

Questions

Q1.

Answer the question with a cross in the box you think is correct ☐ . If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☐ .

Which of the following statements about waves is correct?

- ☐ **A** Both longitudinal and transverse waves can be polarised.
- ☐ **B** Neither longitudinal nor transverse waves can be polarised.
- ☐ **C** Only longitudinal waves can be polarised.
- ☐ **D** Only transverse waves can be polarised.

(Total for question = 1 mark)

Q2.

Answer the question with a cross in the box you think is correct ☐ . If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☐ .

Two photographs, X and Y, were taken of the same car windscreen. Photograph Y was taken through a polarising filter.



Photograph X



Photograph Y

(Source: © Etan J. Tal)

Which row of the table is correct?

	Light transmitted through windscreen	Light reflected from windscreen
☐ A	plane polarised	plane polarised
☐ B	plane polarised	unpolarised
☐ C	unpolarised	plane polarised
☐ D	unpolarised	unpolarised

(Total for question = 1 mark)

Q3.

Which of the following describes the oscillations in polarised waves?

- ☐ A in a single plane which is perpendicular to the direction of wave travel
- ☐ B in many planes, which include the direction of wave travel
- ☐ C in many directions and parallel to the direction of wave travel
- ☐ D in one direction and perpendicular to the direction of wave travel

(Total for question = 1 mark)

Q4.

Answer the question with a cross in the box you think is correct ☐. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☐.

A filament lamp is a source of unpolarised light.

A polarising filter is placed between a filament lamp and an observer. The filter is rotated in the plane perpendicular to the direction of travel of the light.

Which of the following is observed as the filter is rotated through an angle of 90° ?

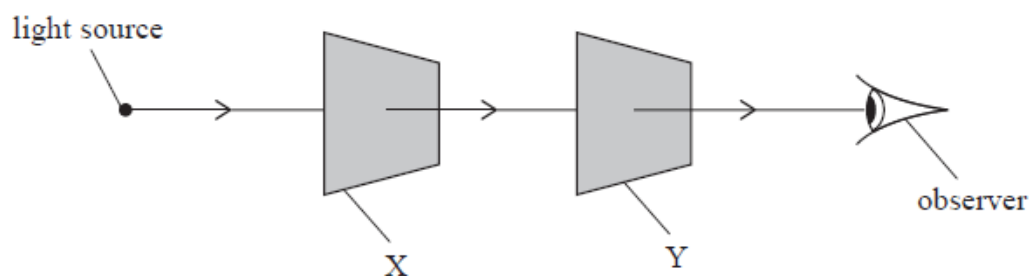
- ☐ A The light intensity changes from maximum to minimum.

- ☐ **B** The light intensity changes from minimum to maximum.
- ☐ **C** The light intensity does not change.
- ☐ **D** The light intensity is zero throughout the rotation.

(Total for question = 1 mark)

Q5.

Two polarising filters, X and Y, are arranged between a light source and an observer as shown.



The intensity of light reaching the observer is a maximum.

The observer rotates filter X. The observer then rotates filter Y so that the intensity of light is a maximum again.

Which row of the table shows possible angles of rotation for the filters?

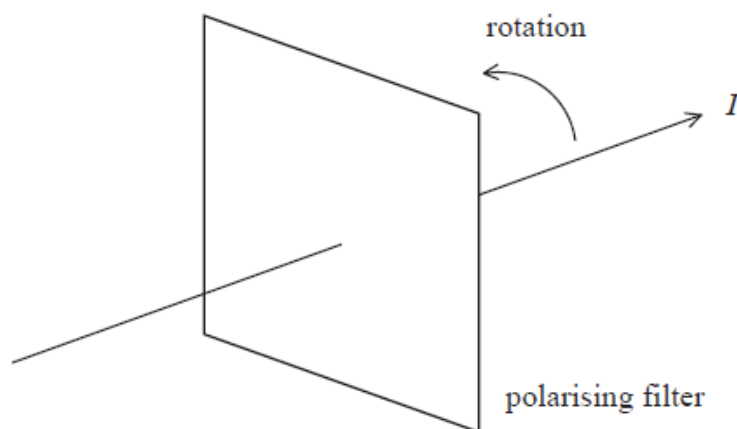
	Angle of rotation of X	Angle of rotation of Y
☐ A	90°	180°
☐ B	180°	270°
☐ C	270°	90°
☐ D	360°	270°

(Total for question = 1 mark)

Q6.

Answer the question with a cross in the box you think is correct (☒). If you change your mind, put a line through the box (☒) and then mark your new answer with a cross (☒).

A ray of unpolarised light is incident on a polarising filter. The polarising filter transmits light of intensity I , as shown.



The polarising filter is then rotated in the direction shown on the diagram.

Which of the following gives the intensity of light transmitted after the filter has been rotated 90° ?

☐ A 0

☐ B $\frac{I}{4}$

☐ C $\frac{I}{2}$

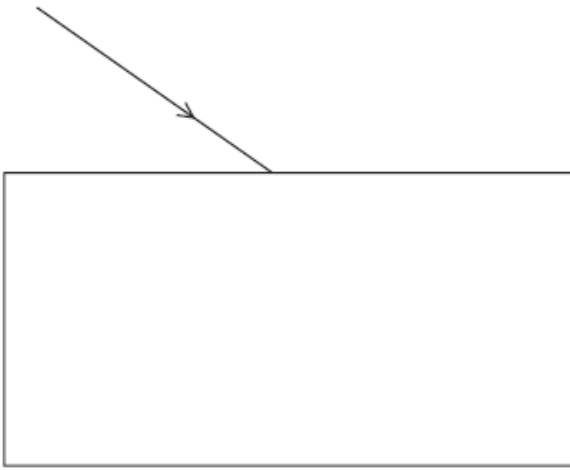
☐ D I

(Total for question = 1 mark)

Q7.

Answer the question with a cross in the box you think is correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

A ray of light is incident on a glass block, as shown.



Which of the following does **not** occur when the ray of light is incident on the glass block?

- ☐ **A** diffraction
- ☐ **B** polarisation
- ☐ **C** reflection
- ☐ **D** refraction

(Total for question = 1 mark)

Q8.

A student wearing polarising sunglasses observes a mobile phone screen.

The student rotates the mobile phone through 90° , as shown. The screen then appears completely black.



mobile phone



mobile phone rotated through 90°

Explain why the screen appears completely black when the student rotates the mobile phone through 90° .

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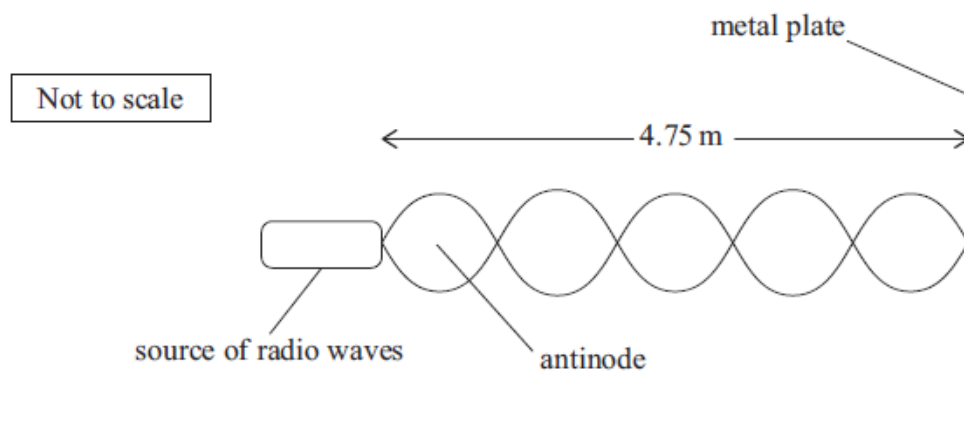
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(Total for question = 3 marks)

Q9.

In 1886 Heinrich Hertz directed radio waves towards a metal plate. A standing wave with 5 antinodes was produced, as shown.



(a) Explain how the antinodes were formed.

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(b) Determine a value for the speed of the radio waves in this experiment.

frequency of radio waves = 157 MHz

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Speed of radio waves =

(c) A teacher demonstrated the properties of radio waves. He used an aerial to detect the radio waves.

Initially, the aerial was vertical, and a maximum intensity of radio waves was detected. The teacher rotated the aerial by 90° so that it was horizontal.

He observed that when the aerial was horizontal, the radio waves were **not** detected.

Explain this observation.

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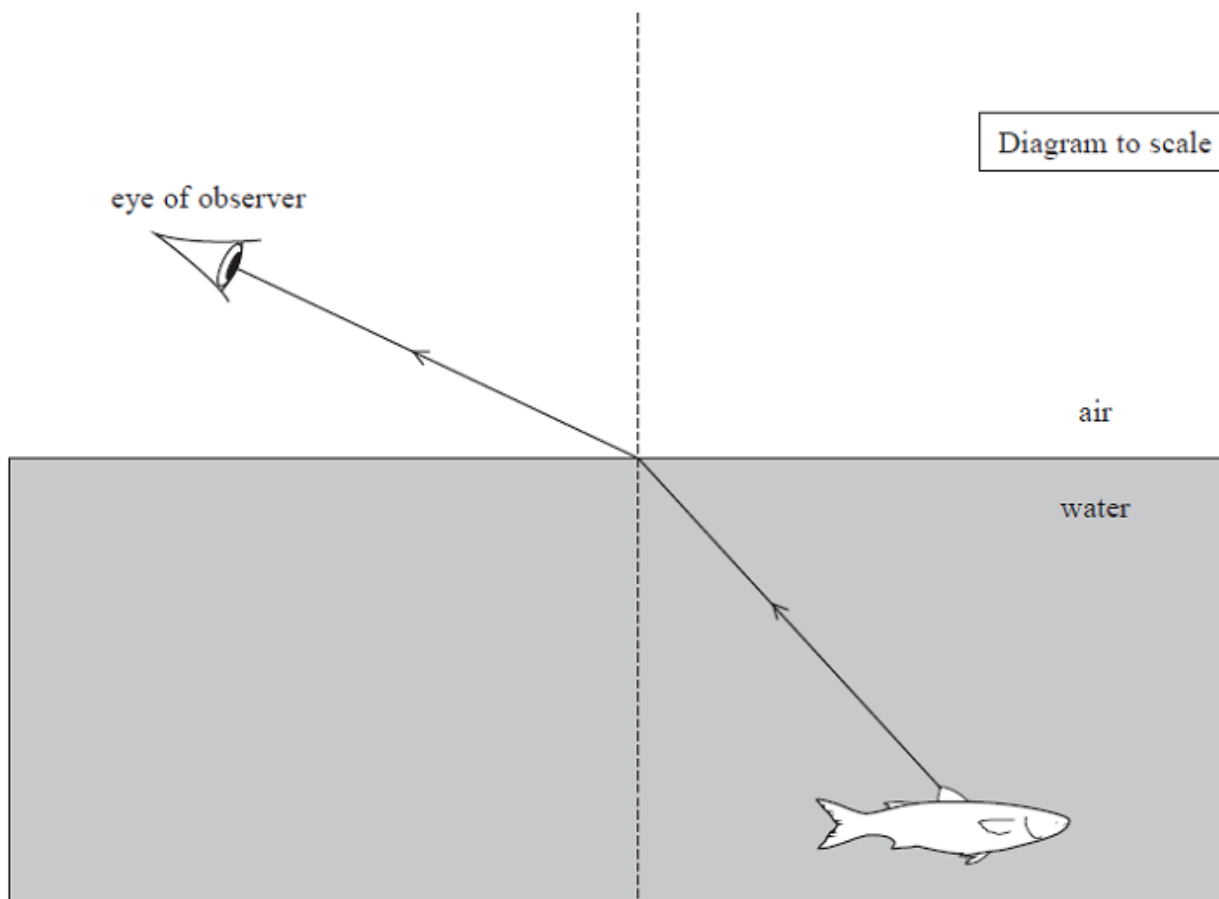
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(Total for question = 8 marks)

Q10.

The diagram shows a ray of light travelling from a fish to an observer. The ray of light refracts at the water-air boundary.



(a) Determine the refractive index of the water.

You should take measurements from the diagram.

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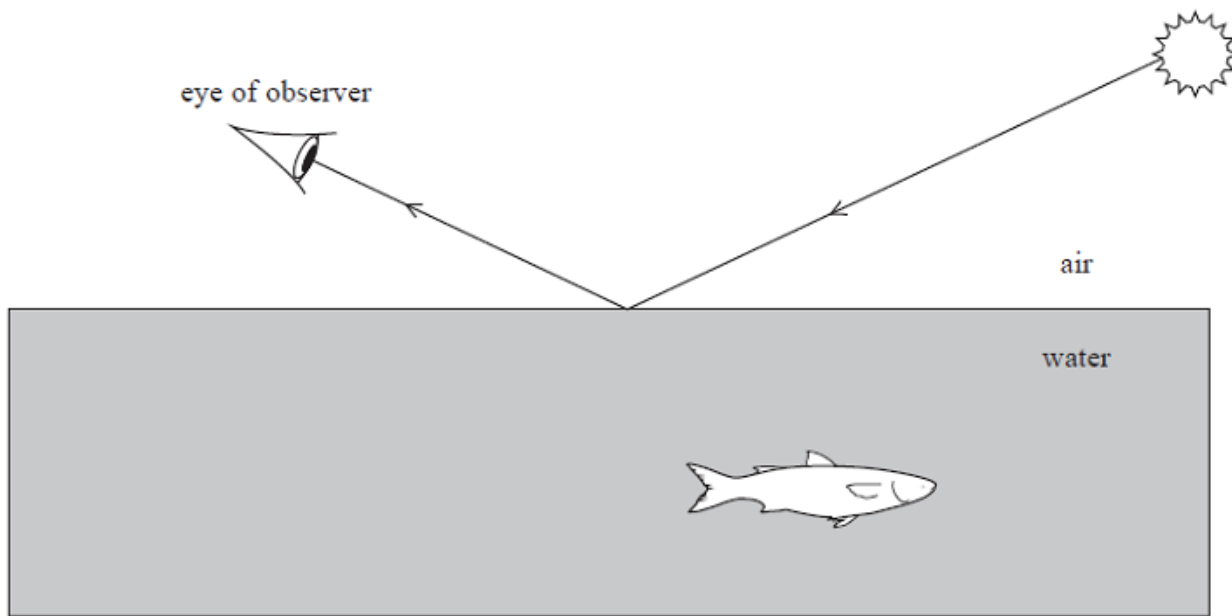
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Refractive index =

(b) The diagram shows light from the Sun reflecting from the water surface into the eye of the observer.



The reflected light is partially plane polarised.

(i) Explain the difference between unpolarised and plane polarised light.

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(ii) Reducing the intensity of the reflected light would help the observer see the fish.

Explain how the observer can use a polarising filter to reduce the intensity of the reflected light.

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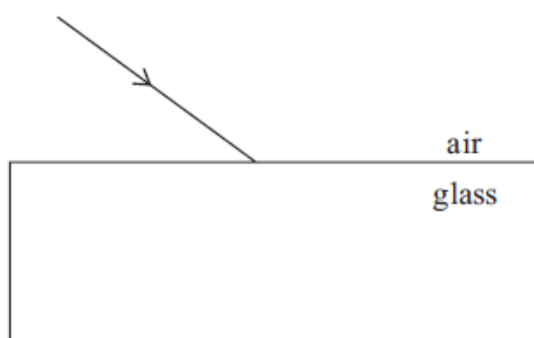
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(Total for question = 8 marks)

Q11.

A student uses a ray box to direct a narrow ray of light onto the surface of a glass block, as shown.



(a) (i) Determine the angle of incidence.

(1)

Angle of incidence =

(ii) Calculate the angle of refraction in the glass block.

refractive index of glass block = 1.5

(2)

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Angle of refraction =

(b) The light from the ray box is unpolarised. When reflected by glass, some of this light will become polarised.

(i) Explain the difference between unpolarised light and polarised light.

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(ii) The student uses a polarising filter to view the light reflected by the glass block.

Explain what she would observe as she rotates the filter.

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(Total for question = 9 marks)

Q12.

When unpolarised light passes through a polarising filter, the light becomes plane polarised.

(a) Explain the difference between unpolarised and plane polarised light.

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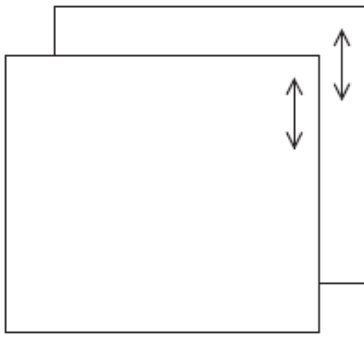
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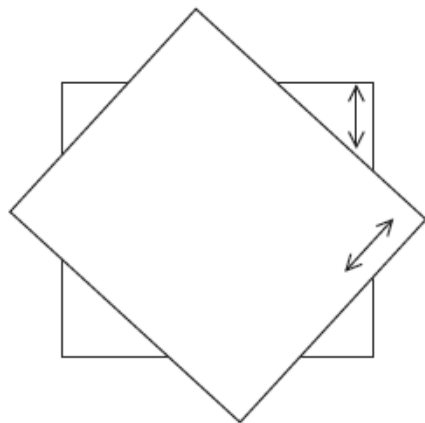
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(b) An unpolarised light source is directed towards a screen. The intensity of radiation measured at the screen
is 1.00 W m^{-2} .

Two polarising filters are placed between the light source and the screen.
Initially there is an angle of 0° between their planes of polarisation, as shown.

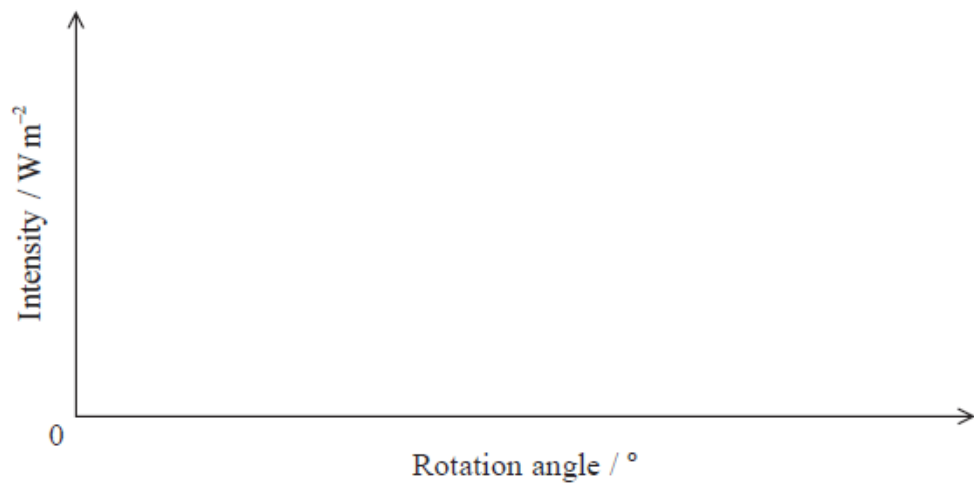


One of the polarising filters is then rotated, as shown.



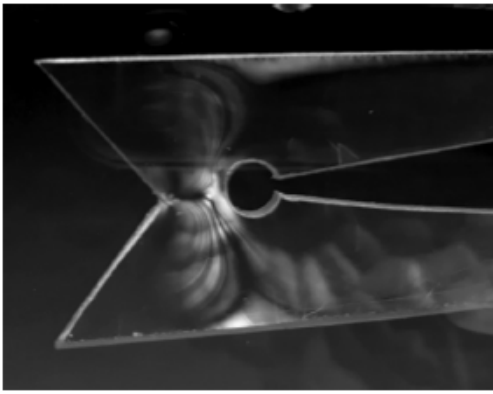
Sketch a graph to show how the intensity of light measured at the screen varies as the filter is rotated from 0° to 90°.

(3)



(c) Polarisation can be used to identify when some materials are under stress. Placing the material under stress causes the plane of polarisation of the light passing through the material to be rotated. The greater the stress, the greater the rotation of the plane of polarisation of the light.

A piece of transparent material under stress is positioned between two polarising filters. There is an angle of 90° between the planes of polarisation of the two polarising filters.



Explain how this photograph can be used to identify areas of the material with different amounts of stress.

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(Total for question = 9 marks)

Q13.

A student directs unpolarised light through a polarising filter.

- (a) After passing through the polarising filter, the light is plane polarised.
- (i) Explain the difference between unpolarised light and plane polarised light.

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The arrows in the diagram show the initial orientation of the plane of polarisation of each filter.

source of light filter 1 filter 2 filter 3

Explain how rotating filter 2 by 45° from its initial orientation affects the intensity of light passing through filter 3.

[illegible]

(Total for question = 10 marks)

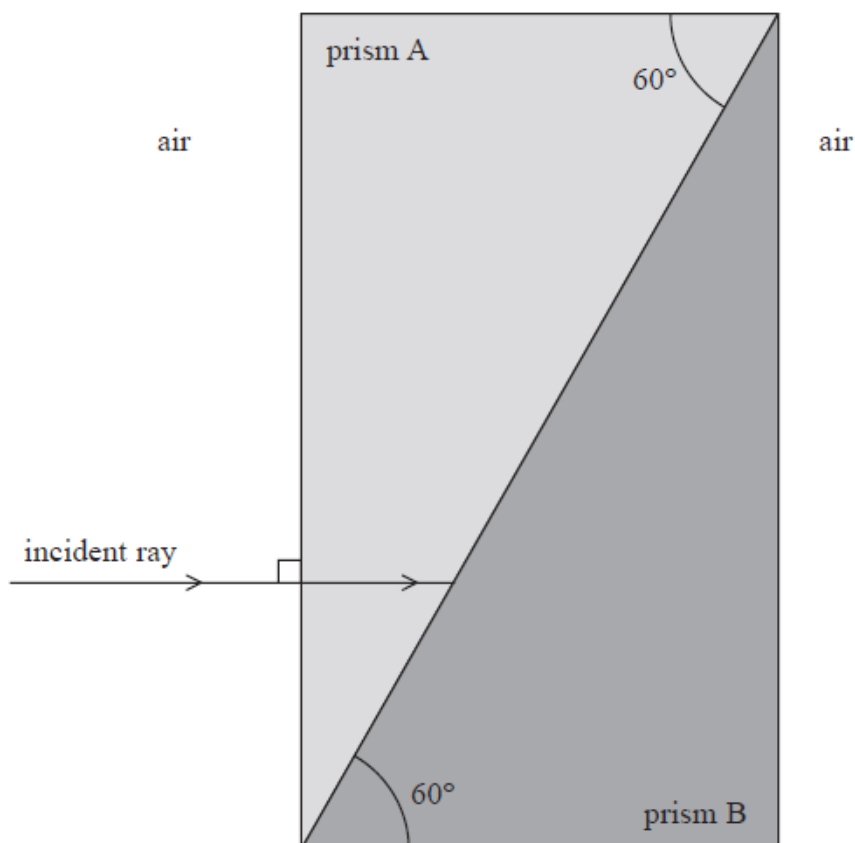
Q14.

Light is a transverse wave.

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

(2)

(b) Two prisms, A and B, made from different types of glass are placed in contact as shown. An incident ray of light enters prism A.



(i) State why the incident ray of light does not change direction as it enters prism A.

(1)

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(ii) The refractive index of the glass in prism B is greater than the refractive index of the glass in prism A. When the ray of light reaches the boundary between the prisms, some light is reflected and some is refracted.

Complete the diagram to show the two paths taken by the reflected and refracted light until they have returned to the air.

(4)

(iii) Calculate the angle of refraction as this ray of light travels across the boundary between prism A and prism B.

refractive index of glass in prism A = 1.40
refractive index of glass in prism B = 1.55

(3)

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Angle of refraction =

(c) The light emerging from prism B is observed through a polarising filter. The polarising filter is rotated gradually, and the light transmitted by the filter varies in intensity.

Explain how this observation demonstrates that light waves are transverse.

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Q15.

An irrigation system uses a pump to move water from a lower level to a higher level. The electricity for the pump is generated using a panel of solar cells.

(a) The panel of solar cells is 1.20 m long and 0.80 m wide. To pump water from the lower level to the higher level the pump needs a minimum power of 140 W.

(i) Calculate the minimum efficiency of the panel of solar cells that will operate the pump.

intensity of sunlight on solar cells = 1040 W m^{-2}

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Minimum efficiency =

(ii) Suggest **two** reasons why the value calculated in (i) is the minimum efficiency that will operate the pump.

(2)

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(b) Light from the Sun arriving at the solar cells is unpolarised.

(i) Explain the difference between unpolarised light and plane polarised light.

(3)

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(ii) Describe how a student can demonstrate that light from the Sun is unpolarised.

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(Total for question = 11 marks)