Question 1 (15 marks)

Food chemistry is the branch of science concerned with the nature of food, its properties and how it is processed and absorbed by the body. It involves the study of components such as water, proteins, fats, vitamins and carbohydrates.

Question 1a (3 marks)

Water is a major component of almost every type of food we eat. In addition to water, food is composed of other molecules such as proteins, carbohydrates and fats. **Select** the correct main function for each of these molecular components

Draggable items:

- **Needed for healthy bones**
- **Used to transport oxygen around the body**
- **Provide short-term energy**
- **Needed for healthy digestive system**
- **Used for muscle growth and repair**
- **Provide long-term energy stores**

Molecular component	Main function
Proteins	
Carbohydrates	
Fats	

Scroll down to continue

Question 1b (1 mark)

Water provides a place for bacterial growth. When bacteria grow on food, it causes the food to spoil. One indicator of how long food can be stored safely before spoiling is the percentage of water it contains.

Using this information and the table below, **select** the food that would contain the lowest number of bacteria when stored in the same conditions.

Food	Percentage of water / %
 Watermelon	92
 Pineapple	95
 Cucumber	96

Select

Question 1c (4 marks)

Food poisoning is an illness caused by eating contaminated food. In most cases of food poisoning, the food is contaminated by bacteria, such as salmonella or *Escherichia coli* (*E. coli*). **Suggest** two precautions to prevent food poisoning when preparing a meal. **Justify** how each suggestion prevents food poisoning.

Suggestion 1

Suggestion 2

Justification 1

Justification 2

Scroll down to continue

Question 1d (2 marks)

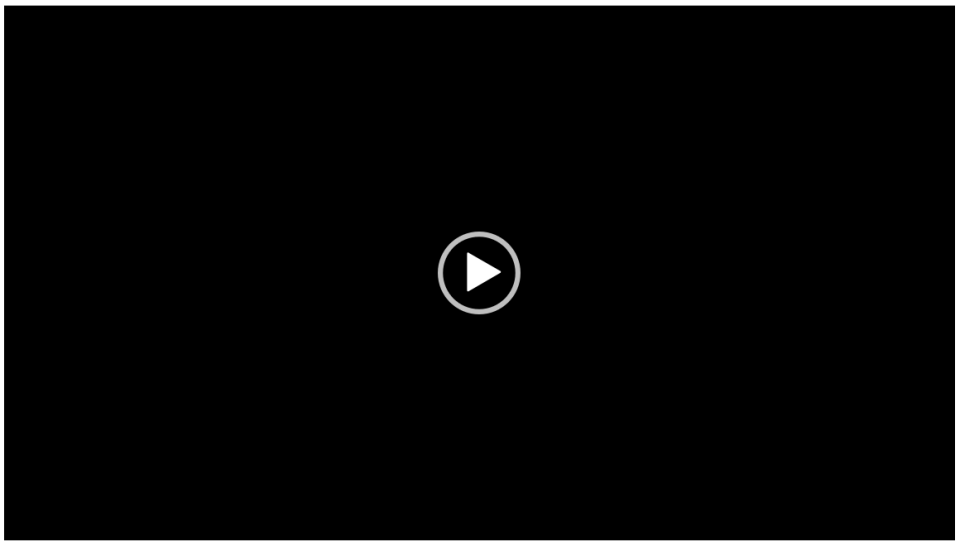
Food can be stored safely for longer by using methods such as refrigeration or dehydration. **Outline**, using scientific terminology, why each of these methods would increase the storage time for food items.

Refrigeration

Dehydration

Question 1e (2 marks)

Bread has been part of human history for thousands of years. Bread is one of the oldest prepared foods and is eaten regularly. Bread is the product of baking a mixture of flour, which is a carbohydrate; water; sugar; salt; yeast and other ingredients. The basic process involves the mixing of ingredients until the flour is converted into a dough, which is then baked.



Scroll down to continue

One chemical process that occurs during bread preparation is fermentation. Fermentation occurs in the absence of oxygen, so it is a type of anaerobic respiration. The word equation for this process is:

glucose → ethanol + carbon dioxide

The chemical equation is shown below. **Select** options to balance the chemical equation for this reaction.

? $C_6H_{12}O_6$ → ? C_2H_5OH + ? CO_2

glucose → ethanol + carbon dioxide

The chemical equation is shown below. **Select** options to balance the chemical equation for this reaction.

? $C_6H_{12}O_6$ → ? C_2H_5OH + ? CO_2

Question 1f (3 marks)

During bread preparation, the dough rises. **Explain** how yeast makes the dough rise.

Question 2 (10 marks)

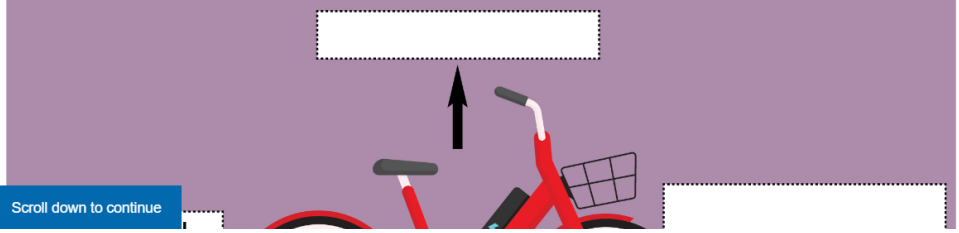
Many governments are looking for sustainable alternatives to replace the use of vehicles that use fossil fuels. Electric bicycles, also known as e-bikes, have shown great promise as an effective and environmentally friendly transport solution. This mode of transport also helps people to improve their health.

Question 2a (2 marks)

Select the location to identify the forces acting on the moving e-bike shown in the image below.

Draggable items:

Friction Air resistance Weight Normal reaction



Scroll down to continue

Question 2a (2 marks)

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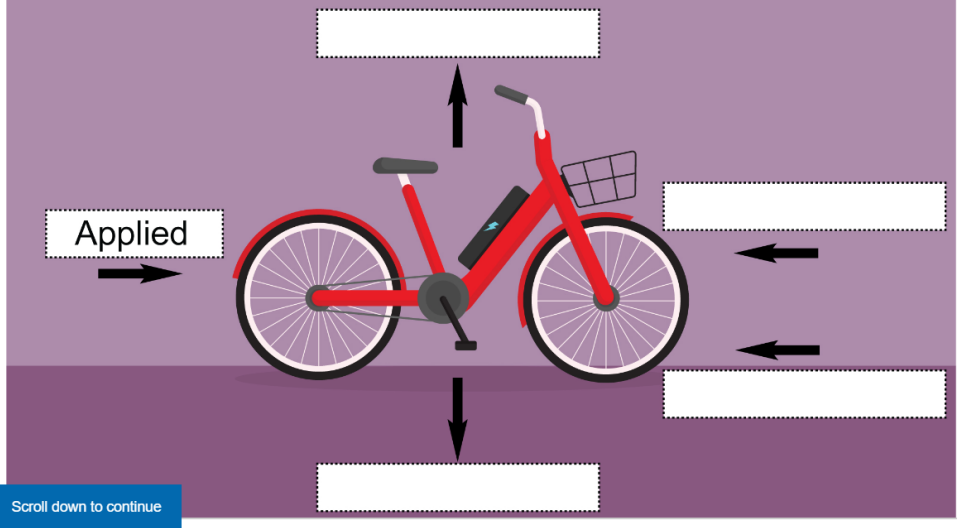
Draggable items:

Friction Air resistance Weight Normal reaction



Scroll down to continue

Question 2b (1 mark)

An e-bike's range indicates the distance you can ride a bike before the battery runs out. There are many factors that affect the range, including the battery capacity, the material of the frame, the terrain and the level of pedalling effort made by the rider.

Higher speed usually means lower range. Battery capacity can be measured using Watt-hours (Wh). Generally, the higher the battery capacity, the higher the range is.

An e-bike battery is measured by its voltage (V) and ampere-hours (Ah) rating. To determine the capacity of the e-bike in Watt-hours, the formula below can be used.

capacity = voltage x ampere-hours

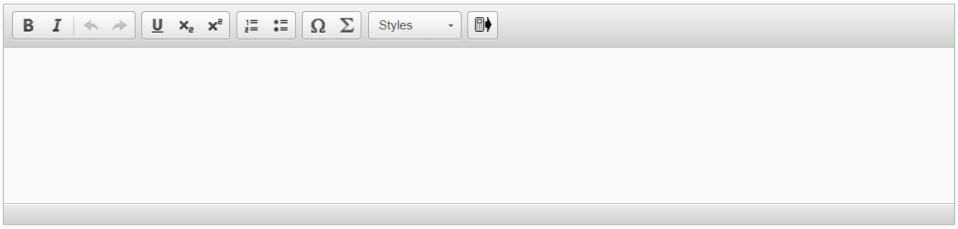
Calculate the capacity of battery 2 using the following data and add your value to the table.

	Voltage / V	Ampere-hours / Ah	Battery capacity / Wh
Battery 1	50	15	750
Battery 2	30	20	

Reset

Question 2c (2 marks)

On average, an e-bike battery provides 1 mile of travel using 4 Wh in a flat terrain and 30 Wh in a mountainous terrain. An e-bike with a battery capacity of 750 Wh can travel for 300 km on flat terrain. **Calculate** the distance in km that the same e-bike can travel on mountainous terrain. Give your answer in km (1 mile = 1.6 km).



Question 2d (1 mark)

Another design factor that affects the performance of an e-bike is its weight. Different materials are used to build e-bikes. The most common materials are aluminium, magnesium alloy and carbon fibre.

Identify the group of the periodic table where magnesium is found.

Question 2e (2 marks)

State the electronic configuration of aluminium and carbon.

Aluminium

Carbon

Question 2f (2 marks)

Depending on the intensity, cycling will increase your heart rate. As your heart rate increases, more blood can flow around your body. **Suggest** why cycling every day improves long-term health.

Scroll down to continue

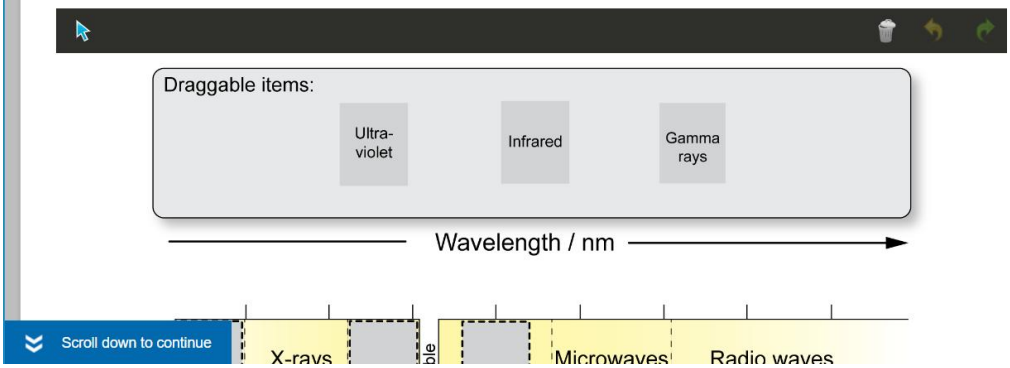
Question 3 (19 marks)

Visible light is the part of the electromagnetic spectrum which our eyes can detect. The colours of the visible spectrum are arranged in order of increasing wavelength, as shown below. The colour we see depends on the wavelength of light. For example, light with a wavelength of 700 nm will look red.

Question 3a (1 mark)

The visible spectrum is only a small part of the electromagnetic spectrum.

Label the regions of the electromagnetic spectrum below.



Question 3a (1 mark)

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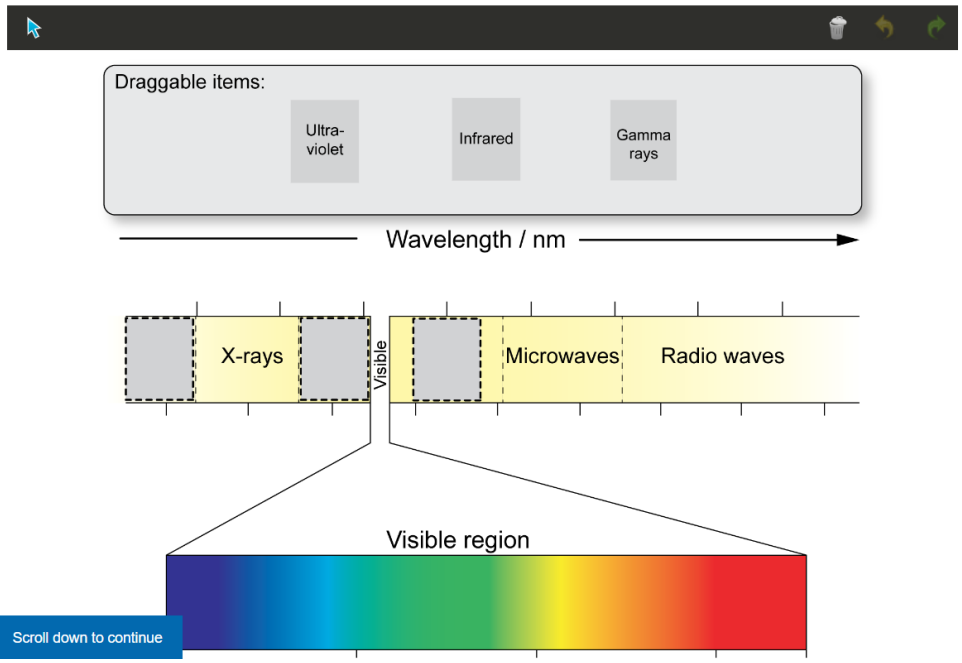
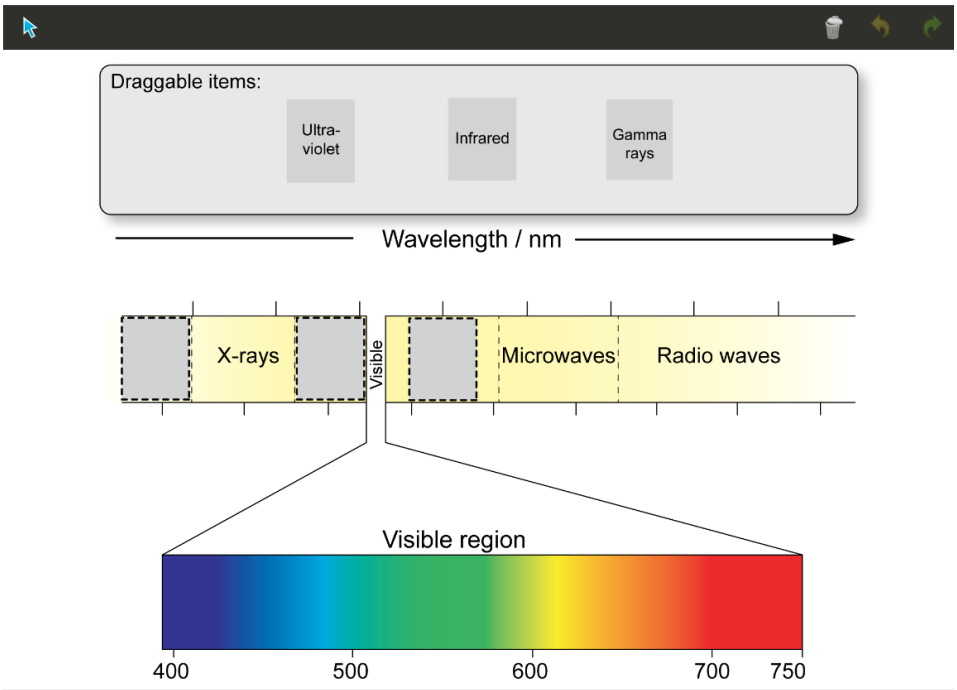
Label the regions of the electromagnetic spectrum below.



Scroll down to continue

Label the regions of the electromagnetic spectrum below.

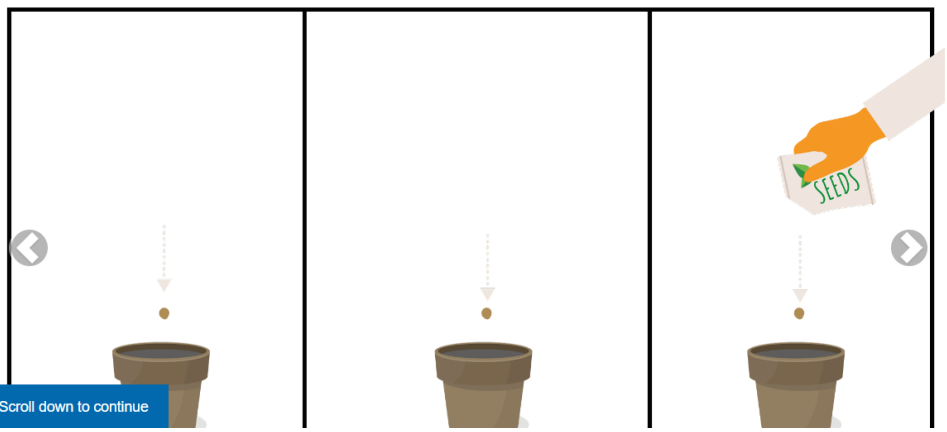


Scroll down to continue

Question 3b (2 marks)

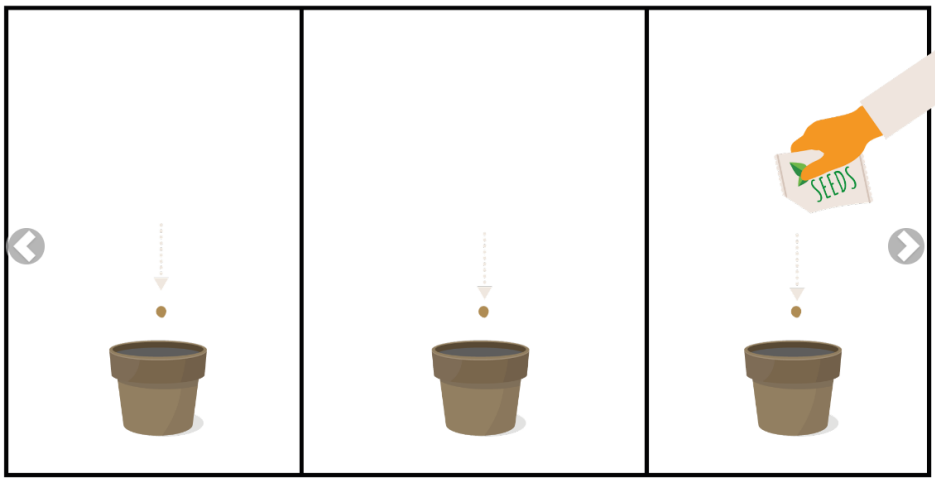
Light appears white when it contains all the different wavelengths of the visible spectrum. A student wishes to find out how different wavelengths of visible light affect the growth of a plant. The independent variable for this investigation is colour of light. They chose to use red light with a wavelength of 700 nm, green light (550 nm) and blue light (400 nm).

The student placed a seed in each of three plant pots.



Scroll down to continue

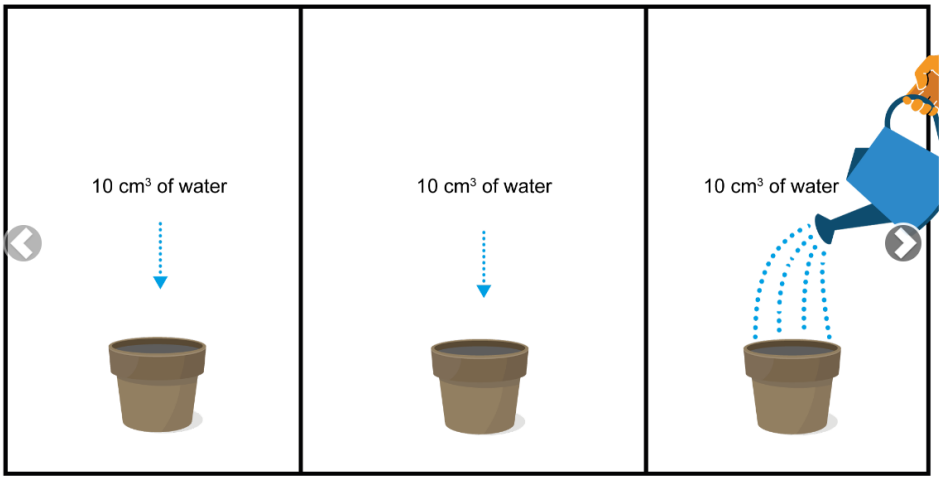
The student placed a seed in each of three plant pots.



Identify two control variables for this experiment.

Scroll down to continue

Each pot was given 10 cm^3 of water.



Identify two control variables for this experiment.

Scroll down to continue

One plant pot was placed in a dark room with a red light, one was placed in a dark room with a green light, and one was placed in a dark room with a blue light.

Identify two control variables for this experiment.

Scroll down to continue

Each day for two weeks, the student measured the height of the plants and gave them an additional 10 cm^3 of water.

○○○●

Identify two control variables for this experiment.

Scroll down to continue

Identify two control variables for this experiment.

Control variable 1

Styles

Control variable 2

Styles

Question 3c (1 mark)

Scroll down to continue

Question 3c (1 mark)

Images of the student's experiment are shown below.

This media is interactive

Day 0

Next

Scroll down to continue

ght of the plant growing in red light on day 14 and add your result to the table

Question 3c (1 mark)

Images of the student's experiment are shown below.

This media is interactive

Back

Day 5

Next

Scroll down to continue

Question 3c (1 mark)

Images of the student's experiment are shown below.

This media is interactive

Back

Day 10

Next

Scroll down to continue

ht of the plant growing in red light on day 14 and add your result to the table

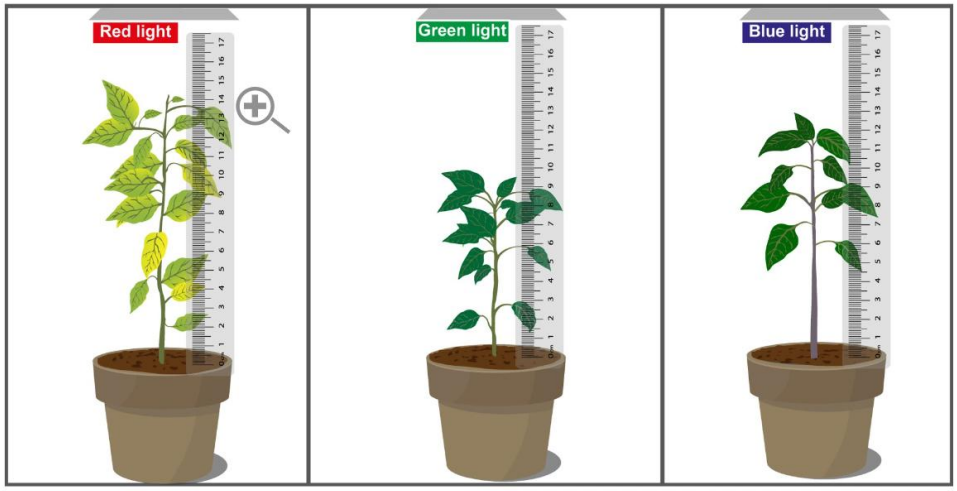
Question 3c (1 mark)

Images of the student's experiment are shown below.

This media is interactive

Back

Day 14



Scroll down to continue

ght of the plant growing in red light on day 14 and add your result to the table

Measure the height of the plant growing in red light on day 14 and add your result to the table below. Click on the ruler to measure the plant.

Time / days	Height / cm Red light (700 nm)	Height / cm Green light (550 nm)	Height / cm Blue light (400 nm)
0	0	0	0
1	0	0	0
2	0	0	0
3	0.3	0.5	0.2
4	0.9	1.7	1.5
5	1.5	2.3	2.2
6	2.8	2.5	3.0
7	4.1	3.0	3.8
8	5.3	3.9	4.2
9	6.4	4.9	5.0
10	8.0	5.6	6.3
11	9.3	7.0	8.1
12	11.0	8.3	10.2
13	12.8	9.3	11.4
14		9.9	12.8

Reset

Question 3d (4 marks)

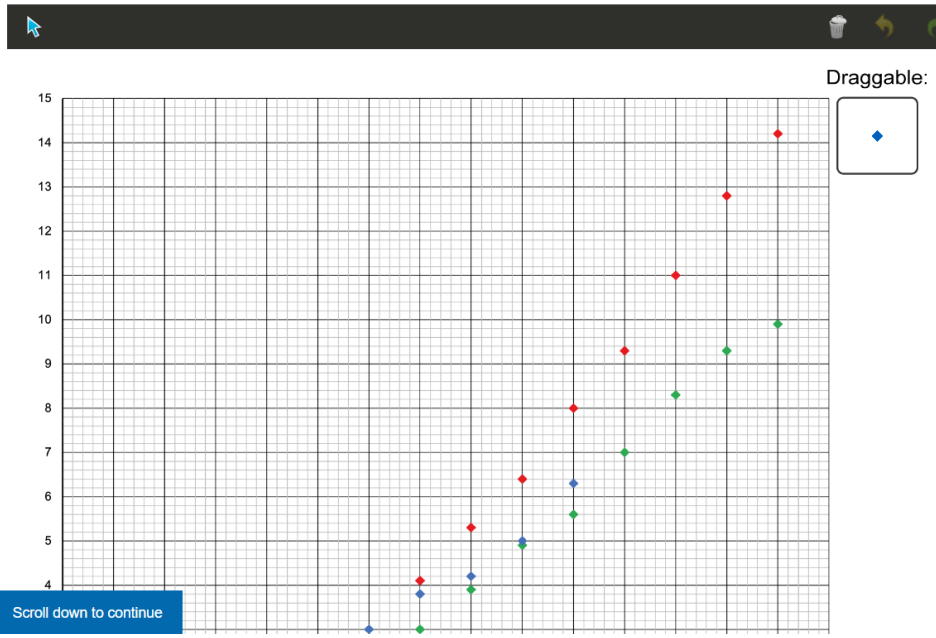
Scroll down to continue

e plants grown in red and green light have been plotted on the graph below,

Question 3d (4 marks)

The results for the plants grown in red and green light have been plotted on the graph below, along with some of the results for the plant grown in blue light.

Plot the last four results for blue light and **label** the axes.



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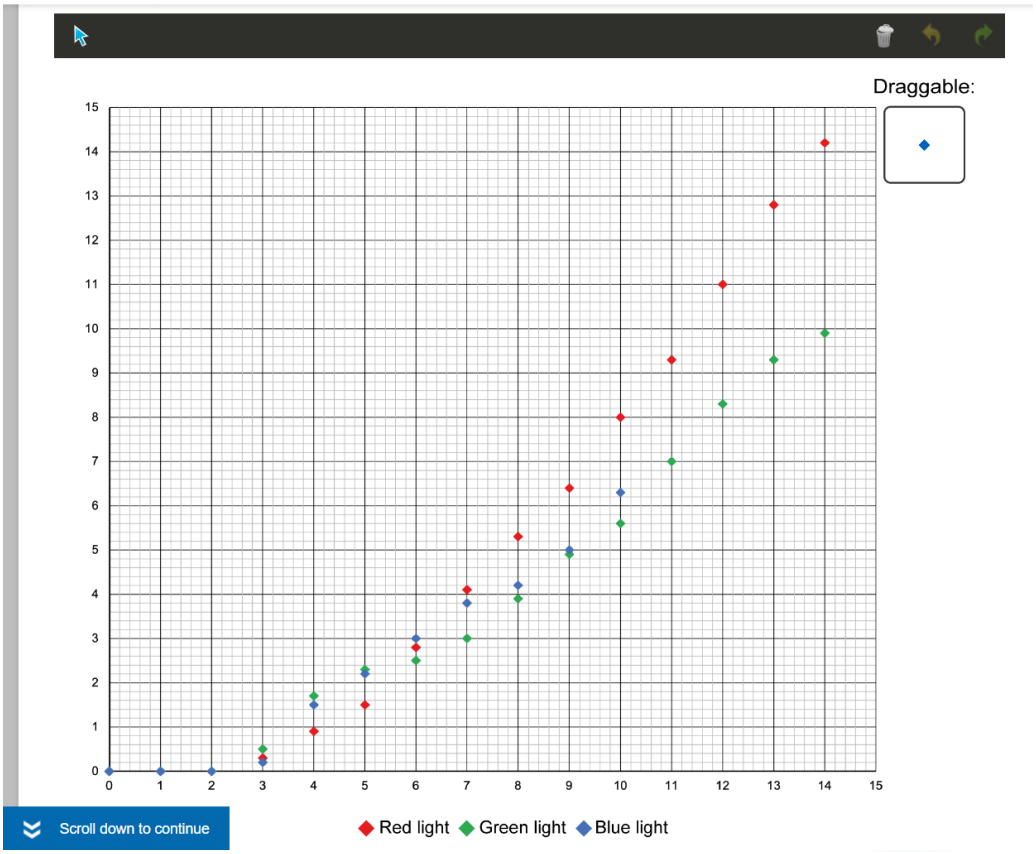
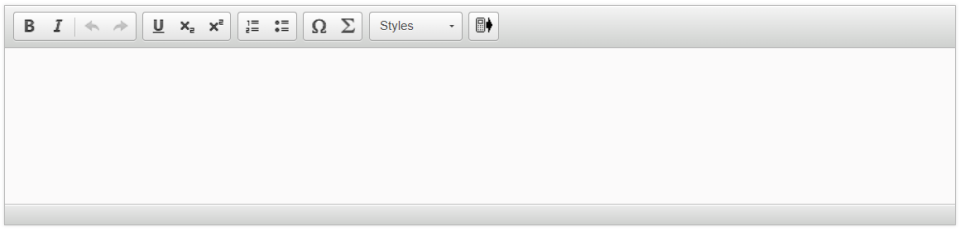

Draggable:
Scroll down to continue
Red light
Green light
Blue light

Question 3e (2 marks)

The student wanted to compare how fast each plant was growing. They calculated the average increase in height over 14 days. The plant growing under red light had an average height increase of 1.0 cm per day. The plant growing under blue light had an average height increase of 0.9 cm per day.

Use the data in part (c) to **calculate** the average height increase per day for the plant growing under green light. Give your answer to one decimal place.



Question 3f (3 marks)

The student knows that they should record not only quantitative data, such as the height of the plant, but also qualitative data.

Use the interactive media in part (c) to **state** one qualitative observation for each plant.

Scroll down to continue

Question 3f (3 marks)

The student knows that they should record not only quantitative data, such as the height of the plant, but also qualitative data.

Use the interactive media in part (c) to **state** one qualitative observation for each plant.

Red light

Green light

Scroll down to continue

Green light

Blue light

Question 3g (2 marks)

Use the data in part (c) and part (f) to **identify** the healthiest plant. **Justify** your answer.

Scroll down to continue

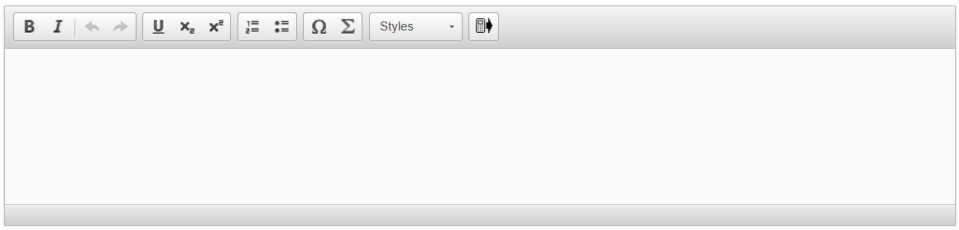
ant is the Select .

Question 3g (2 marks)

Use the data in part (c) and part (f) to **identify** the healthiest plant. **Justify** your answer.

The healthiest plant is the Select.

Justification



Question 3h (3 marks)

Another student suggests that the method could be improved by carrying out the investigation using white light also.

Explain how this would help the student to draw conclusions from the investigation.

Scroll down to continue

Question 3h (3 marks)

Another student suggests that the method could be improved by carrying out the investigation using white light also.

Explain how this would help the student to draw conclusions from the investigation.

Question 3i (1 mark)

The teacher suggests that the research question could be improved, as it is very difficult to measure which plant is healthiest. The research question is given below.

> Which colour of light produces the healthiest plant?

Write down a new testable research question by completing the sentence below.

Scroll down to continue

Question 3i (1 mark)

The teacher suggests that the research question could be improved, as it is very difficult to measure which plant is healthiest. The research question is given below.

> Which colour of light produces the healthiest plant?

Write down a new testable research question by completing the sentence below.

Which colour of light produces...

Question 4 (15 marks)

It is not only the wavelength of light that affects how we see things, but also the material the light is travelling through. Transparent materials have a property called optical density, which affects light as it passes through them.

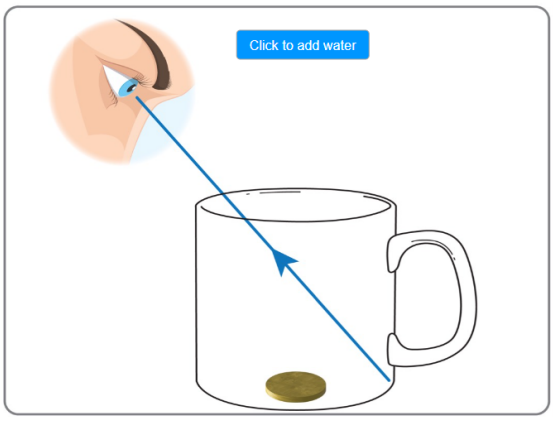
Scroll down to continue

ark)

Question 4a (1 mark)

A student places a coin in the bottom of a cup. From where they are standing, they cannot see the coin. If they put water in the cup, the coin becomes visible because the light is refracted.

This media is interactive



Select the definition of refraction.

- ○ The change of direction of light at a boundary due to a different optical density
- ○ The bouncing back of light off an object, such as a mirror
- ○ ut of light when it passes through a very small gap

Scroll down to continue

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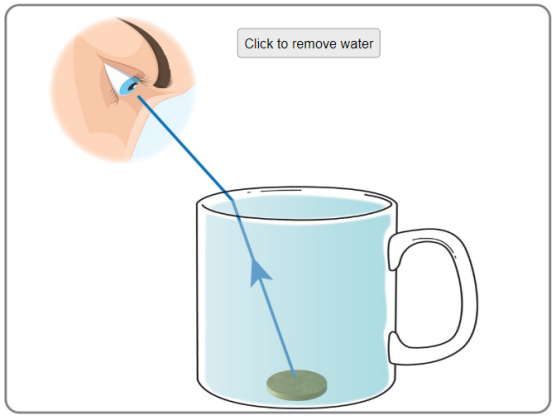
This media is interactive



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- ○ The change of direction of light at a boundary due to a different optical density
- ○ The bouncing back of light off an object, such as a mirror
- ○ ...ut of light when it passes through a very small gap

Scroll down to continue

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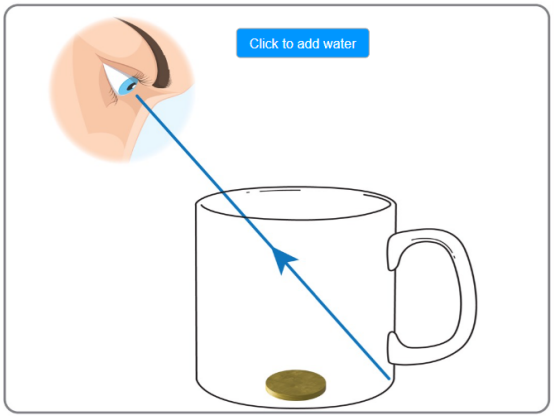
This media is interactive



Select the definition of refraction.

- ○ The change of direction of light at a boundary due to a different optical density
- ○ The bouncing back of light off an object, such as a mirror

Scroll down to continue

ut of light when it passes through a very small gap

Select the definition of refraction.

- ○ The change of direction of light at a boundary due to a different optical density
- ○ The bouncing back of light off an object, such as a mirror
- ○ The spreading out of light when it passes through a very small gap
- ○ The light becomes brighter in different optical densities

Question 4b (2 marks)

A student decides to investigate how light is refracted when it travels into a glass block.

The student puts a semi-circular glass block onto a piece of paper and marks the position of the block. They use a protractor to mark down the normal and every 5 degrees. They then change the angle at which the light enters the block, known as the angle of incidence, and measure the angle at which the light leaves the block, known as the angle of refraction.

ANGLE OF INCIDENCE / °	ANGLE OF REFRACTION / °
0	0
	10
	20

Scroll down to continue

Question 4b (2 marks)

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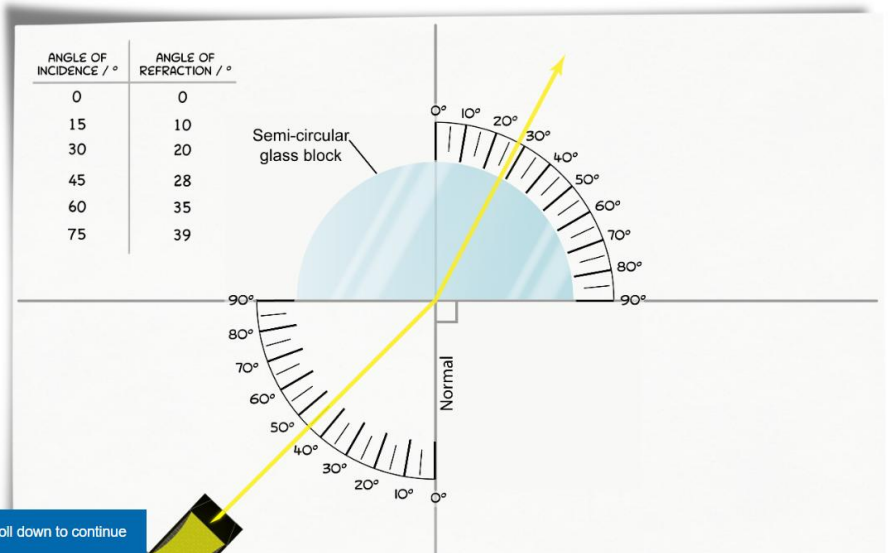
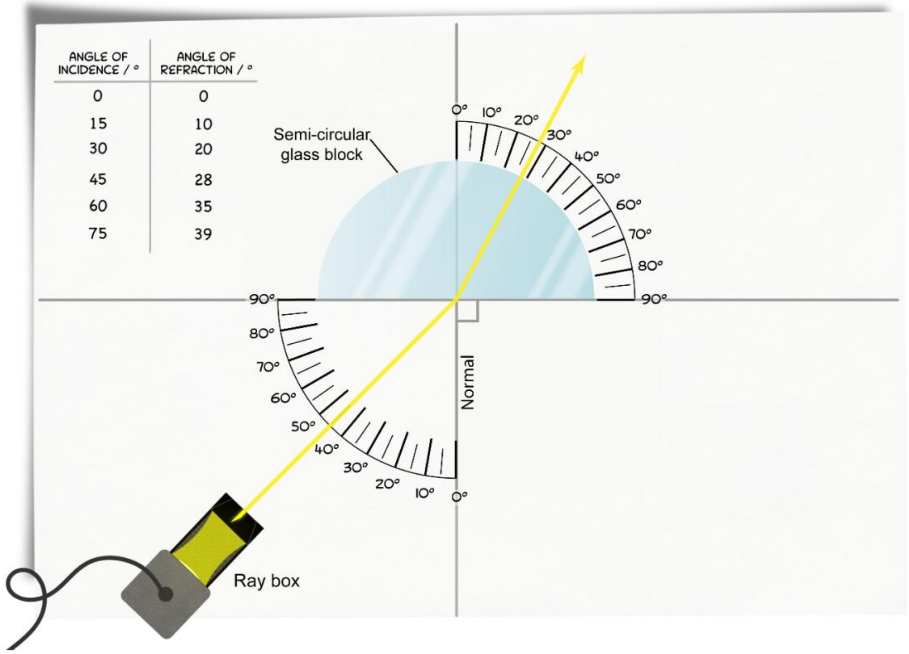
ANGLE OF INCIDENCE / °	ANGLE OF REFRACTION / °
0	0
15	10
30	20
45	28
60	35
75	39



Scroll down to continue

ANGLE OF INCIDENCE / °	ANGLE OF REFRACTION / °
0	0
15	10
30	20
45	28
60	35
75	39



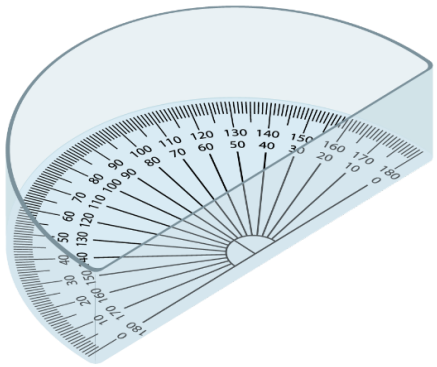
Formulate a prediction for this investigation.

When light travels from a Select optically dense material to a Select optically dense material, the light is refracted Select the normal.

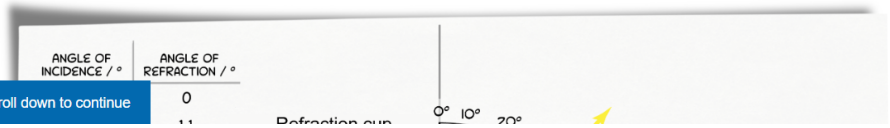
Scroll down to continue

Question 4c (3 marks)

A student wishes to investigate the angle of refraction when light passes from air into water. To do this, they use a special piece of equipment called a refraction cup. It is a semi-circular shaped cup with a protractor printed on the bottom; liquids can be poured into the cup.



The refraction cup has plastic walls that are very thin so the light travels through the plastic without refracting. The student shines the ray of light through the water and records the angle of refraction.



Scroll down to continue

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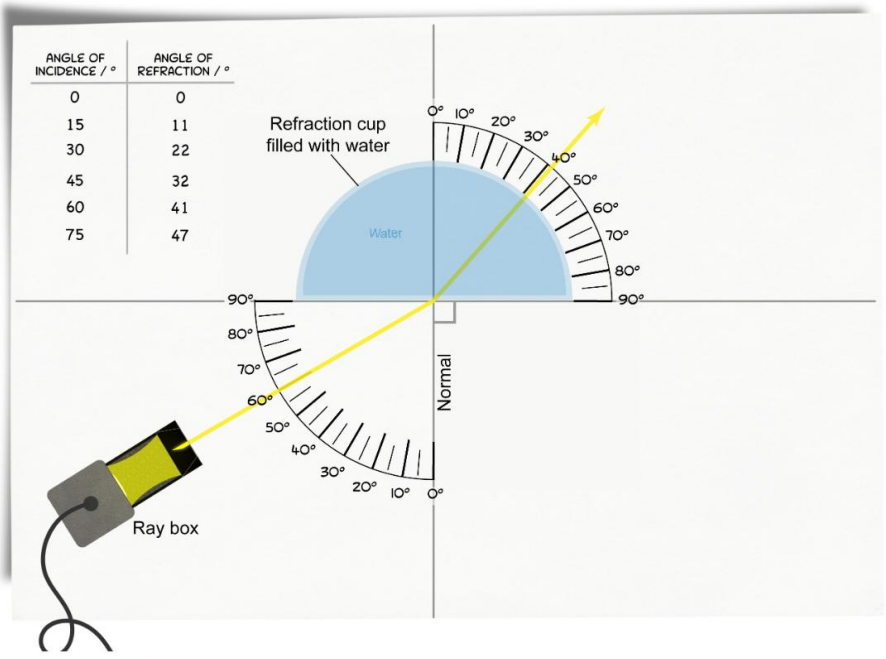
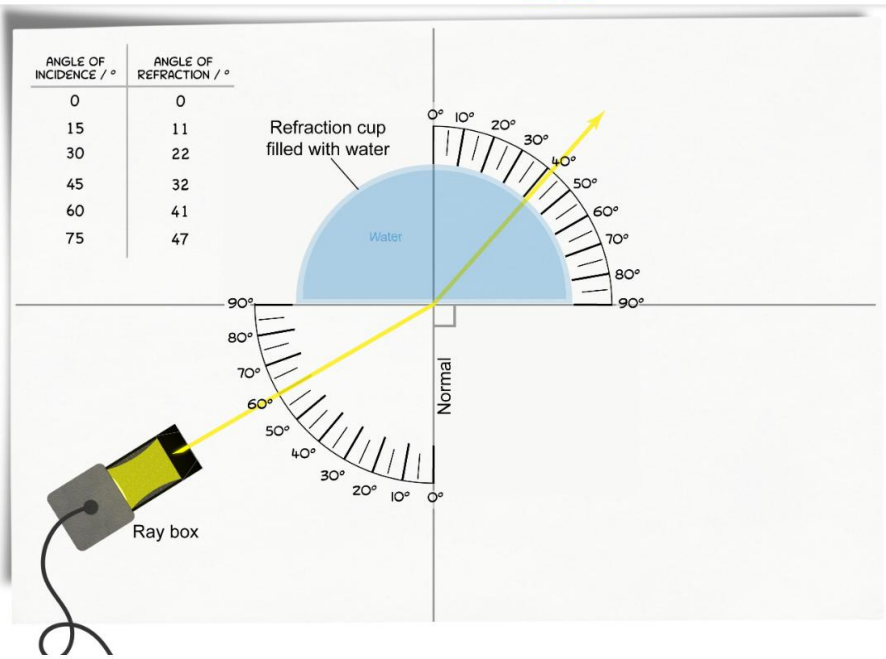
ANGLE OF INCIDENCE / °	ANGLE OF REFRACTION / °
0	0
15	11
30	22
45	32
60	41
75	47



Scroll down to continue

nt's research question.

ANGLE OF INCIDENCE / °	ANGLE OF REFRACTION / °
0	0
15	11
30	22
45	32
60	41
75	47



Outline the student's research question.

B I U Styles

Scroll down to continue

Question 4d (3 marks)

Before the investigation, the student made the following prediction:

> Light will be refracted more in glass than in water because glass has a greater optical density.

Outline the validity of this prediction, using the results from the experiments in parts (b) and (c).

Question 4e (3 marks)

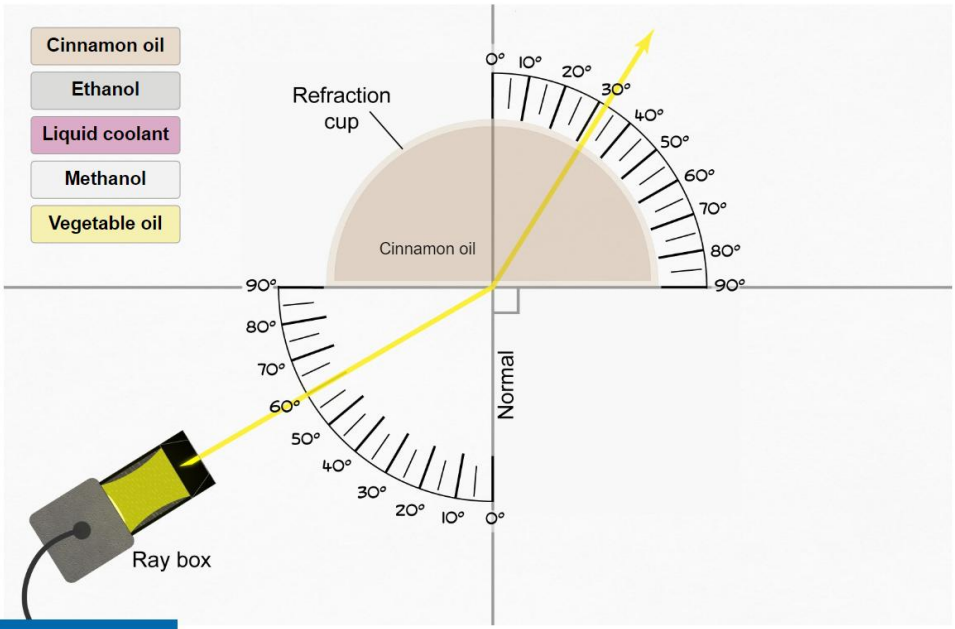
Discuss why the method for investigating how optical density affects the angle of refraction in parts (b) and (c) is only partially valid.

Scroll down to continue

Question 4f (2 marks)

The student repeated the experiment in part (c) with different liquids.

This media is interactive



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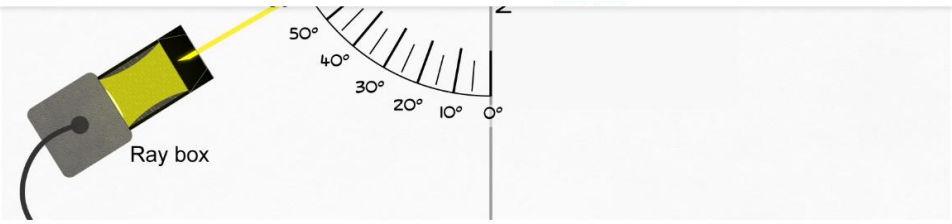


Use these results to **organize** the liquids in order of optical density.

Draggable items:

Cinnamon oil | Ethanol | Liquid coolant | Methanol | Vegetable oil

Highest density

Lowest density

Scroll down to continue

Lowest density

Question 4g (1 mark)

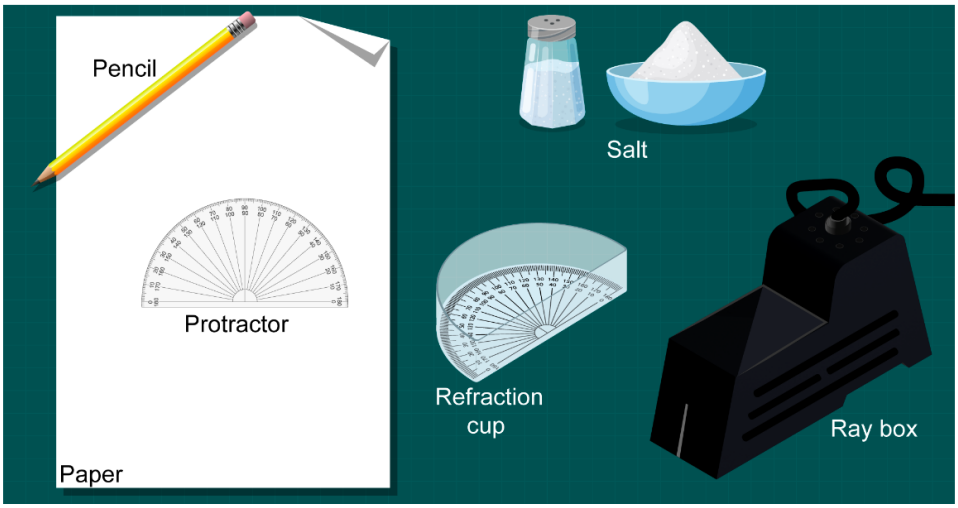
Use the data from the experiments in part (c) and part (f) to **identify** the liquid that has the same optical density as water.

- ○ Cinnamon oil
- ○ Ethanol
- ○ Liquid coolant
- ○ Methanol
- ○ Vegetable oil

Question 5 (17 marks)

The student decides to investigate how the concentration of salt in water affects the refraction of light.

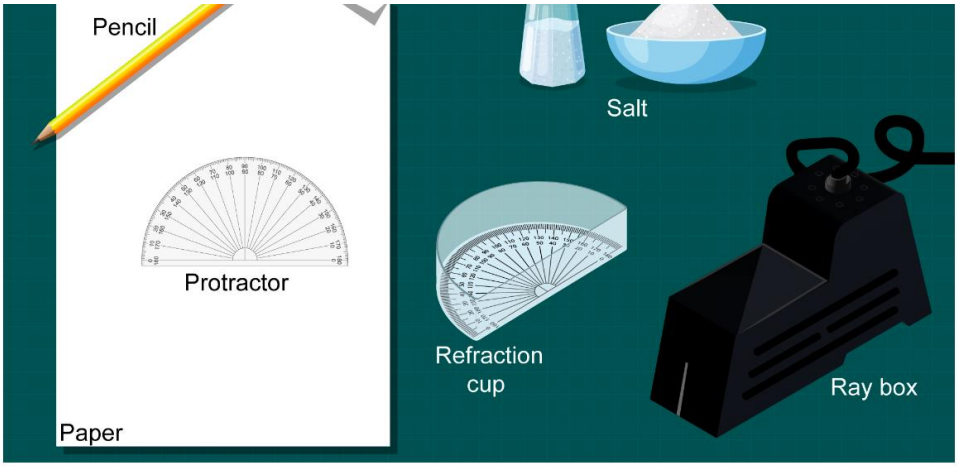
Some of the equipment the student needs to conduct their investigation is shown below:



Design a method the student can use to study how the mass of salt in the water affects the

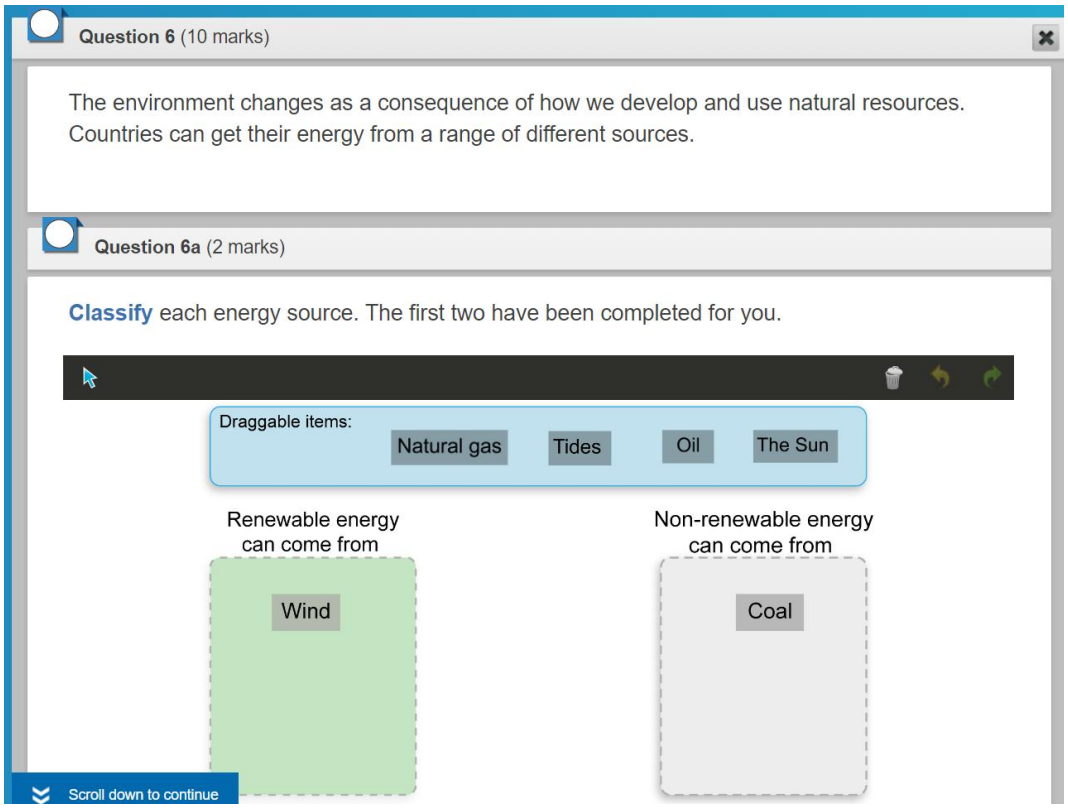
Scroll down to continue

You are provided with the specialist equipment above and can include any



Design a method the student can use to study how the mass of salt in the water affects the refraction of light. You are provided with the specialist equipment above and can include any additional laboratory equipment you need. In your answer, you should:

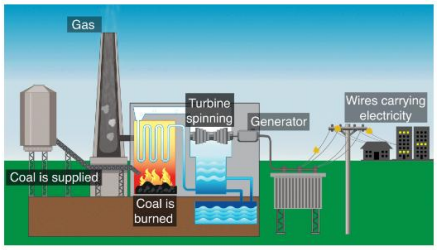
- state the independent variable, the dependent variable and two control variables
- list all the equipment you will use
- outline how the variables should be manipulated to collect sufficient data
- describe the method you will use to make measurements
- describe how you will process the data
- state how you will make sure that your method is safe.


Question 6 (10 marks)
The environment changes as a consequence of how we develop and use natural resources. Countries can get their energy from a range of different sources.
Question 6a (2 marks)
Classify each energy source. The first two have been completed for you.
Draggable items:
Natural gas
Tides
Oil
The Sun
Renewable energy can come from
Wind
Non-renewable energy can come from
Coal
Scroll down to continue

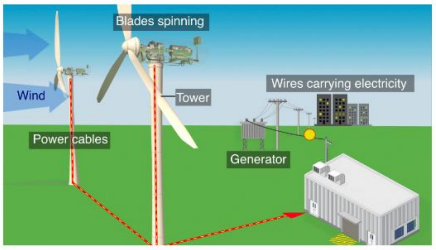
Question 6b (4 marks)

Many countries are trying to reduce pollution by changing from non-renewable to renewable energy sources to produce electricity. One example of producing electricity using a non-renewable energy source is a coal-fired power station. One example of producing electricity using a renewable energy source is a windmill.

Coal-fired power station



Windmill



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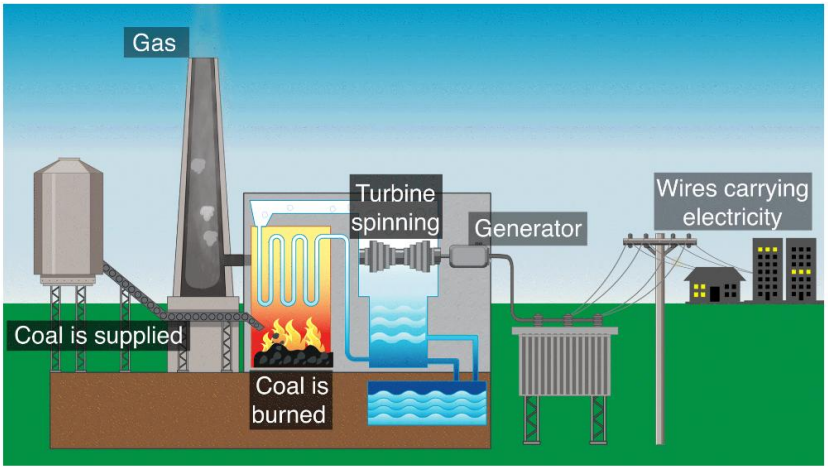
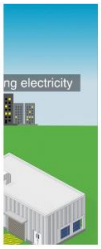
ilarities and differences in the two methods shown above to produce electricity.

Coal-fired power station





Describe the similarities and differences in the two methods shown above to produce electricity.

Similarities

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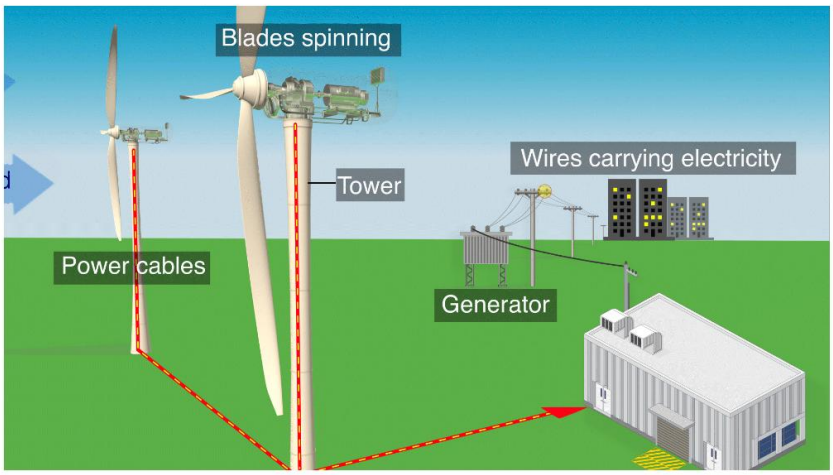
Coal-fire Windmill



Describe the similarities and differences in the two methods shown above to produce electricity.

Similarities

Scroll down to continue

Describe the similarities and differences in the two methods shown above to produce electricity.

Similarities

Differences

Scroll down to continue

Question 6c (4 marks)

The video below describes how humans use natural resources as raw materials.

Video | Transcript

Human survival depends on materials, or resources, that come from nature.

Natural resources include not only the water we consume, or fossil fuels we use in vehicles and to produce electricity, but also other materials we need to manufacture clothes and devices we use daily.

Some natural resources, such as water, materials for shelter and food, are key to our survival. Others just make our lives easier or more entertaining.

Natural resources hold great value for us personally, but also economically. Extracting natural resources from the Earth and selling them to companies that process them is an important source of income for many people and countries.

Extracting natural resources has positive and negative consequences for the environment and local communities.

Most countries have a government agency that monitors and protects natural resources, so that they are used in a sustainable way.

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Describe two ways in which the extraction of natural resources can affect local communities.

Effect 1

Effect 2

Question 7 (14 marks)

As part of a government programme to develop solutions to reduce pollution caused by poor waste disposal, different cities were asked to share their approaches.

City A

City A is running a public education campaign about waste disposal and its effects on the local rivers. They have set up plastic recycling bins throughout the community and displayed posters promoting the use of these recycling bins. When the recycling bins get full, trucks take the plastic waste to a recycling plant.

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City A

City A is running a public education campaign about waste disposal and its effects on the local rivers. They have set up plastic recycling bins throughout the community and displayed posters promoting the use of these recycling bins. When the recycling bins get full, trucks take the plastic waste to a recycling plant.

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City B

City B uses a waste capture method. They have put nets on the outlets of pipes to prevent waste from reaching rivers and seas. When the nets get full, they are emptied by trucks and the waste is taken to a recycling plant. Materials that can be recycled are processed, and organic material is used as biomass energy to power the city.

Scroll down to continue

Using the information provided and knowledge from your wider MYP studies, **discuss** and **evaluate** the solutions used by the two cities.

In your answer, you should include:

- the global implications of plastic waste for aquatic ecosystems
- benefits and limitations of each solution to reduce waste for local society
- a comparison of the financial implications of each solution over five years
- a concluding appraisal giving your opinion about the best solution to reduce pollution from reaching rivers.

Styles

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