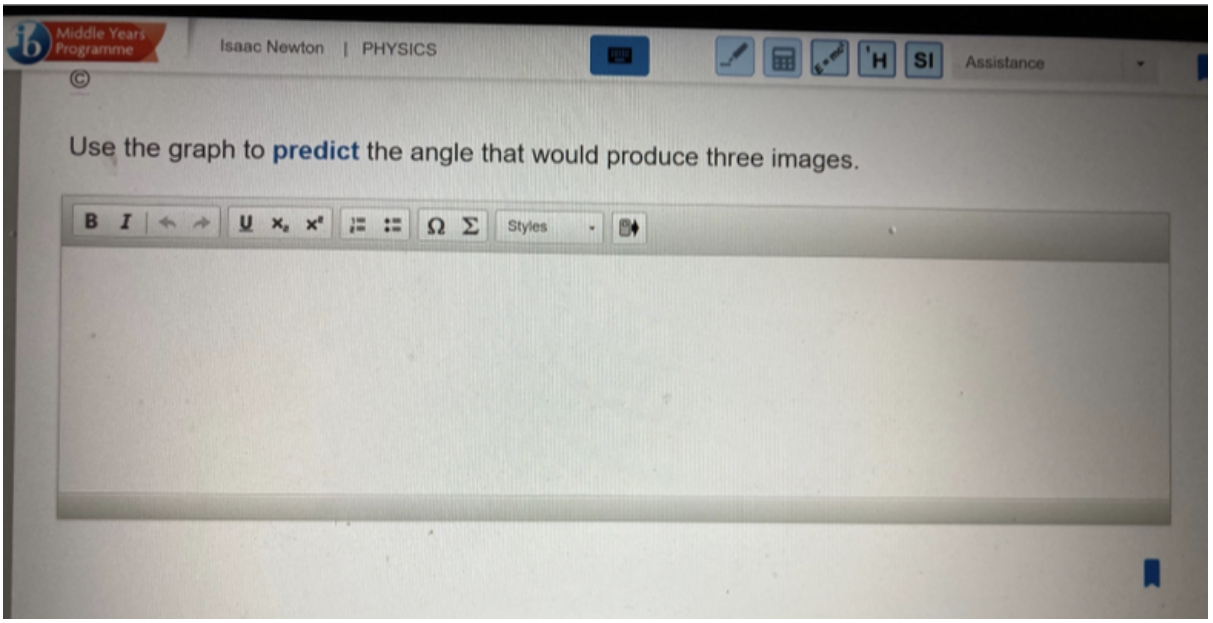





Question 4d (1 mark)

After collecting data, the student presents his results in the form of the graph shown.

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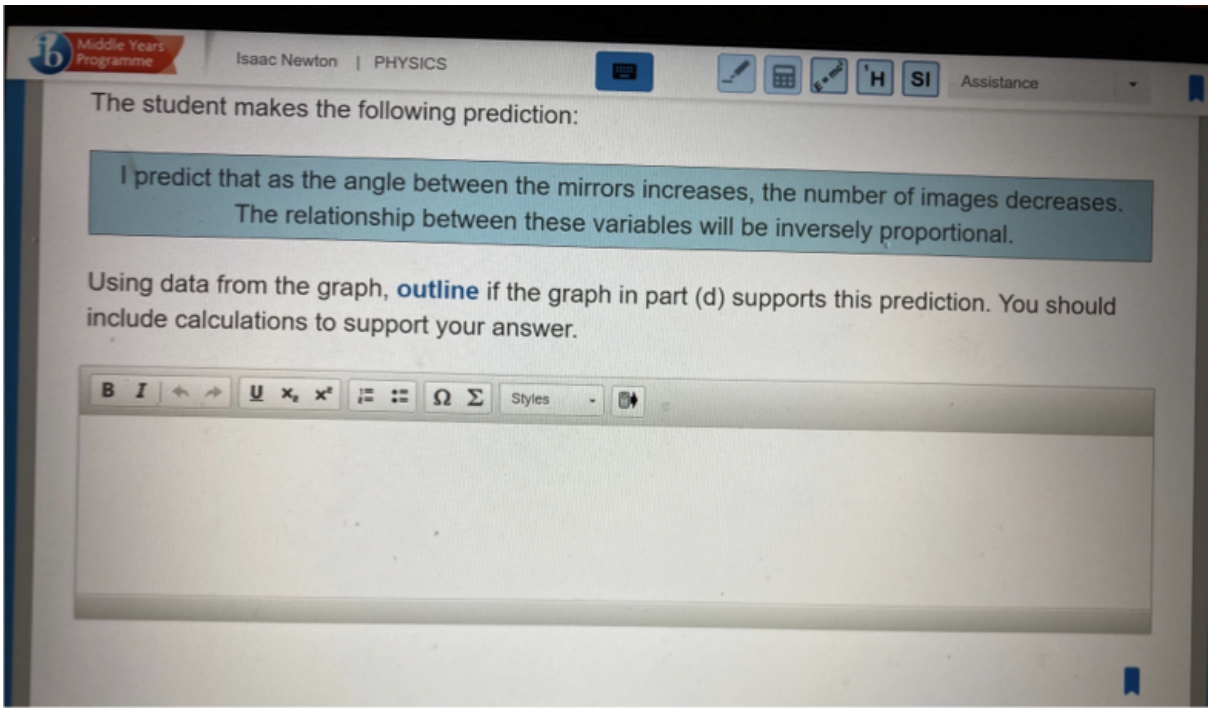
Assistance
Use the graph to predict the angle that would produce three images.
Styles


Middle Years Programme
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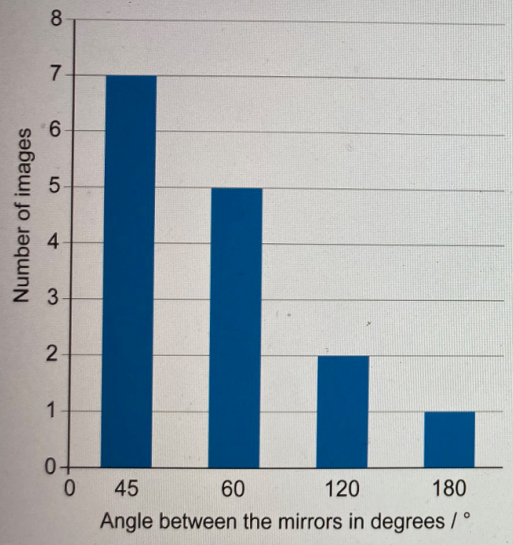
Assistance
The student makes the following prediction:
I predict that as the angle between the mirrors increases, the number of images decreases. The relationship between these variables will be inversely proportional.
Using data from the graph, outline if the graph in part (d) supports this prediction. You should include calculations to support your answer.
Styles

Question 4f (2 marks)

The bar chart below is an alternative presentation of the data from part (d).



Justify why a bar chart is a more appropriate form of presenting this data.

Question 4g (2 marks)

A second student in the same class presents a table of results for her investigation as shown below.

Angle between the mirrors / °	Number of images
30	11
45	7
60	5
75	3
90	3
105	2
120	2
135	1
150	1
165	1
180	1

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Outline if the first student's data in part (d) or the second student's data above are better for exploring the relationship between the two variables.

B I U x_2 x^2 Ω Σ Styles

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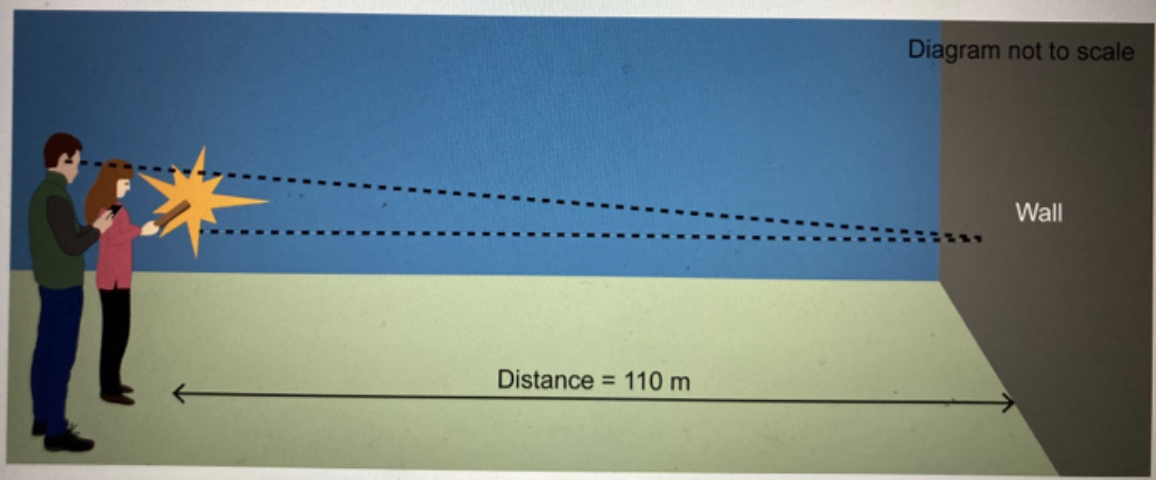
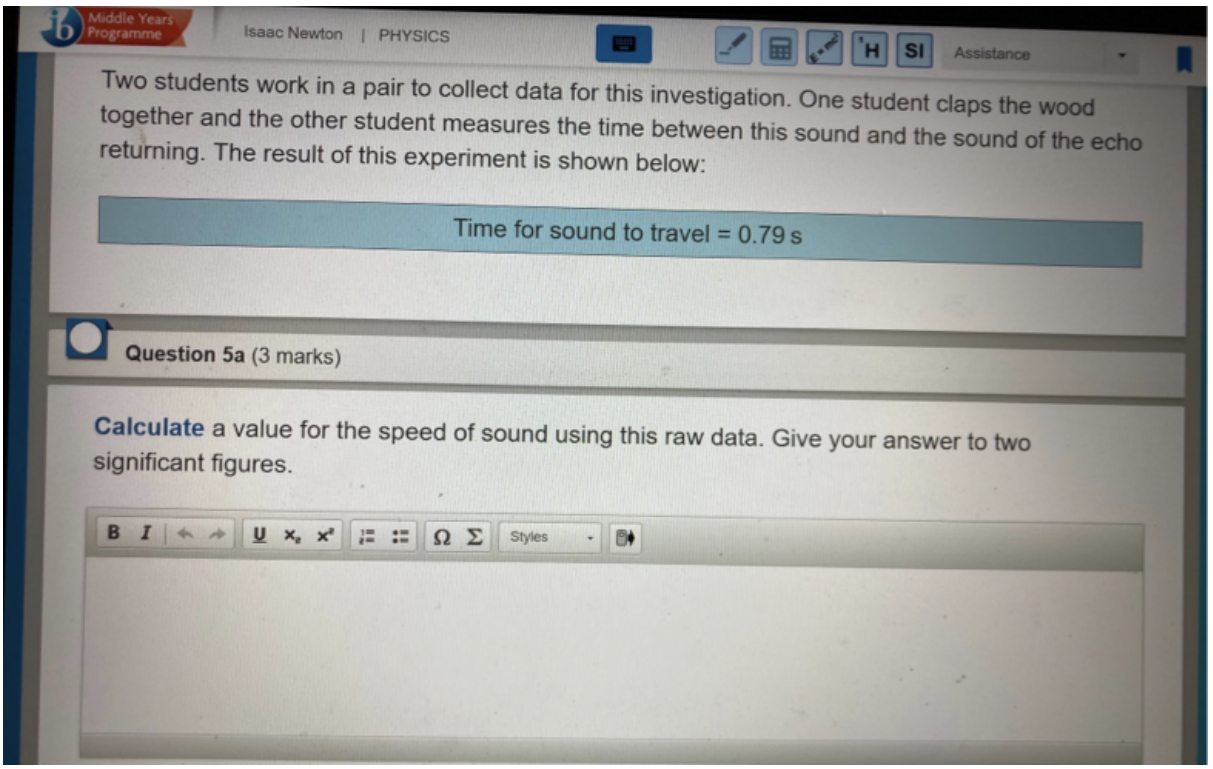
Question 5 (20 marks)

Like light, sound also reflects. We experience reflected sound as an echo. Echoes can be used to investigate the speed of sound. A student stands a known distance away from a wall and makes a loud sound by hitting two pieces of wood together. The time that the sound takes to travel to the wall and back can be used to calculate a value for the speed of sound.



Scroll down to continue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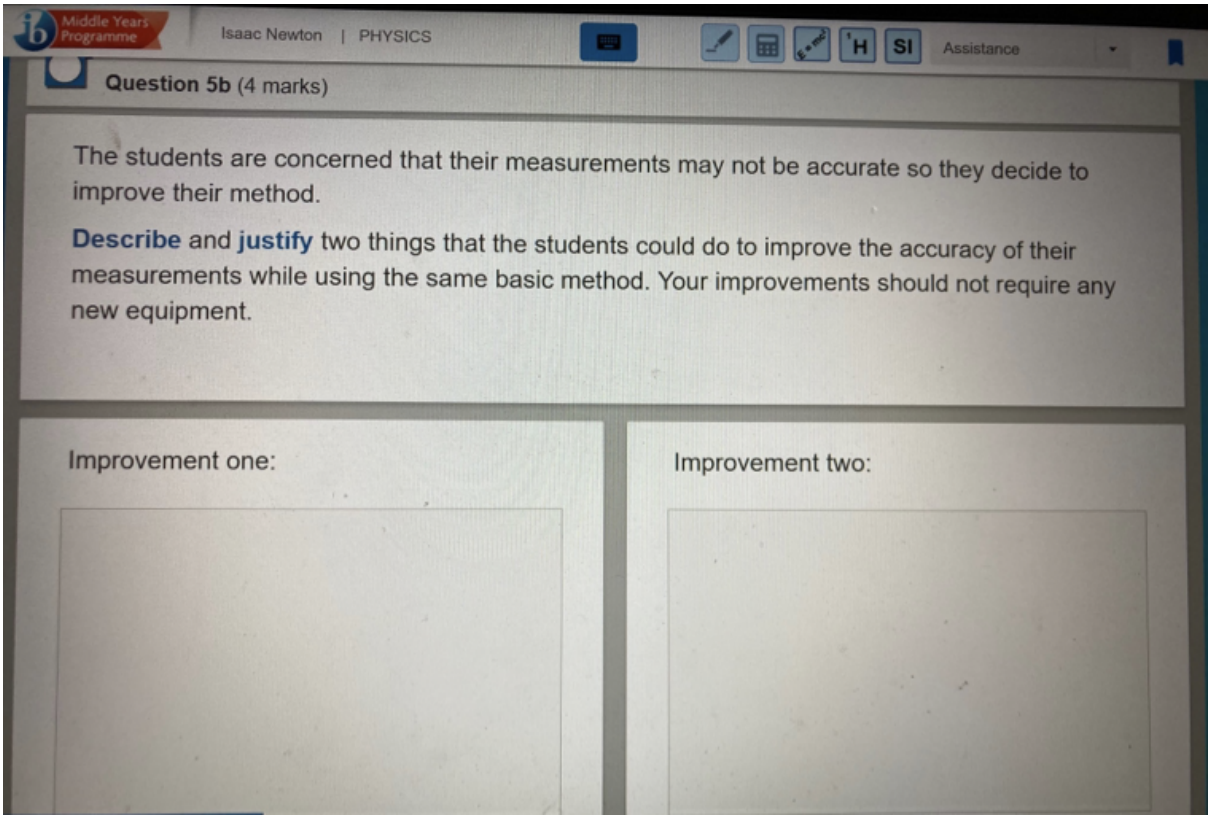
H
SI
Assistance
Two students work in a pair to collect data for this investigation. One student claps the wood together and the other student measures the time between this sound and the sound of the echo returning. The result of this experiment is shown below:
Time for sound to travel = 0.79 s
Question 5a (3 marks)
Calculate a value for the speed of sound using this raw data. Give your answer to two significant figures.
Styles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SI
Assistance
Question 5b (4 marks)
The students are concerned that their measurements may not be accurate so they decide to improve their method.
Describe and justify two things that the students could do to improve the accuracy of their measurements while using the same basic method. Your improvements should not require any new equipment.
Improvement one:
Improvement two:

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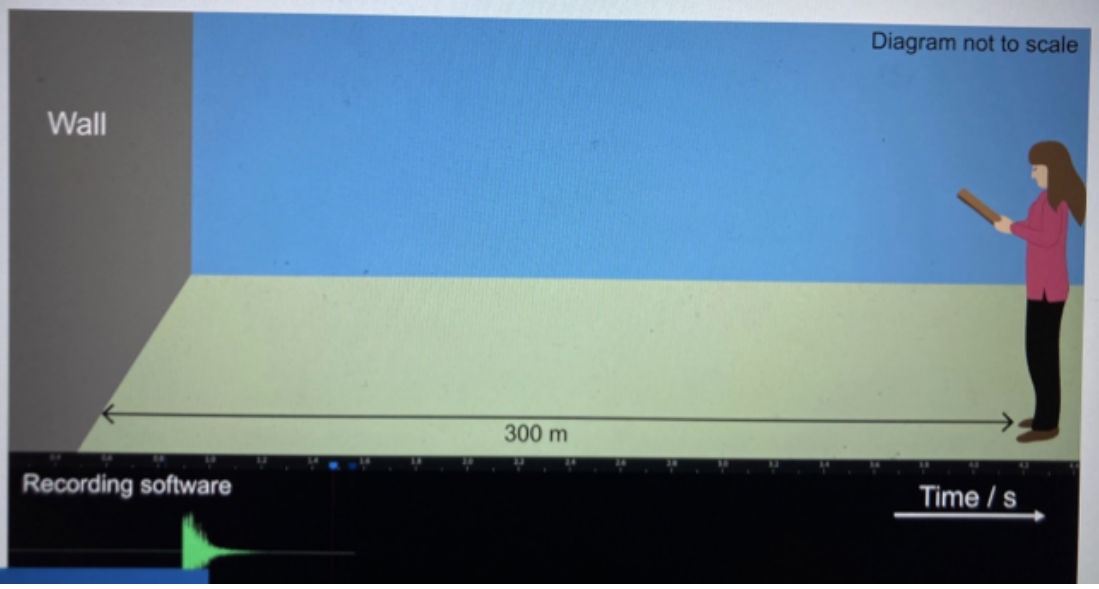
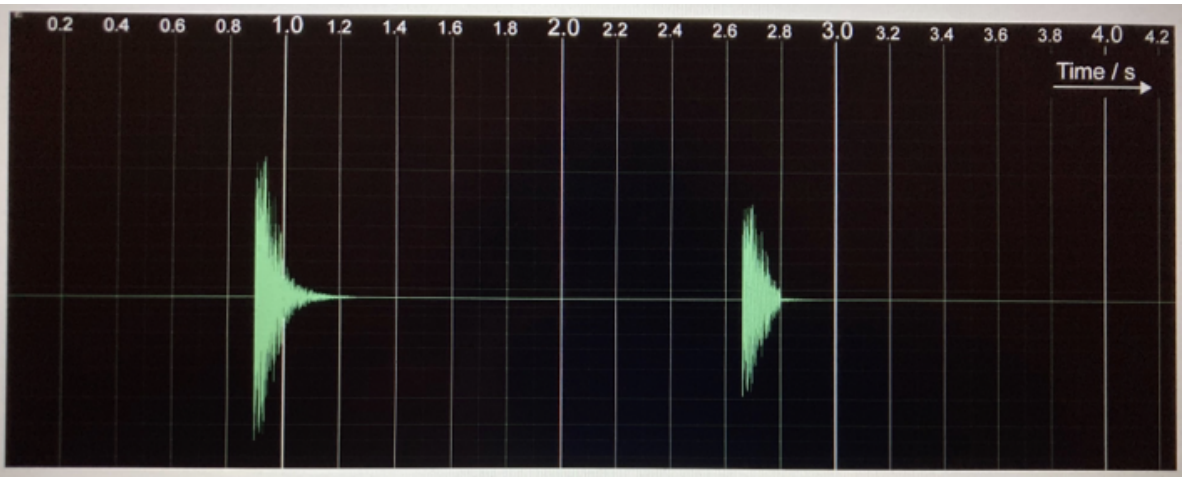
Question 5c (2 marks)

Instead of using a stopwatch to time the interval between the first sound and the echo, a laptop with a microphone and some sound recording software can be used.

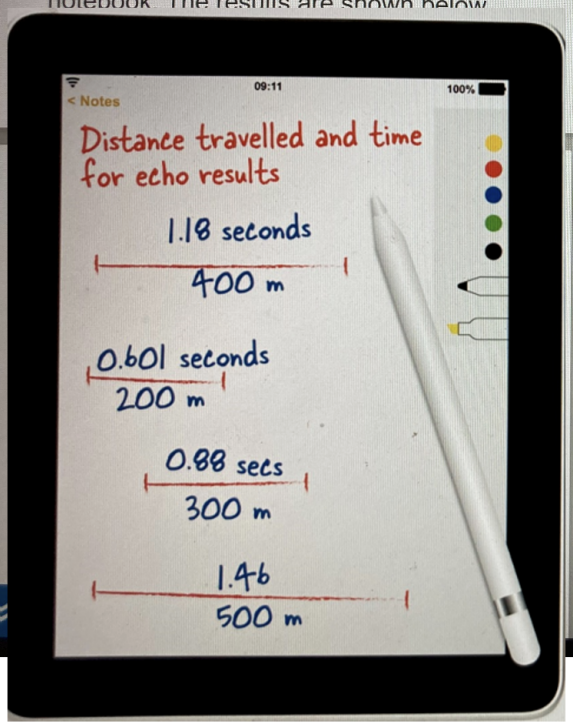




Use the image to **calculate** the time taken for the sound to travel 600 m.

Question 5d (4 marks)

The students vary the distance the sound travels and write down four sets of results in their notebook. The results are shown below.



Organize and **present** the data in a table that shows the distance travelled by the wave and the time taken. Include the data from part (c) in your answer.

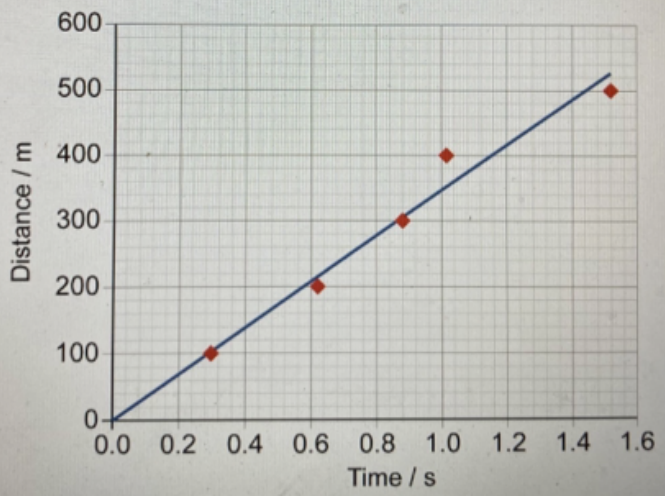
Create New Table

Reset

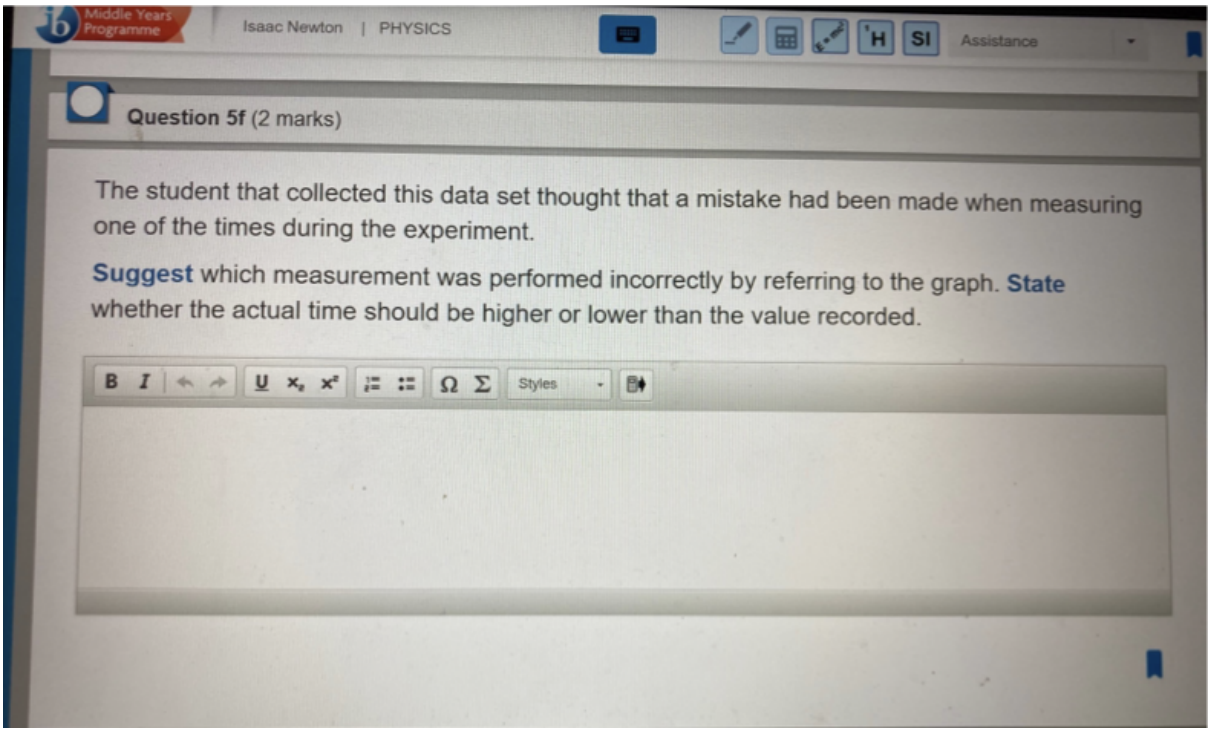
Question 5e (2 marks)

Another student collects data using the same method. To process their data to find the speed of sound, they plot a graph of the distance travelled by the sound wave on the *y* axis, against the time taken on the *x* axis. The data points are shown in the graph below.

Distance - time graph for sound echoes



Use data from the graph to **calculate** the speed of sound.



Question 5g (3 marks)

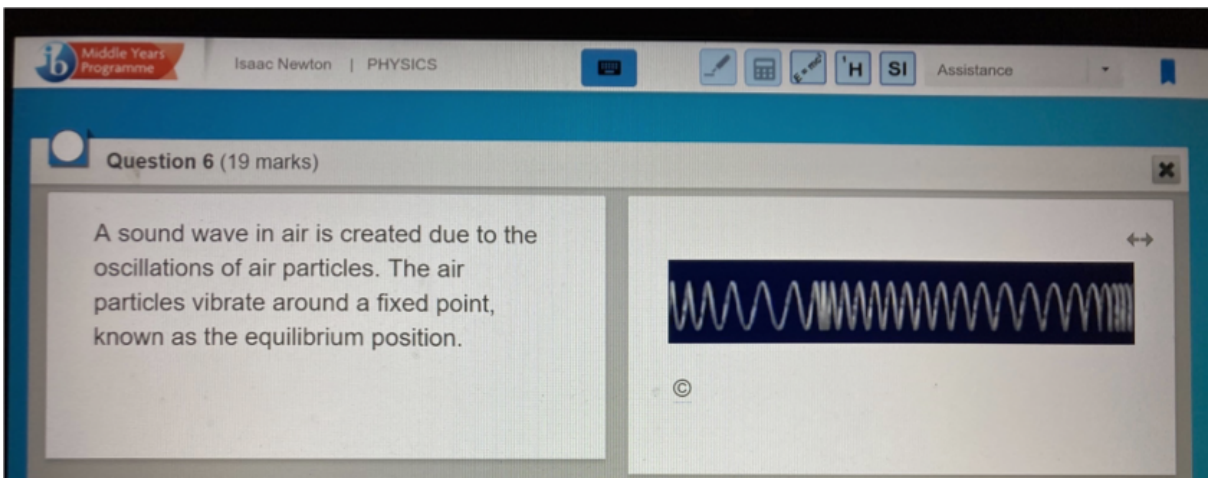
During any speed of sound investigation, it is important to measure temperature as sound travels at different speeds through air at different temperatures.

For temperatures close to room temperature, the speed of sound in air is given approximately by the relationship:

$$\text{speed of sound in air} = 330 + (0.6 \times T)$$

where T is the temperature of the air in degrees celsius and the speed of sound in air is measured in metres per second.

Explain why the speed of sound is dependent on temperature. Your answer should contain reference to the motion of particles.



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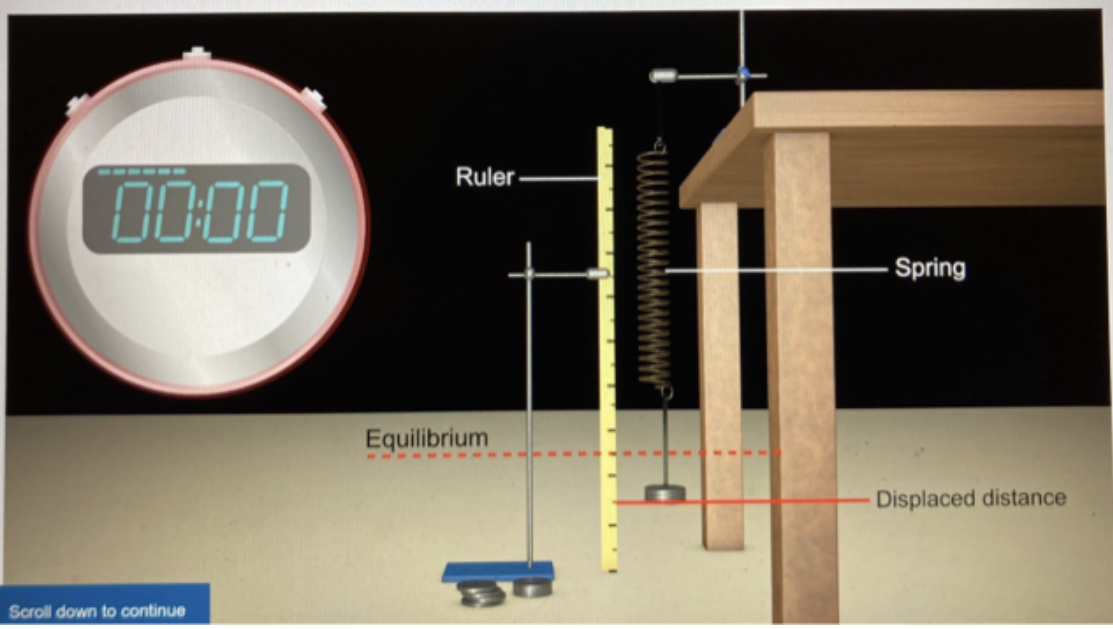
An MYP student is interested in the factors that affect oscillations of air particles. He decides to conduct an investigation by modelling an oscillating particle using a hanging mass on a spring.

This media contains no audio



Scroll down to continue

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In this simple model, an air particle is represented by the mass which vibrates when it is moved from its equilibrium position. The student formulates the research question:

If the mass on a spring increases, what happens to the time period of the oscillation?

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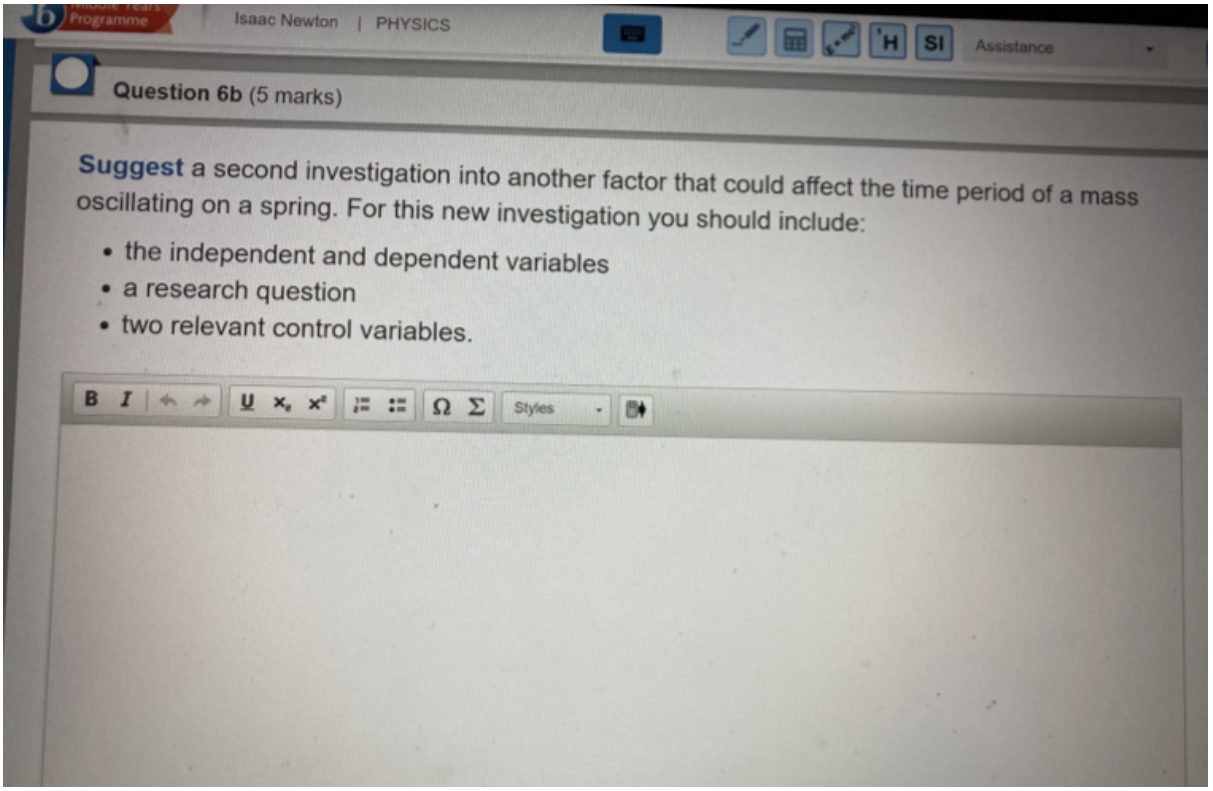
Question 6a (14 marks)

Design an experiment to investigate this research question. In your plan you must include:

- the independent variable, the dependent variable and the justification of two control variables
- a hypothesis that can be tested by this investigation
- how you will collect sufficient data
- a method detailing the procedure you will follow.

B I U x_2 x^2 Ω Σ Styles

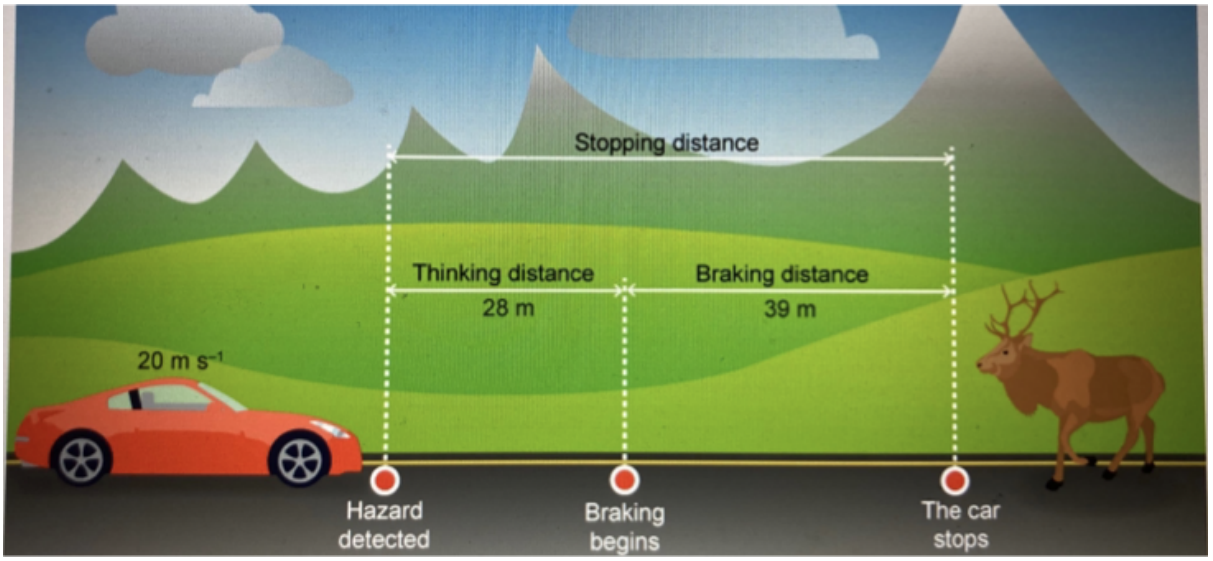


Question 7 (10 marks)

This task will consider some of the factors that affect the stopping distance of a car. Stopping distance has important implications for road safety.

The following diagram shows how the stopping distance of a car is made up of two components, thinking distance and braking distance.

- The thinking distance is how far the car has travelled in the time taken for the driver to react to a hazard.
- The braking distance is how far a car has travelled while it is decelerating.



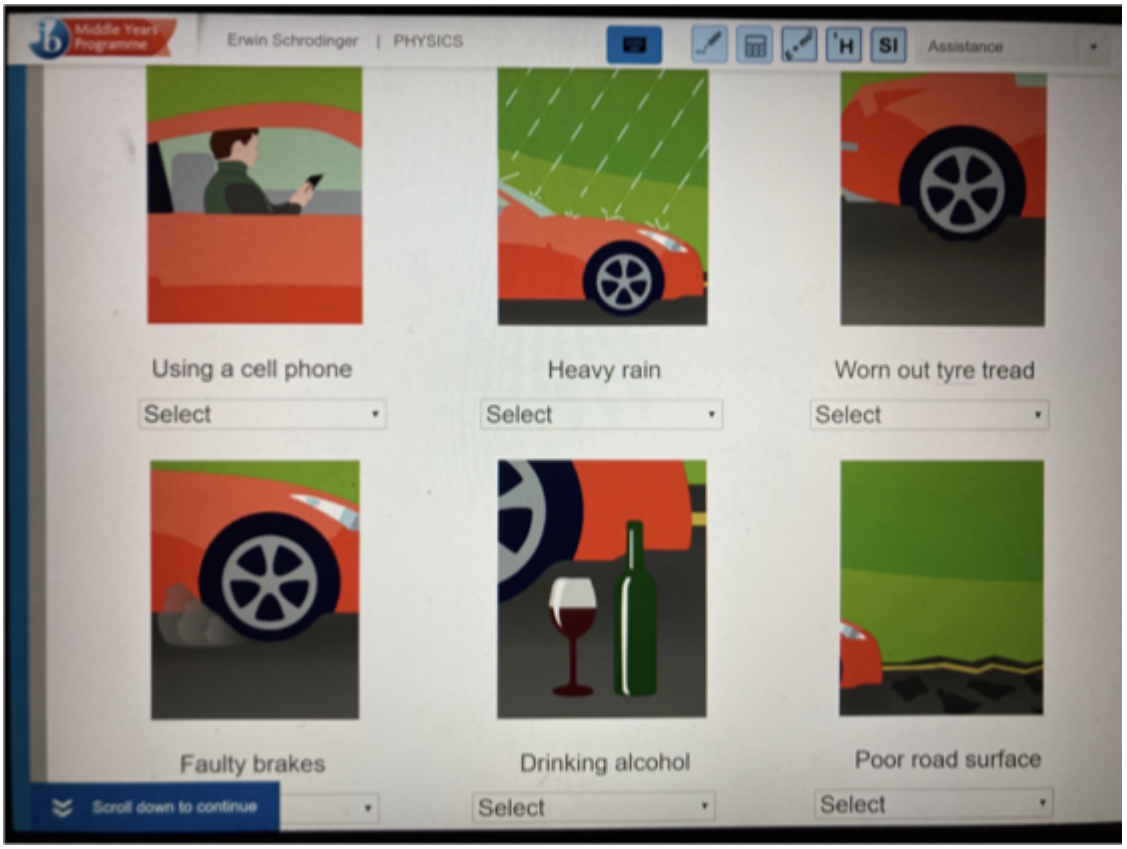
Question 7a (4 marks)

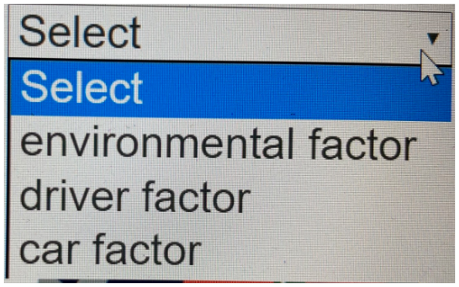
In the diagram, the car decelerates at 5 m s^{-2}. If the brakes are worn and are only able to decelerate at 2 m s^{-2}, **calculate** the new braking distance.

B I U x_2 x^2 Ω Σ Styles

Question 7b (2 marks)

Factors related to the driver, the car or the environment can have an impact on the stopping distance for a given speed. For example: driving when tired, or distracted (driver factors) can significantly increase reaction times and subsequently increase the stopping distance of a car. **Classify** the following into environmental factors, driver factors and car factors.


Middle Year's Programme
Erwin Schrodinger | PHYSICS
Assistance
Using a cell phone
Heavy rain
Worn out tyre tread
Select
Select
Select
Faulty brakes
Drinking alcohol
Poor road surface
Select
Select
Scroll down to continue


Select
Select
environmental factor
driver factor
car factor

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Question 7c (4 marks)

Drinking alcohol and poor road surface are two of the factors which affect stopping distance. **Select** which part of the stopping distance each factor will affect and **outline** the impact of drinking alcohol and poor road surface on stopping distance using your scientific knowledge.

Drinking alcohol:

- thinking distance
- braking distance

Effect on stopping distance:

Poor road surface:

- thinking distance
- braking distance

Effect on stopping distance:

Scroll down to continue

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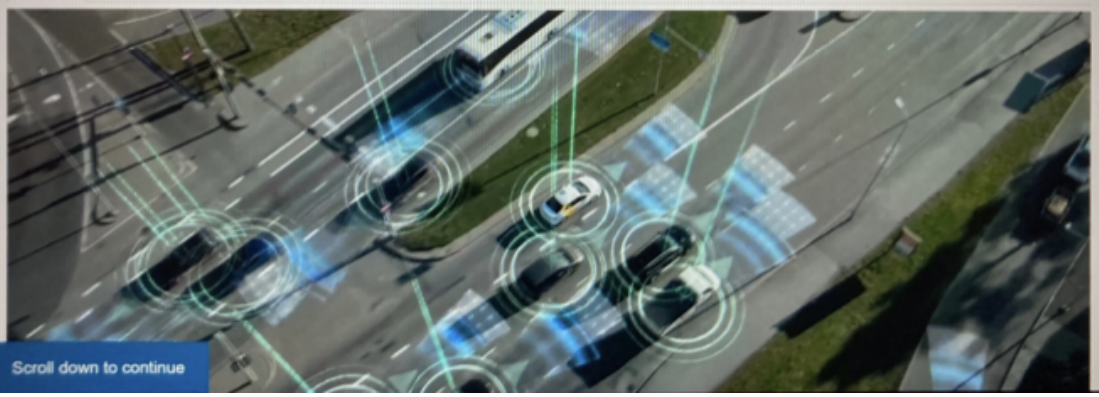
Question 8 (14 marks)

In recent years, a number of countries have focused on improving road safety. In these countries there has been a significant reduction in the number of road casualties. Further improvements in the way cars are engineered could allow us to continue this trend. One such innovation is the use of electronic systems which can reduce driver error.

Video Script



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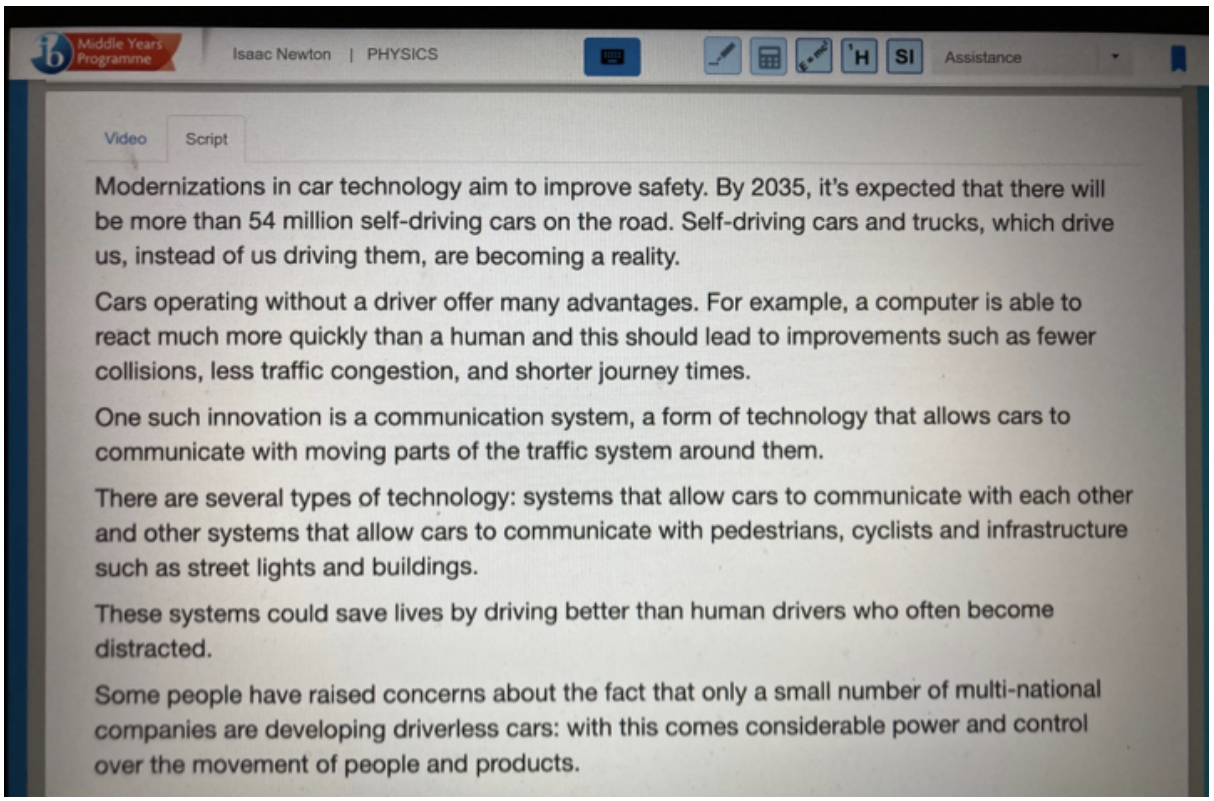
Middle Years Programme
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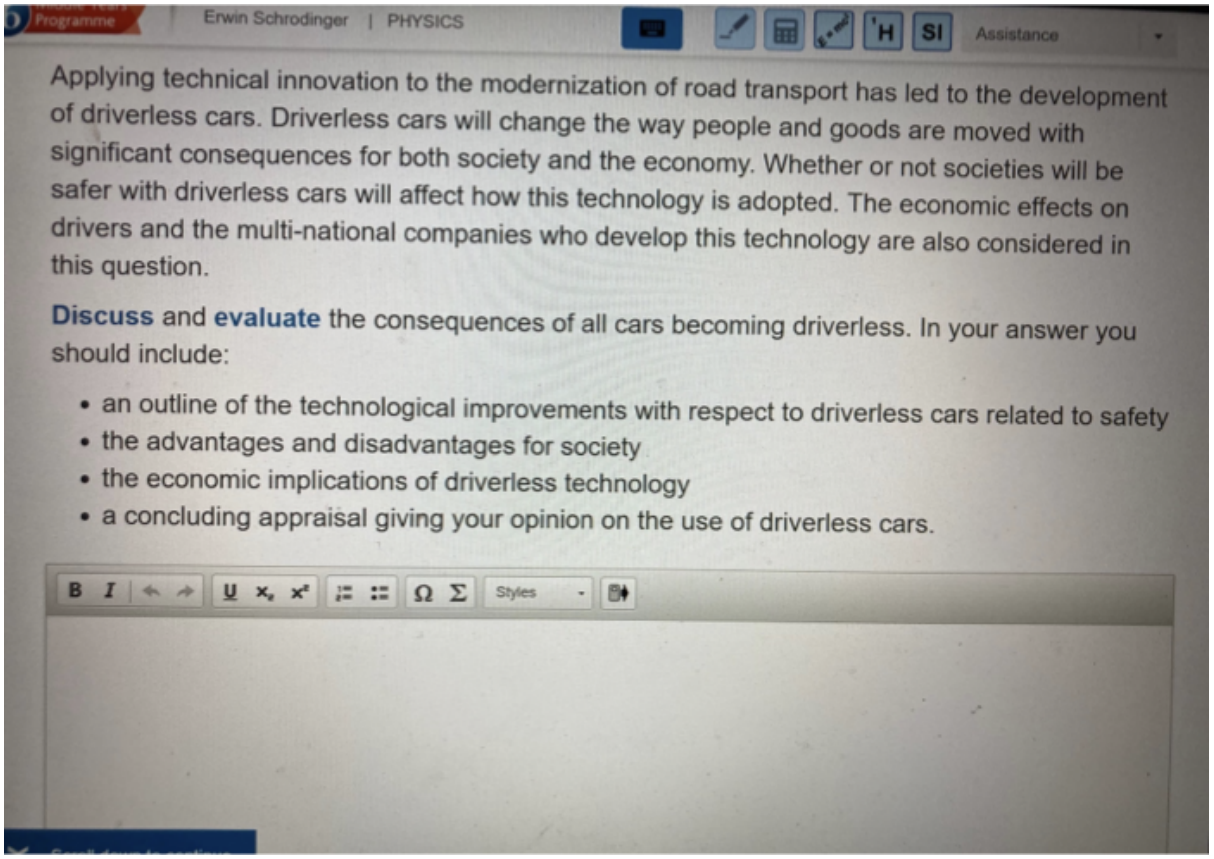
Assistance
Video
Script
Modernizations in car technology aim to improve safety. By 2035, it's expected that there will be more than 54 million self-driving cars on the road. Self-driving cars and trucks, which drive us, instead of us driving them, are becoming a reality.
Cars operating without a driver offer many advantages. For example, a computer is able to react much more quickly than a human and this should lead to improvements such as fewer collisions, less traffic congestion, and shorter journey times.
One such innovation is a communication system, a form of technology that allows cars to communicate with moving parts of the traffic system around them.
There are several types of technology: systems that allow cars to communicate with each other and other systems that allow cars to communicate with pedestrians, cyclists and infrastructure such as street lights and buildings.
These systems could save lives by driving better than human drivers who often become distracted.
Some people have raised concerns about the fact that only a small number of multi-national companies are developing driverless cars: with this comes considerable power and control over the movement of people and products.


Programme
Erwin Schrodinger | PHYSICS
Assistance
Applying technical innovation to the modernization of road transport has led to the development of driverless cars. Driverless cars will change the way people and goods are moved with significant consequences for both society and the economy. Whether or not societies will be safer with driverless cars will affect how this technology is adopted. The economic effects on drivers and the multi-national companies who develop this technology are also considered in this question.
Discuss and evaluate the consequences of all cars becoming driverless. In your answer you should include:
• an outline of the technological improvements with respect to driverless cars related to safety
• the advantages and disadvantages for society
• the economic implications of driverless technology
• a concluding appraisal giving your opinion on the use of driverless cars.
Styles