

Light & Sound

Question Paper

Level	GCSE
Subject	Physics
Exam Board	Edexcel IGCSE
Module	Double Award (Paper 1P)
Topic	Waves
Sub-Topic	Light & Sound
Booklet	Question Paper

Time Allowed: 96 minutes

Score: /80

Percentage: /100

Grade Boundaries:

A*	A	B	C	D	E	U
>85%	75%	70%	60%	55%	50%	<50%

1. A student is investigating refraction of light.

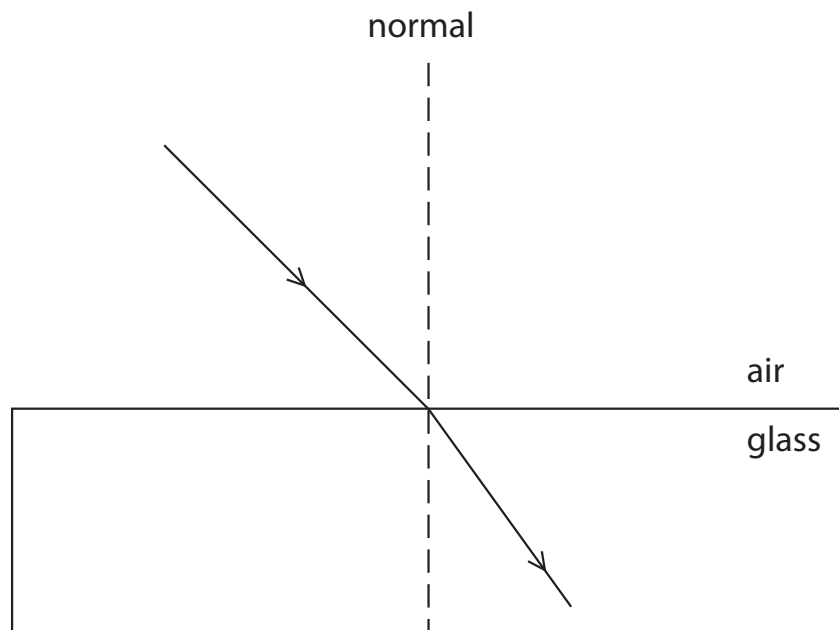
(a) What is **refraction**?

(1)

(b) The diagram shows a ray of light travelling from air to glass.

Add labels to show the angle of incidence, i , and the angle of refraction, r .

(2)

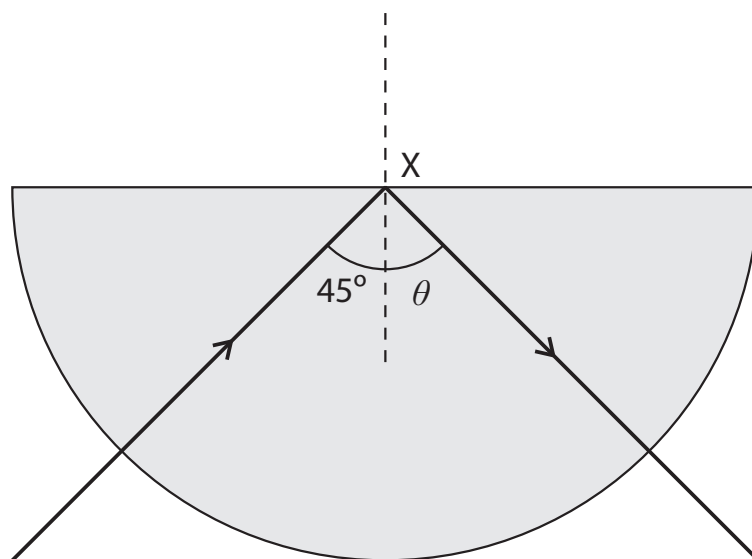


(c) The student wants to find the refractive index of the glass.

(i) State the equation linking refractive index, angle of incidence and angle of refraction.

(1)

2. The diagram shows a light ray passing through a semicircular block of glass.



The dotted line is the normal to the surface at X.

When the light ray hits the surface as shown, **all** of it is reflected back inside.

(a) (i) Name the process shown in the diagram.

(2)

(ii) What is the angle labelled θ ?

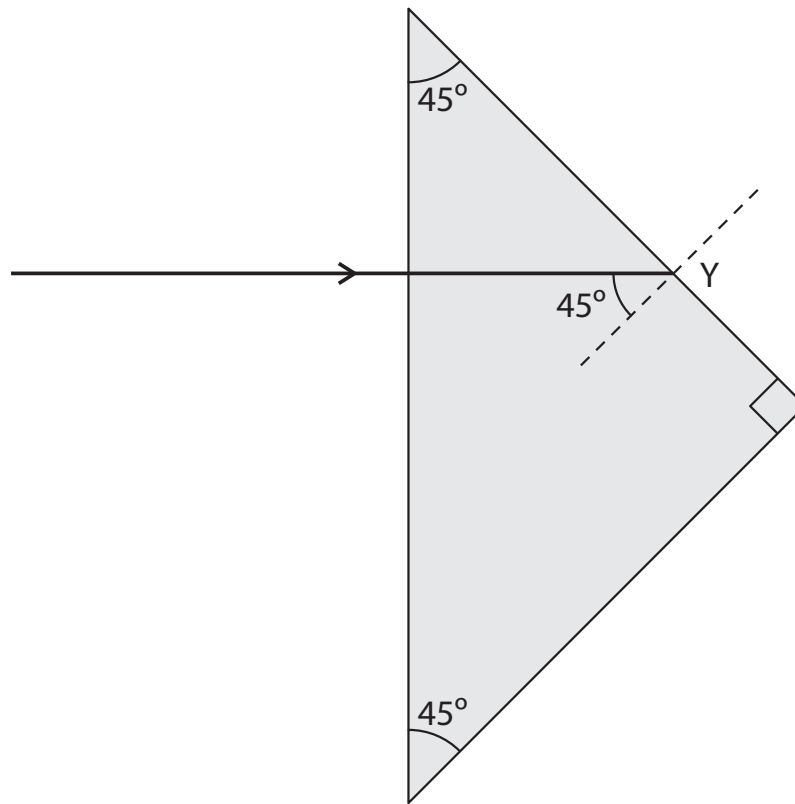
(1)

(b) The diagram shows another light ray entering a right-angled glass block.

It hits the inside surface at Y as shown.

Add to the diagram to complete the path of the ray.

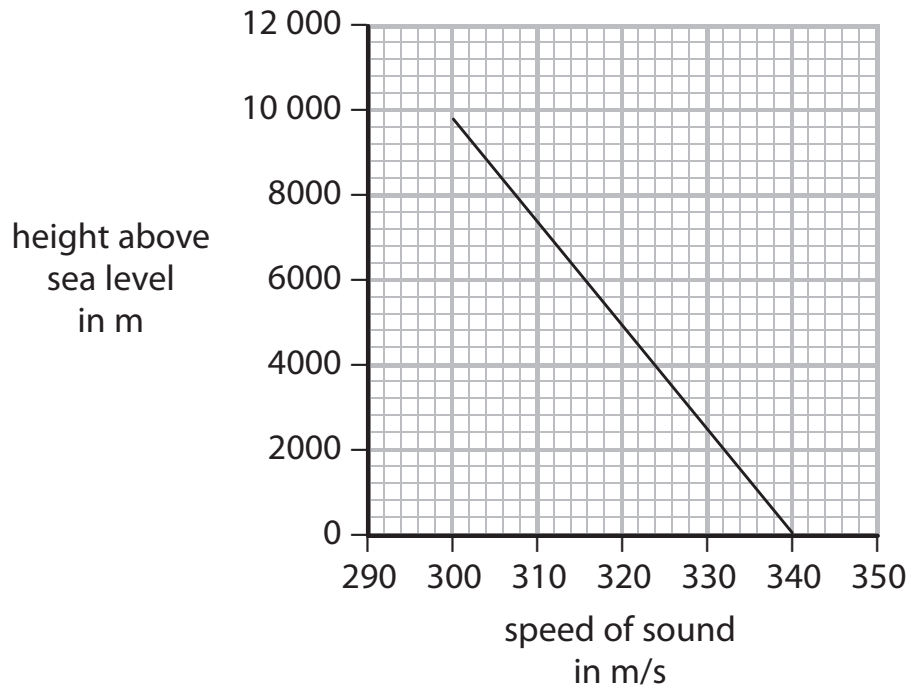
(3)



(Total for Question 2 = 6 marks)

(c) The speed of sound in air is different for different heights above sea level.

The graph shows how the speed of sound varies with height.



(i) Use the graph to estimate the speed of sound in air 6000 m above sea level.

(1)

Speed = m/s

(ii) Describe the pattern shown by the graph.

(2)

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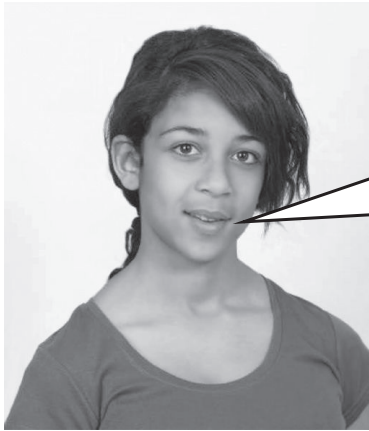
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(iii) Some aeroplanes can travel faster than the speed of sound.

When an aeroplane travels faster than the speed of sound it causes a shock wave. People on the ground hear this shock wave as a sonic boom.

A student says



It is easier for an aeroplane to make a sonic boom when it travels higher up.

Do you agree with the student?

Explain why.

(2)

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(Total for Question 3 = 11 marks)

4. This question is about the reflection of light.

(a) Light reflects from a plane mirror.

(i) Use words from the box to complete the sentence below.

(1)

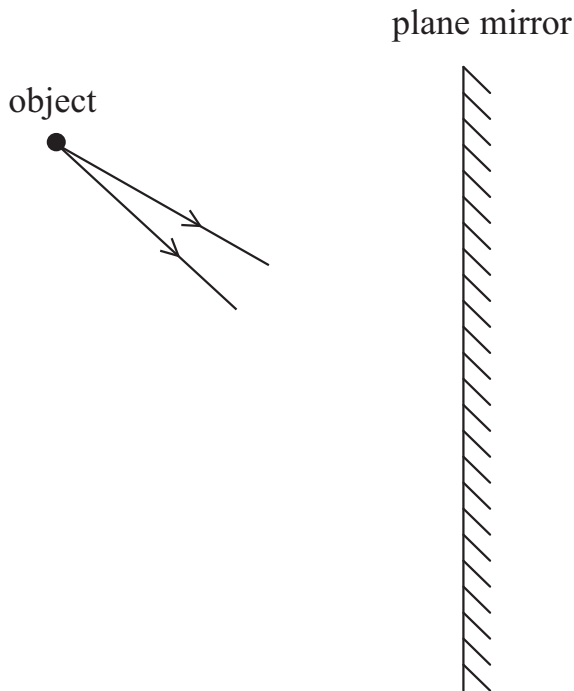
less than	equal to	greater than
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When light reflects from the surface of a plane mirror, the angle of incidence is the angle of reflection.

(ii) The diagram shows two rays of light coming from an object.

Continue the two rays and add further lines to the diagram to show how an image is formed by a plane mirror.

(2)



(iii) The image in a plane mirror is a **virtual image**.

How can you tell this from your diagram?

(1)

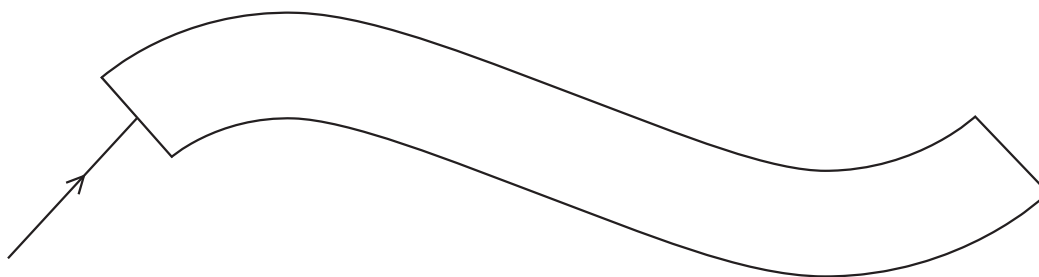
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(b) Light can also reflect along optical fibres by total internal reflection.

(i) Complete the diagram to show the path of the ray of light as it enters and passes through the optical fibre.

(2)



(ii) State **two** conditions required for total internal reflection to happen.

(2)

1

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2

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(iii) Telephone signals can be sent along optical fibres using light. In earlier systems the signals were sent using electric currents in copper wires.

Suggest **one** advantage of sending signals using optical fibres.

(1)

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(Total for Question 4 = 9 marks)

5. A ray of light enters a glass block and is refracted as shown in Figure 1.

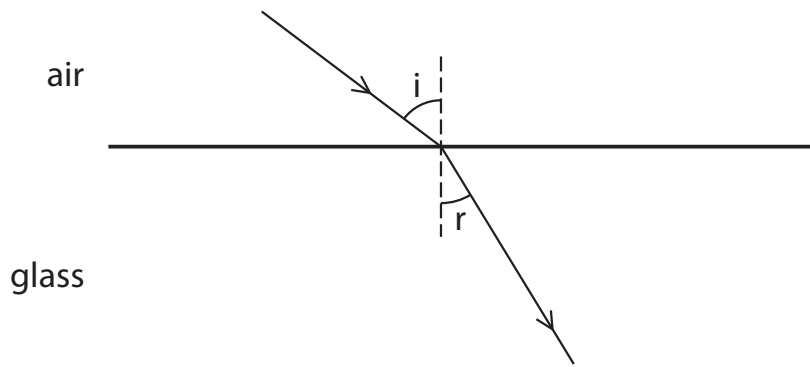


Figure 1

(a) Explain why the ray of light is refracted towards the normal.

(2)

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(b) Opals and diamonds are transparent stones used in jewellery.

Jewellers shape the stones so that light is reflected inside.

Figure 2 shows the path of a ray of light that enters and leaves a shaped piece of opal.

This ray of light is totally internally reflected.

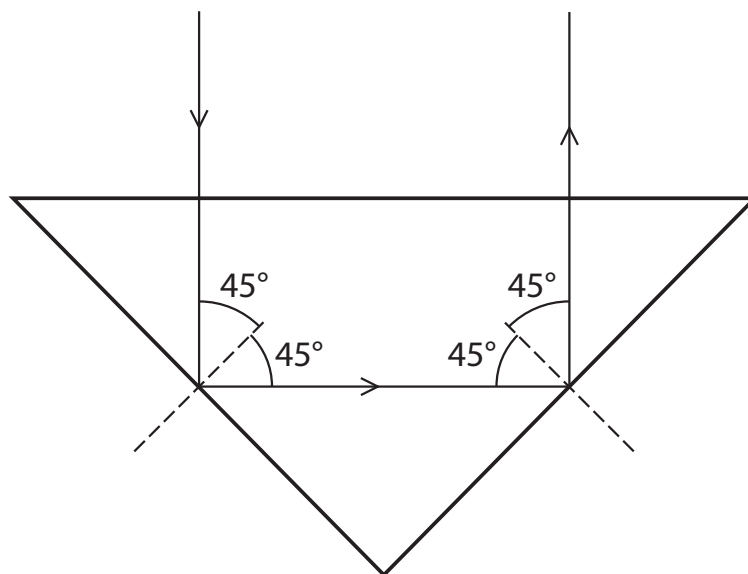


Figure 2

(i) State the equation linking refractive index and critical angle.

(1)

(ii) The critical angle of opal is 43° .

Show that the refractive index of opal is about 1.5.

(2)

(iii) The refractive index of diamond is 2.4.

Explain why rays of light inside a diamond are more likely to be totally internally reflected than those inside an opal.

(3)

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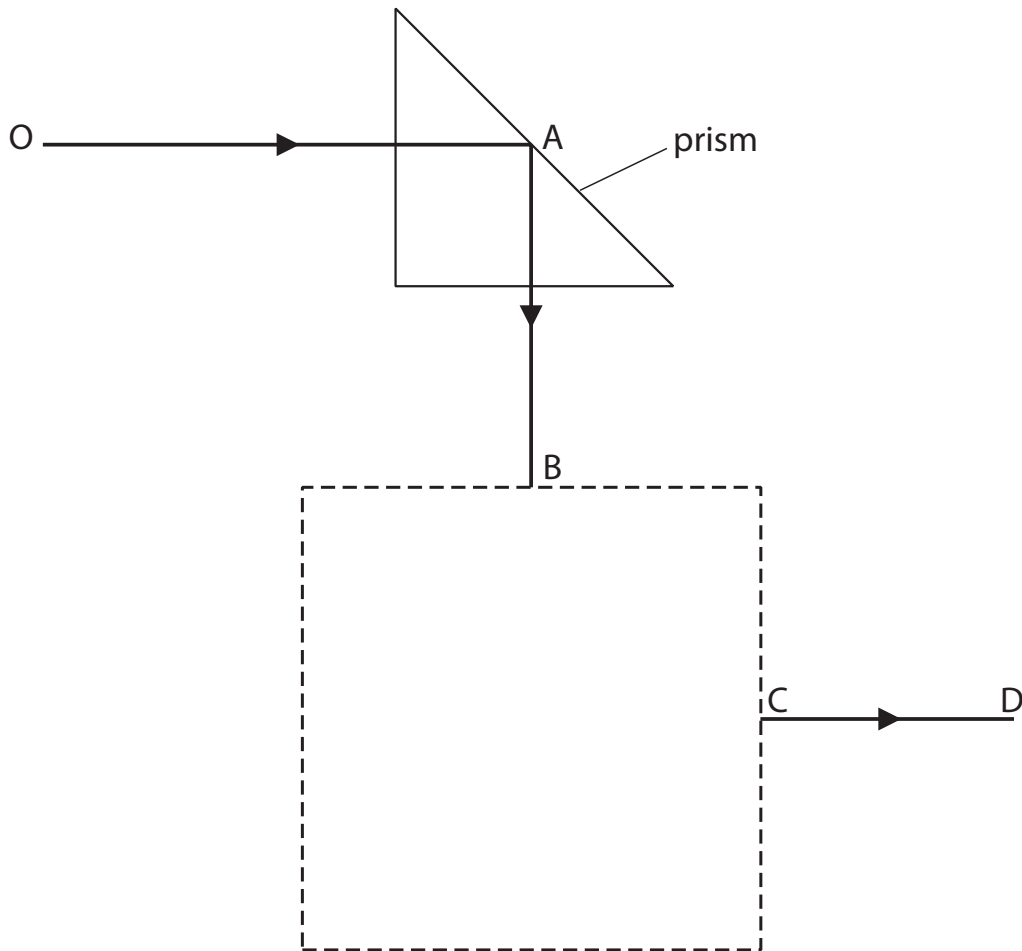
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(Total for Question 5 = 8 marks)

6. The diagram shows one of two 45° prisms used in an optical instrument.

The second prism is not shown.

The path of a ray of light is partly shown.



(a) What is the effect shown at point A?

(1)

(b) The ray of light exits from the second prism along the line CD.

(i) Draw the position of the second prism inside the dotted square.

(1)

(ii) Complete the path of the light through the second prism.

(1)

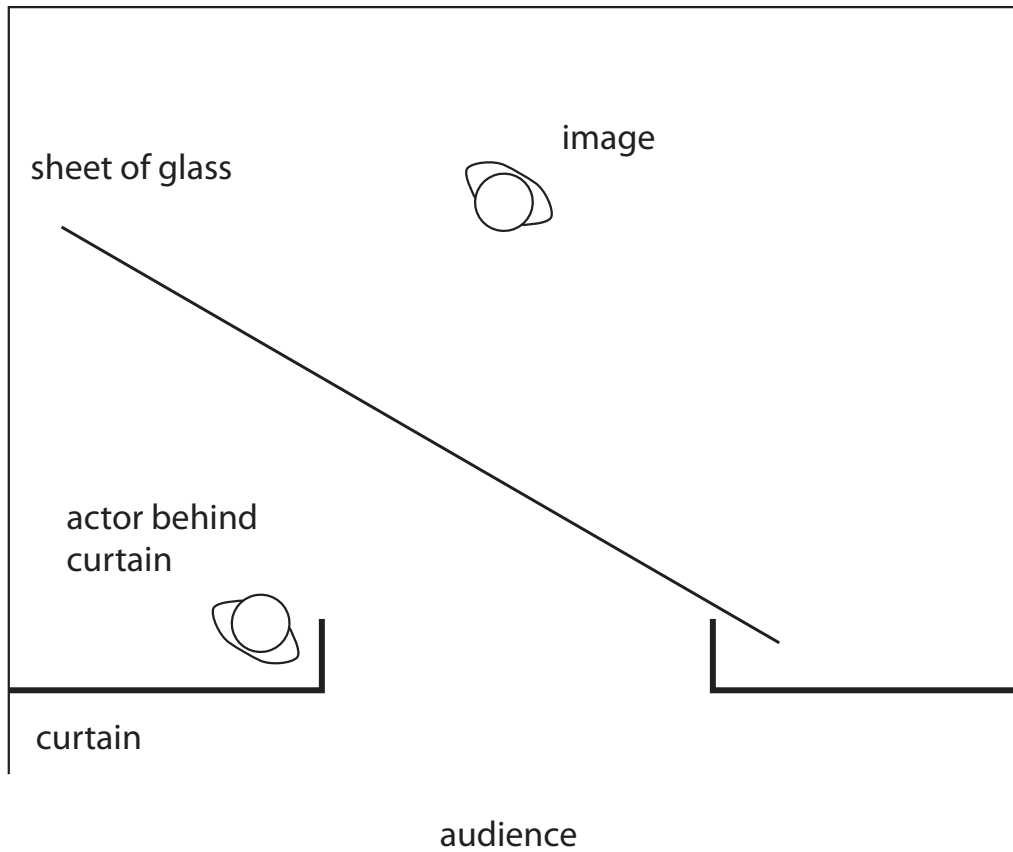
(Total for Question 6 = 3 marks)

7. Pepper's Ghost is a theatre effect used to make it appear that there is an image on stage.

The diagram shows a theatre viewed from above.

A sheet of glass is placed on the stage. A brightly lit actor stands behind a curtain at the side of the stage.

The audience sees the reflection of this actor in the glass.



(a) Add a ray diagram to show how light from the actor appears to come from the image. (3)

(b) The image formed by the glass is a virtual image.

State what is meant by the term **virtual image**.

(1)

(c) Light travels as a transverse wave.

Some waves travel as longitudinal waves.

(i) Give an example of a wave that travels as a longitudinal wave.

(1)

(ii) Describe the difference between transverse waves and longitudinal waves.

You may draw diagrams to help your answer.

(3)

(Total for Question 7 = 8 marks)

8. Echo sounding is used to detect fish in the sea.

Sound waves are emitted from a fishing boat. Some of the sound waves are reflected by fish and detected back at the boat.

(a) The shortest time between the sound waves being emitted and detected is 0.26 s.

The speed of sound in water is 1.5 km/s.

Calculate the distance between the boat and the nearest fish.

(4)

distance = m

(b) Each sound wave is emitted for a very short time.

The reflected sound wave received at the boat lasts for a longer time.

Suggest a reason for this difference in time.

(2)

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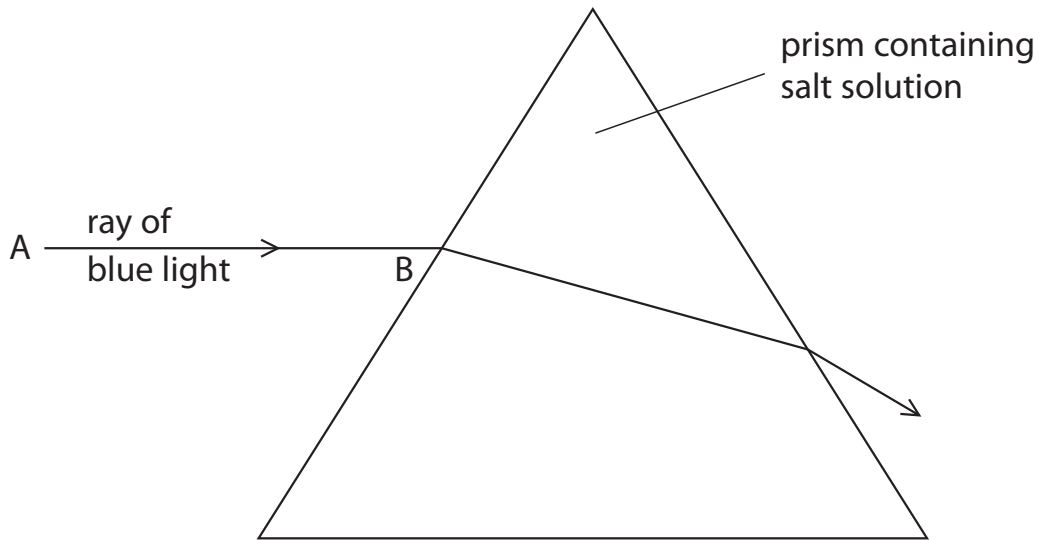
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(Total for Question 8 = 6 marks)

9. (a) A student investigates refraction of light by using a salt solution in a hollow prism. He shines a ray of blue light from A to B and traces the path of the ray through the prism. The diagram shows the path of the ray of blue light.



- (i) Explain what is meant by the term **refraction**.

(1)

- (ii) On the diagram, draw the normal at B and measure the angle of incidence.

(3)

angle of incidence =

- (iii) The student then shines a ray of red light from A to B.

The refractive index of the salt solution is lower for red light than it is for blue light.

On the diagram, sketch a possible path for the red light through the solution and out of the prism.

(3)

- (iv) Suggest what would happen to the path of the blue light if the student used a salt solution with a higher refractive index.

(2)

(b) A technician working in a soft drinks factory uses refraction of light to measure sugar concentration in drinks.

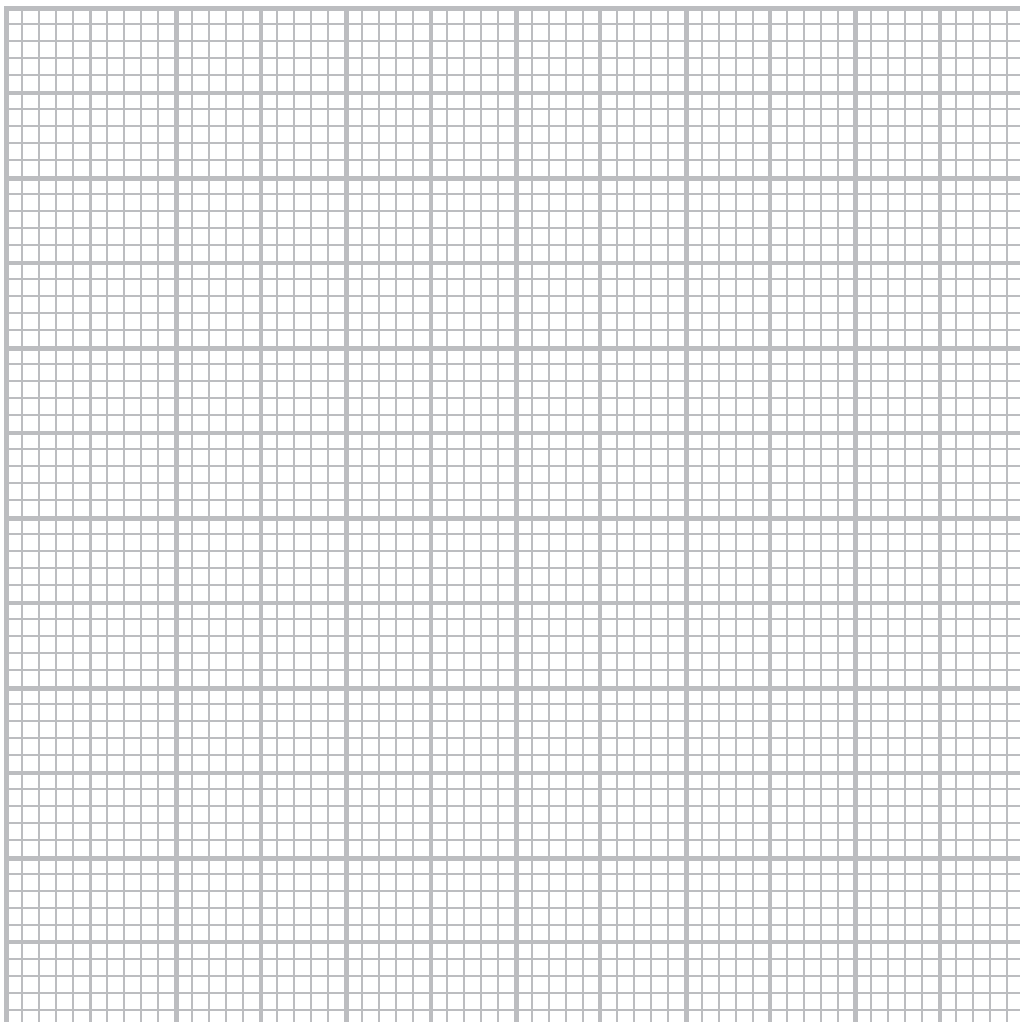
She takes readings using a refractometer. Different sugar concentrations give different scale readings on the refractometer.

The table shows her results.

Sugar concentration (%)	Refractometer reading
0	48
10	60
30	57
50	69
70	86
90	108

(i) Plot a graph of the refractometer reading against sugar concentration and draw the curve of best fit.

(5)



(ii) Circle the anomalous point on your graph and suggest what the correct refractometer reading should be.

(2)

refractometer reading =

(iii) Use your graph to find the sugar concentration when the refractometer reading is 80.

(1)

sugar concentration = %

(iv) Describe the pattern shown by your graph.

(2)

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(Total for Question 9 = 19 marks)