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EB Education Revision Guide

How to work with Required Practicals: Part 9
Triple (AQA Physics 2022 Paper 1 & 2)

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Assessed Required Practical Activities
Paper 1

Foundation & Higher

Required practical activity 2: investigate the effectiveness of different materials as thermal insulators and the factors that may affect the thermal insulation properties of a material.
Required practical activity 5: use appropriate apparatus to make and record the measurements needed to determine the densities of regular and irregular solid objects and liquids. Volume should be determined from the dimensions of regularly shaped objects, and by a displacement technique for irregularly shaped objects. Dimensions to be measured using appropriate apparatus such as a ruler, micrometer or Vernier callipers.

Practical 2:Thermal Insulation

What you need to know

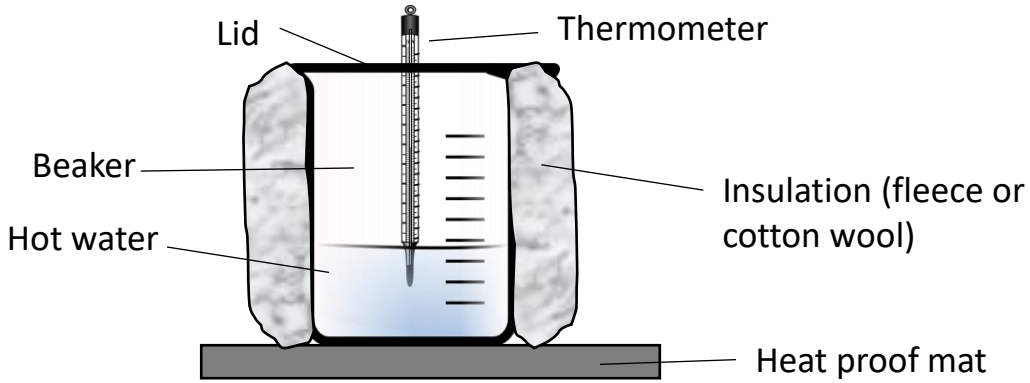
To investigate the effectiveness of different materials as thermal insulators and the factors that may affect the thermal insulation properties of a material.

A beaker is filled with a measured volume of boiling water, and the starting temperature is measured. The temperature of the water is then taken every 2 minutes for 20 minutes.

This is repeated using beakers with different insulating materials placed securely around the beaker. A cooling curve graph can then be plotted. You cans also complete an experiment changing the thickness of the insulating material, for example by adding layers of newspaper to the beaker.

You may need to explain:

- The curve which takes the longest time for the water temperature to drop (the shallowest) should be the material which is the best insulator.
- The temperature falls quickly at high temperatures and slowly at low temperatures. When the beaker is at a high temperature, there is a big difference between the temperature of the beaker and the temperature of the surrounding air. This means there is a high rate of energy transfer. When the beaker is at a lower temperature, there is less difference between the temperature of the beaker and the temperature of the surrounding air. This means there is a lower rate of energy transfer.



The higher the thermal conductivity of a material, the higher the rate of energy transfer by conduction across the materials. The rate of cooling of an object can therefore be affected by the thickness and thermal conductivity of its walls as well as adding extra “layers” of insulating material to reduce the transfer of thermal energy

Practical 5: Calculating Density

What you need to know

To explain how to find out the density of regular and irregular objects.

To calculate the volume of regular objects, for example, cubes, you can use the dimensions (length x width x height).

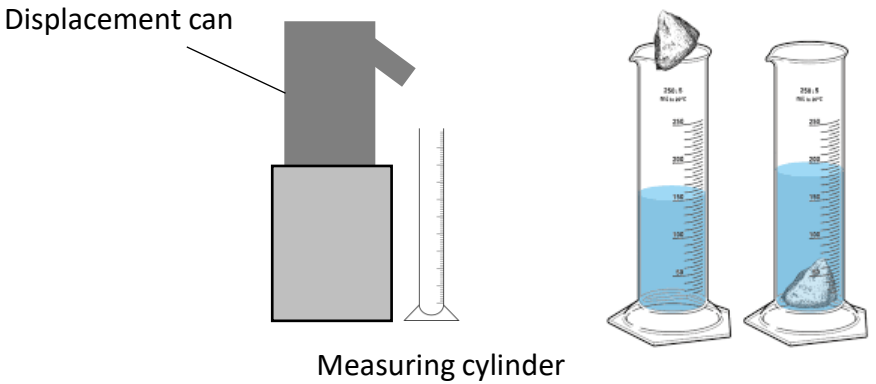
To calculate the volume of irregular objects you will need to use a Eureka can. The object must be lowered carefully into the can, and the water displaced captured in a measuring cylinder.

The mass of the objects is obtained using a top pan balance.

You may be asked about:

a) How to reduce errors. You should discuss lowering the object slowly to avoid water spilling, and waiting for water to stop dripping from the can before lowering the object in. You also need to ensure that the balance is set at zero before measuring the mass of the objects.

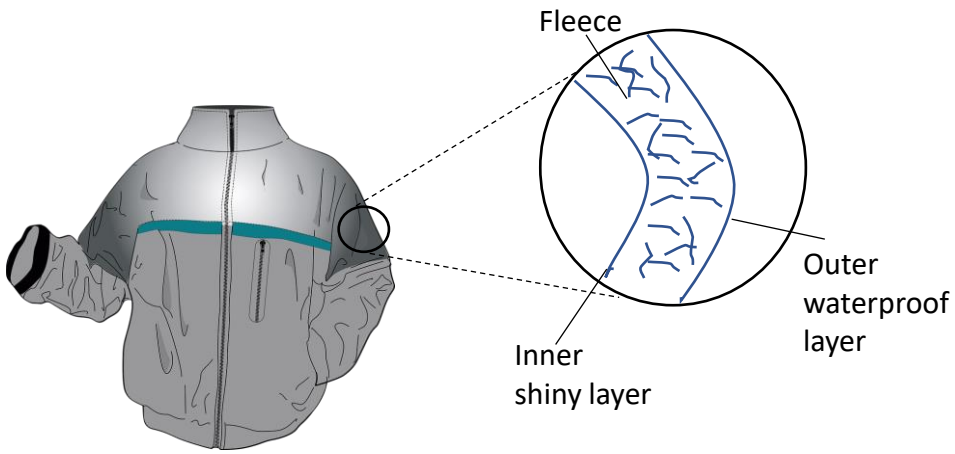
b) The resolution and the uncertainty of the measurements: The resolution would be the smallest measurement that could be made, it would usually be 0.1g. If the balance increases in 0.1g increments – the uncertainty would be ±0.05g.



$$\text{Density} = \frac{\text{mass}}{\text{volume}}$$

Your turn:

1. Below is a diagram of a ski jacket that has been designed to keep a skier warm. It is made from layers of different materials.



a) Heat transfer is reduced by the shiny inner layer.
Which process of heat transfer will it reduce?

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b) Why does the layer of fleece reduce the transfer of heat from a skier's body?

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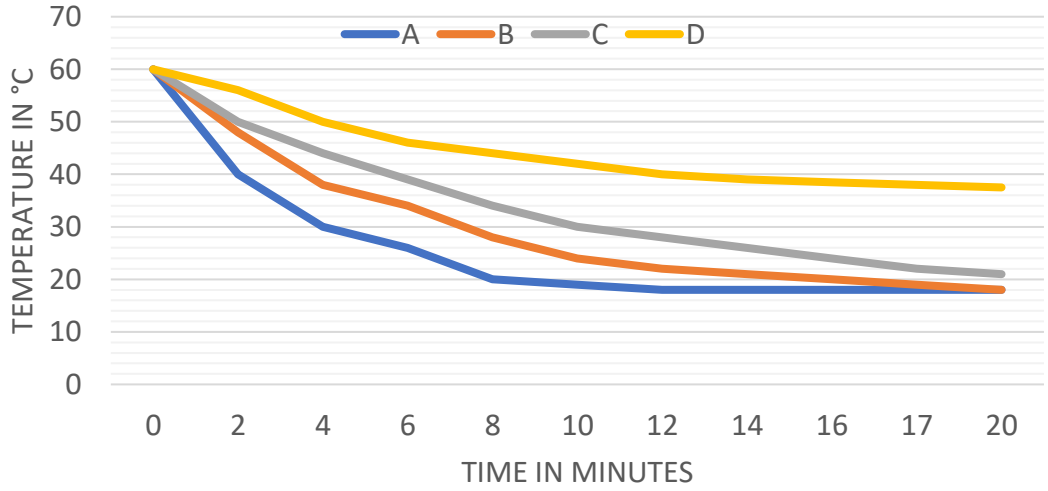
c) Billy decided to test which of four different types fleece would make the warmest jacket. He wrapped each type of fleece around a can, which he then filled with hot water.
He measured the temperature of the water every two minutes for twenty minutes.



The water cooled faster during the first five minutes in every test.
Why?

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Your turn:

d) In order to compare the results, the same volume of water was used in each test.
What other quantity needed to be kept the same in each test?

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e) Using the graph, estimate what the temperature of the water in the can wrapped in fleece B would be after 40 minutes.

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f) Which type of fleece should Billy recommend to be used in the ski jacket? Explain why.

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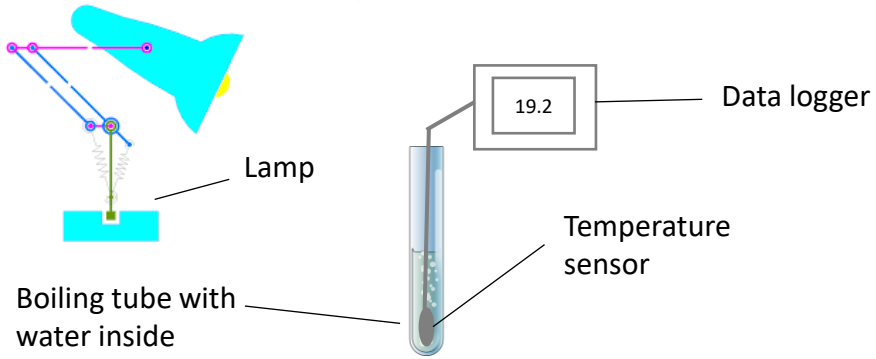
2. Laura read an article in the newspaper about a glacier that had been covered in insulating material in order to slow down the rate at which it melts in the summer.
She wanted to investigate this idea using the apparatus shown below.



She measured 30cm^3 of cold water into the boiling tube, placed it 30cm away from the lamp and recorded the temperature of the water. She then switched on the lamp and recorded the temperature of the water every 5 minutes. She repeated this with boiling tubes covered in different insulating materials.

a) Name one control variable.
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b) Give an advantage of using a temperature sensor and data logger rather than a thermometer.
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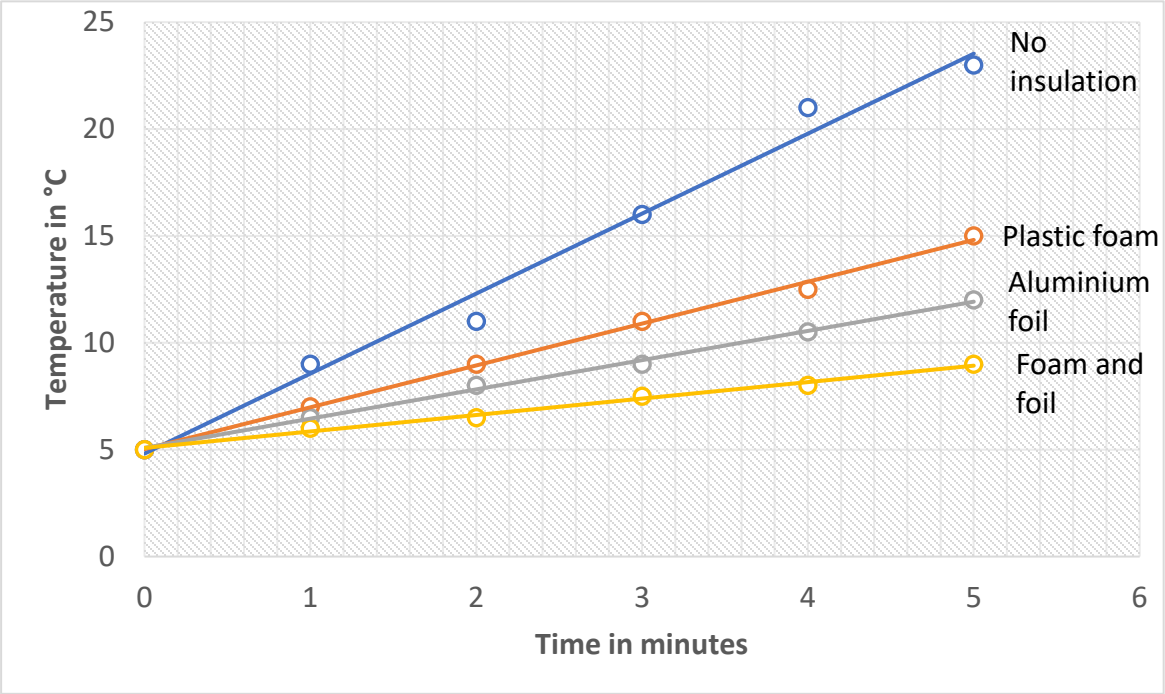
Your turn:

Her results are shown in the graph below.



c) Why did she use a boiling tube with no insulation?

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d) Using her results, what should she recommend is used to insulate the glacier?

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e) Explain why the insulation Laura recommended will reduce the heat transfer from the Sun to the glacier.

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f) Explain, in terms of particles, how heat is transferred through the glass wall of a boiling tube.

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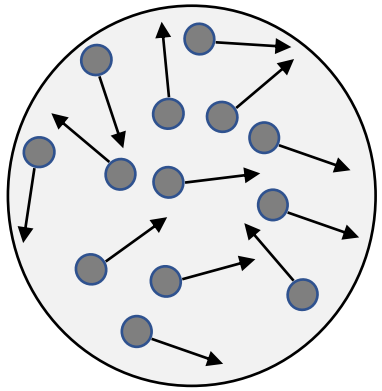
Your turn:

3. The diagram below shows a balloon which is filled with helium gas.



a) Describe how the particles of gas inside the balloon move.

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b) What is the name given to the total potential energy and kinetic energy of all the particle of helium gas inside the balloon.

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c) Which equation links density, volume and mass?

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d) The mass of helium in the balloon is 0.00254kg.
The volume of the balloon is 0.0141m^3
Calculate the density , including units in your answer.

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Your turn:

4. Your teacher provides you with a range of regularly and irregularly shaped objects. Describe how you would calculate the density of these objects.

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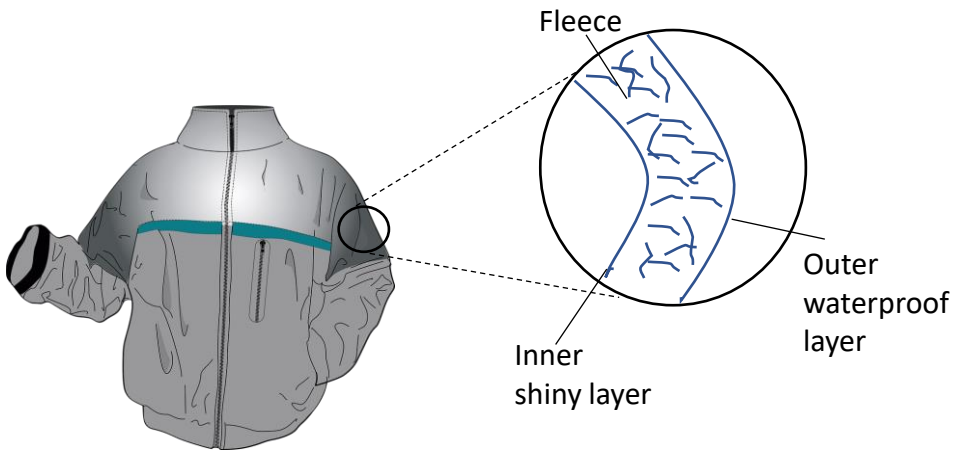
Answers:

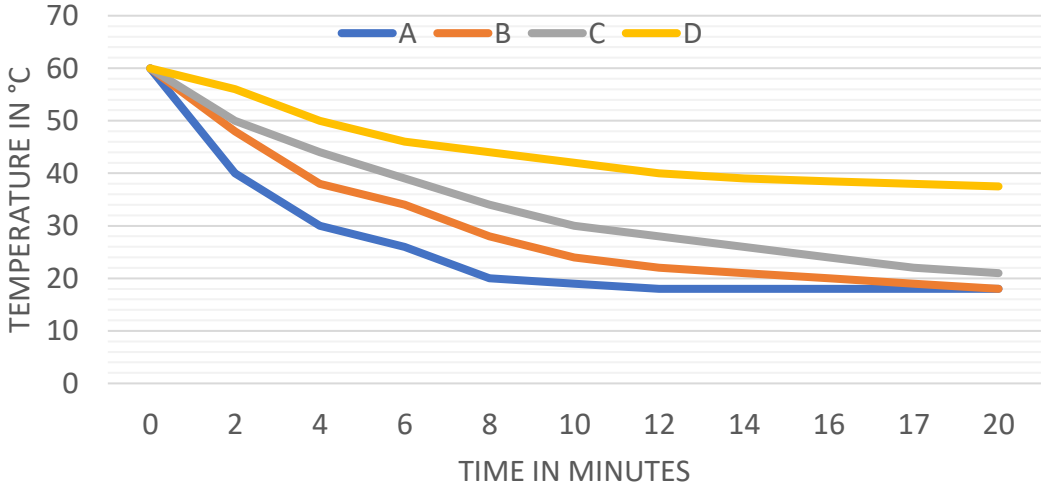
1. Below is a diagram of a ski jacket that has been designed to keep a skier warm. It is made from layers of different materials.



a) Heat transfer is reduced by the shiny inner layer.
Which process of heat transfer will it reduce?
Radiation

b) Why does the layer of fleece reduce the transfer of heat from a skier's body?
Traps small pockets of air stopping heat loss via convection

c) Billy decided to test which of four different types fleece would make the warmest jacket. He wrapped each type of fleece around a can, which he then filled with hot water.
He measured the temperature of the water every two minutes for twenty minutes.



The water cooled faster during the first five minutes in every test.
Why?
Bigger temperature difference between the water and the surroundings

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Answers:

d) In order to compare the results, the same volume of water was used in each test.
What other quantity needed to be kept the same in each test?

Starting temperature of the water/ thickness of the fleece

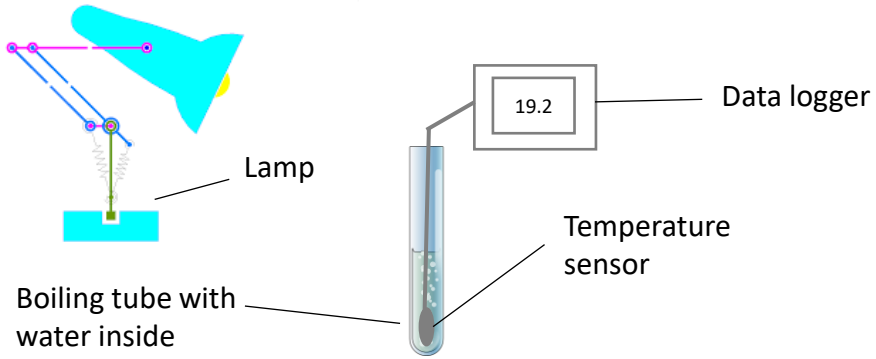
e) Using the graph, estimate what the temperature of the water in the can wrapped in fleece B would be after 40 minutes.

18°C

f) Which type of fleece should Billy recommend to be used in the ski jacket? Explain why.

D - Smallest temperature drop after 20 minutes

2. Laura read an article in the newspaper about a glacier that had been covered in insulating material in order to slow down the rate at which it melts in the summer.
She wanted to investigate this idea using the apparatus shown below.



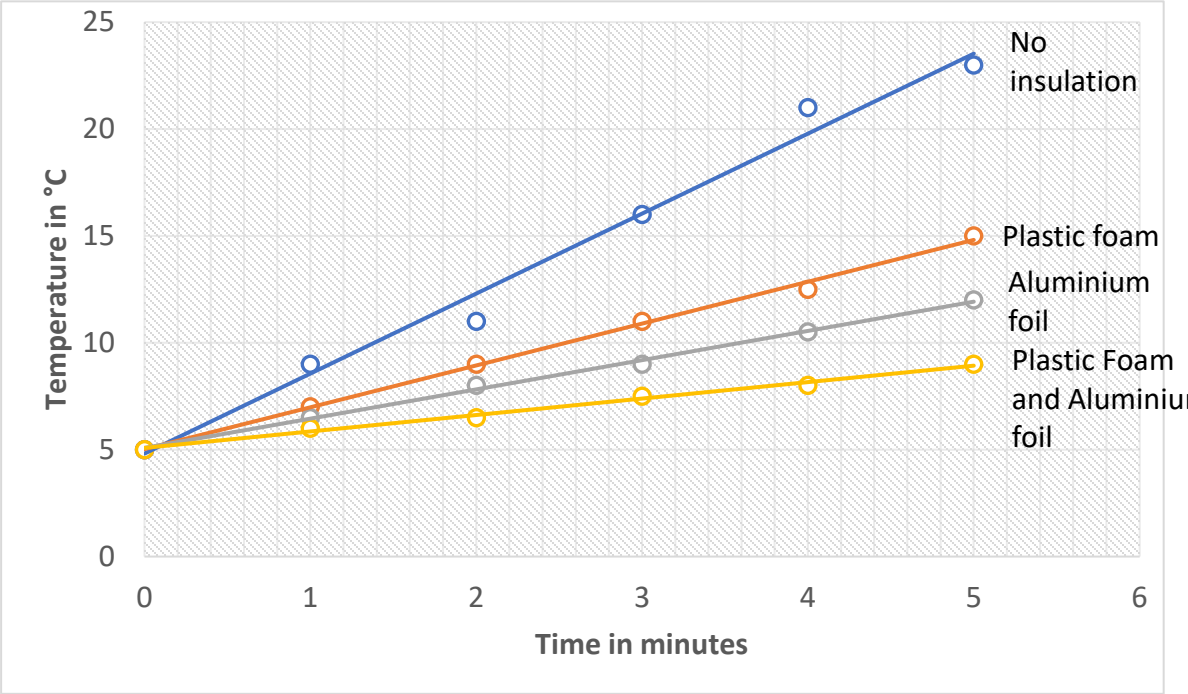
She measured 30cm^3 of cold water into the boiling tube, placed it 30cm away from the lamp and recorded the temperature of the water. She then switched on the lamp and recorded the temperature of the water every 5 minutes. She repeated this with boiling tubes covered in different insulating materials.

a) Name one control variable. Volume of water/distance of lamp/starting temp of water/same room temperature

b) Give an advantage of using a temperature sensor and data logger rather than a thermometer. Greater sensitivity/precision/take more frequent readings

Answers:

Her results are shown in the graph below.



c) Why did she use a boiling tube with no insulation?

Acts as a control

d) Using her results, what should she recommend is used to insulate the glacier?

Plastic foam and aluminium foil

e) Explain why the insulation Laura recommended will reduce the heat transfer from the Sun to the glacier.

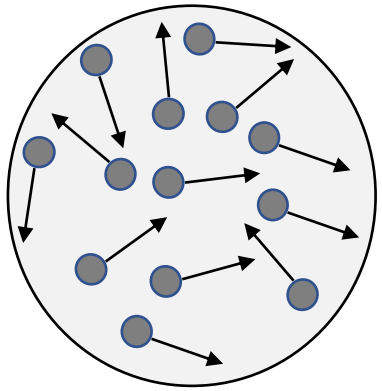
Aluminium foil is a poor absorber/good reflector of thermal radiation.
Foam traps air which is a good insulator

f) Explain, in terms of particles, how heat is transferred through the glass wall of a boiling tube.

Particles vibrate with more energy. Energy is transferred by collisions with other particles.

Your turn:

3. The diagram below shows a balloon which is filled with helium gas.



a) Describe how the particles of gas inside the balloon move.

The particles move randomly, colliding with each other and the sides of the balloon

b) What is the name given to the total potential energy and kinetic energy of all the particle of helium gas inside the balloon.

Internal energy

c) Which equation links density, volume and mass?

Density = Mass/Volume

d) The mass of helium in the balloon is 0.00254kg.
The volume of the balloon is $0.0141m^3$
Calculate the density , including units in your answer.

Density = 0.00254/0.0141
=0.18 kg/m^3

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Your turn:

4. Your teacher provides you with a range of regularly and irregularly shaped objects. Describe how you would calculate the density of these objects.

Calculate the volume of the regular objects -
Volume = length x width x height.
Find the volume of the irregular objects using a Eureka can. Fill the can with water until it stops dripping. Slowly lower the object in, collecting the water displaced with a measuring cylinder, this is the volume of the object
Measure the mass of the objects using a top pan balance.
Use the equation Density = Mass/Volume to calculate the density.

Assessed Required Practical Activities
Paper 2

Foundation & Higher

Required practical activity 9: investigate the reflection of light by different types of surface and the refraction of light by different substances.

Practical 9: Light

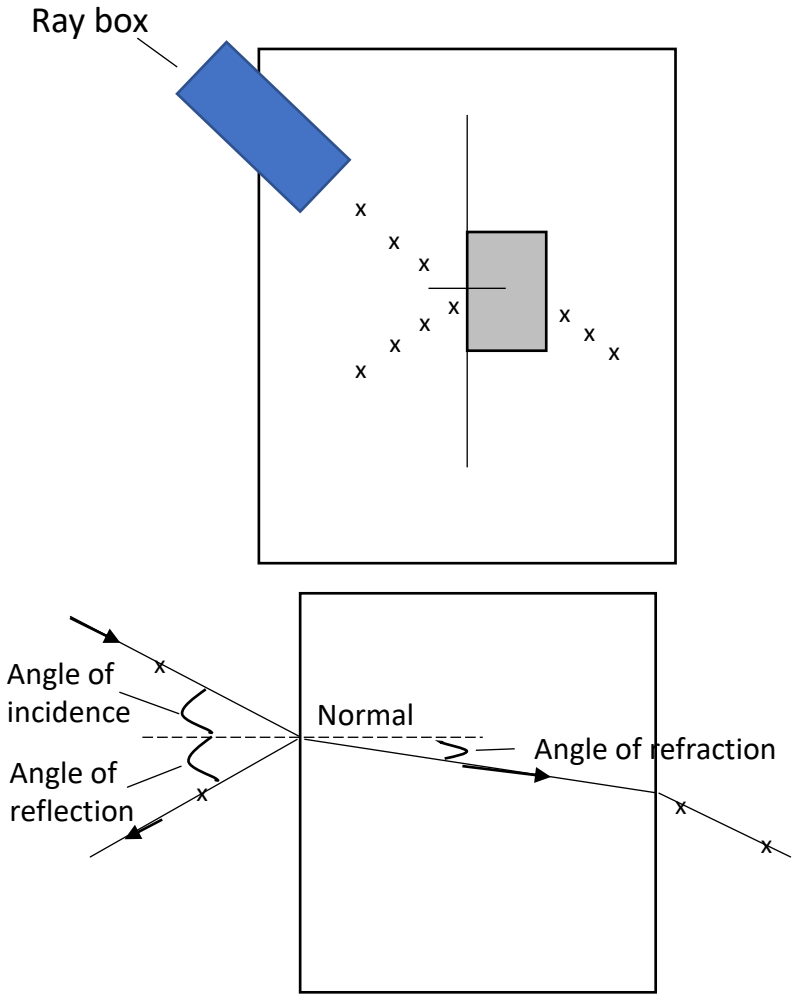
What you need to know

To investigate the reflection of light by different types of surface and the refraction of light by different substances.

A ray box is used to direct a ray of light onto the surface of a transparent block. The path of the ray that is reflected from the surface of the block and the ray that passes through the block are marked. The angles of incidence, reflection and refraction are measured. This is repeated with different blocks.

You may be asked to:

- Explain that for the same material, the angles if incidence and reflection will be the same, but the angle of incidence will be different to the angle of refraction.
- Explain that as a wave passes from a less dense medium (e.g. air) to a more dense medium (e.g. glass) it bends towards the normal, and the angle of incidence is therefore greater than the angle of refraction. This is the reverse when travelling from more dense medium to a less dense medium
- Describe the safety hazards – the ray box will get hot, and there will be an increased trip hazard due to the darkness of the room.



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Your turn:

1. Harry carried out an investigation into the refraction of light at an air to glass boundary. The results are below.

Angle of incidence (°)	Angle of refraction (°)
20°	12°
30°	18°
40°	25°
50°	31°

a) Describe how Harry could have carried out his investigation. You may use a labelled diagram as part of your answer.

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b) Why is light refracted as it crosses from air into glass?

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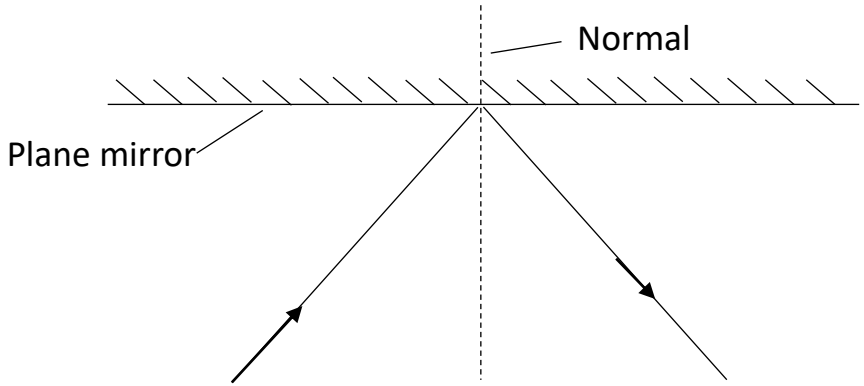
Your turn:

2. Brooke investigated the reflection of light by a plane mirror, as shown by the diagram below.



Her results are shown in the table below.

Angle of incidence (°)	Angle of reflection (°				Mean angle of reflection (°)
	Test 1	Test 2	Test 3	Test 4	
10	13	11	11	10	
30	32	31	28	27	
50	48	63	49	50	
70	74	69	72	71	

a) Complete the table.

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b) Brooke concluded that the angle of incidence is equal to the angle of reflection. Using examples from the data collected, explain whether you agree with this conclusion.

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c) Suggest what further evidence Brooke could collect to support the conclusion she made.

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Answers:

1. Harry carried out an investigation into the refraction of light at an air to glass boundary. The results are below.

Angle of incidence (°)	Angle of refraction (°)
20°	12°
30°	18°
40°	25°
50°	31°

a) Describe how Harry could have carried out his investigation. You may use a labelled diagram as part of your answer.

place a glass block on a piece of paper
draw around the glass block and then remove from the paper
draw a line at 90° to one side of the block (the normal)
use a protractor to measure and then draw a line at an angle of 20° to the normal
replace the glass block
using a ray box and slit, point the ray of light down the drawn line
mark the ray of light emerging from the block
remove the block and draw in the refracted ray
measure the angle of refraction with a protractor
repeat the procedure for a range of values of the angle of incidence

b) Why is light refracted as it crosses from air into glass?

Velocity/speed of the light decreases

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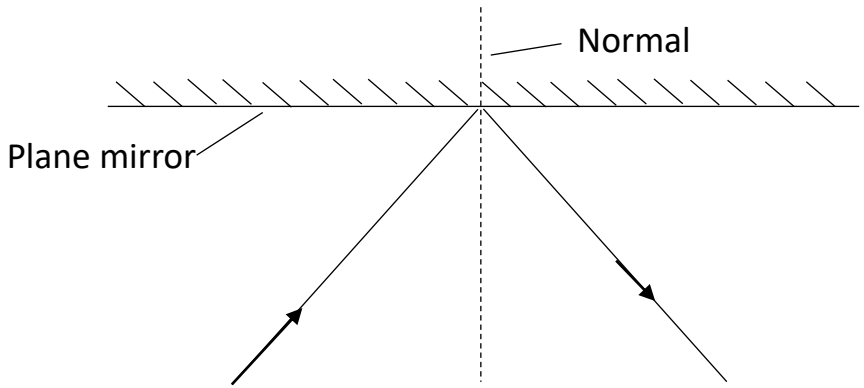
Answers:

2. Brooke investigated the reflection of light by a plane mirror, as shown by the diagram below.



Her results are shown in the table below.

Angle of incidence (°)	Angle of reflection (°)				Mean angle of reflection (°)
	Test 1	Test 2	Test 3	Test 4	
10	13	11	11	10	11.25
30	32	31	28	27	29.5
50	48	63	49	50	49
70	74	69	72	71	71.5

a) Complete the table.

Mean: (13 + 11 + 11 + 10) ÷ 4 = 11.25°

(32 + 31 +28 + 27) ÷ 4 = 29.5°

(48 + 49 + 50) ÷ 3 = 49°

(74 + 69 + 72 + 71) ÷ 4 = 71.5°

b) Brooke concluded that the angle of incidence is equal to the angle of reflection. Using examples from the data collected explain whether you agree with this conclusion.

Agree:

Angle of incidence and angle of reflection are almost the same. There are 2 angles where they are exactly the same (50° and 70°). Angle of incidence = mean angle of reflection.

c) Suggest what further evidence Brooke could collect to support the conclusion she made.

Further data could be collected for angle not yet measured, for example 20°, 40° and 60°

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