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

(3)

(b) Two photographs of the same car windscreen were taken, under the same conditions. One of these was taken through a polarising filter.



Photograph A



Photograph B

Explain which photograph was taken through a polarising filter.

(3)

(Total for Question 13 = 6 marks)

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13 Polarising filters are often used when taking photographs outdoors.

Light from the sky is partially plane-polarised. A polarising filter can be placed in front of a camera lens to make the sky appear darker. The intensity of the light transmitted through the polarising filter is reduced, compared to the intensity without the polarising filter, as shown.



(a) Explain what is meant by plane-polarised light.

(2)

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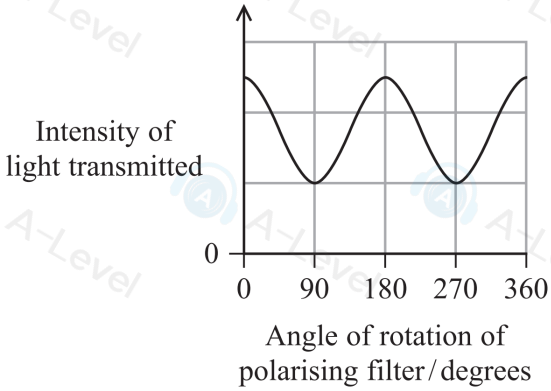
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*(b) The light from the sky is transmitted through the polarising filter into the camera. As the polarising filter is rotated, the intensity of the light transmitted through the polarising filter varies as shown.



Explain why the intensity of the light transmitted through the polarising filter varies as shown.

(4)

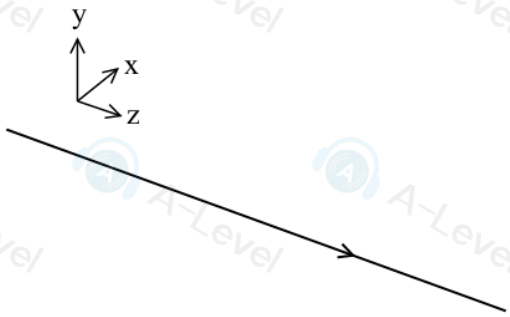
(c) Suggest why the clouds don't appear to darken as much as the sky when viewed through the polarising filter.

(1)

(Total for Question 13 = 7 marks)

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3 x, y and z are three perpendicular directions. A polarised light wave is travelling in the z direction.



Which of the following describes the direction of the oscillations of the polarised light wave?

☒ **A** They must be in the x direction.

☒ **B** They must be in a plane which is perpendicular to the x direction.

☒ **C** They must be in the z direction.

☒ **D** They must be in a plane which is perpendicular to the z direction.

(Total for Question 3 = 1 mark)

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13 Polarising filters may be used to investigate stress patterns in transparent materials.

(a) Describe the difference between unpolarised light and polarised light.

(3)

(b) A polarising filter is placed above a source of unpolarised light.

A second filter is placed over the first filter so that the filters are aligned, as shown in Photograph 1.



Photograph 1

The second filter is then rotated by 90° and the result is shown in Photograph 2.



Photograph 2

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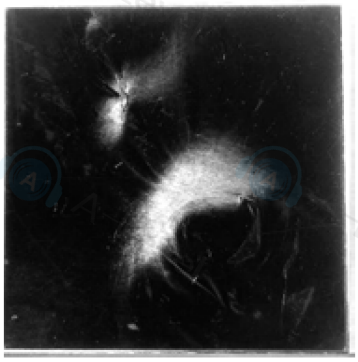
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(i) Explain the appearance of Photograph 2.

(2)

(ii) A sheet of thin, transparent plastic is stretched and then placed between the filters. The result is shown in Photograph 3.



Photograph 3

Explain why the stretched plastic produces the pattern shown in Photograph 3.

(2)

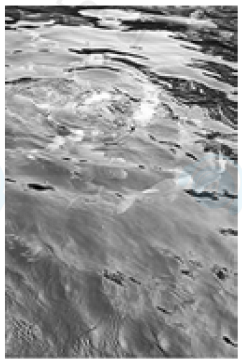
(Total for Question 13 = 7 marks)

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17 It is sometimes difficult for fishermen to see the fish due to glare, which is caused by the reflection of sunlight from the surface of the water. The use of polarising sunglasses can help to reduce the effect of glare, as shown in the photographs.



Without polarising sunglasses



With polarising sunglasses

(a) Describe what is meant by a polarised wave.

(2)

(b) Explain why the fish look darker when viewed through polarising sunglasses.

(2)

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(c) The diagrams show two polarising filters, A and B, which could be used in sunglasses. The arrows represent the plane of polarisation of light transmitted by the filter.



A B

A fisherman is viewing fish, that are under the water, through polarising sunglasses. Light reflected from the surface of the water is partially polarised in a plane parallel to the surface of the water.

Explain which filter, A or B, the fisherman should have in the sunglasses in order to see the fish clearly.

(2)

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(Total for Question 17 = 6 marks)

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2 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 2 = 1 mark)

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18 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.

(3)

(ii) The student rotates the polarising filter.

Explain why rotating the polarising filter will **not** change the intensity of the light that passes through the filter.

(2)

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(b) The student arranges three polarising filters in different orientations.

10 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 10 = 1 mark)

2 Unpolarised light with a power of 8 W is incident on a polarising filter.

What is the power of the light after passing through the filter?

☒ **A** 8W

☒ **B** 4W

☒ **C** 2W

☒ **D** 0

(Total for Question 2 = 1 mark)

2 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 2 = 1 mark)

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11 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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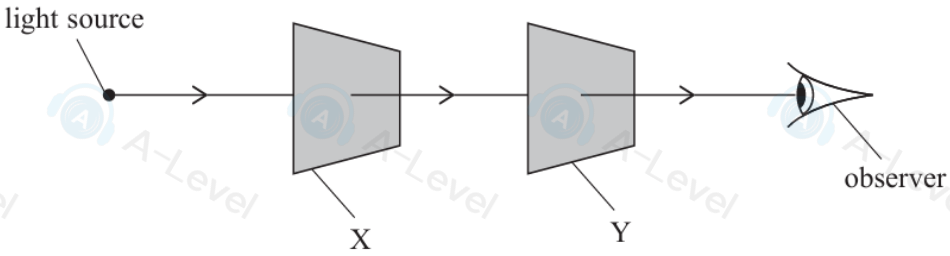
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9 Two polarising filters, X and Y, are arranged between a light source and an observer as shown.



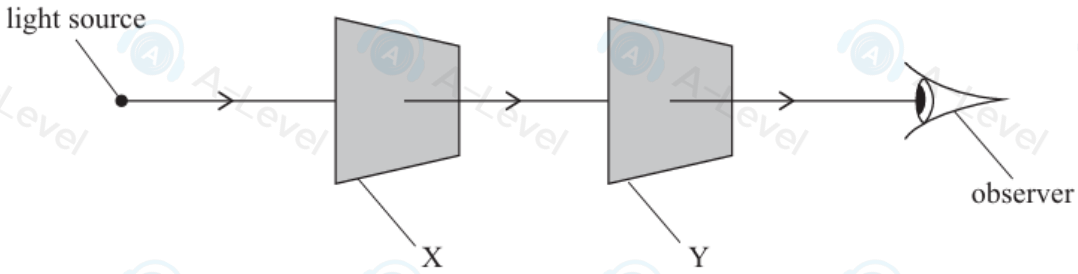
The intensity of light reaching the observer is a maximum.

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°

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



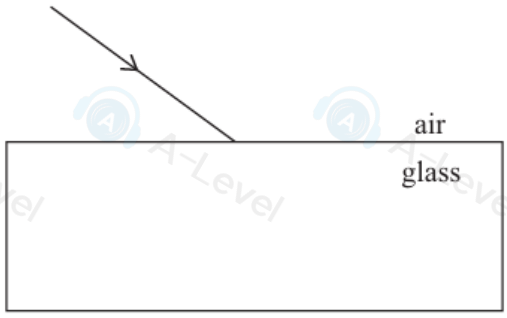
The intensity of light reaching the observer is a maximum.

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?

	Header	Header
A	90°	180°
B	180°	270°
C	270°	90°
D	360°	270°

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



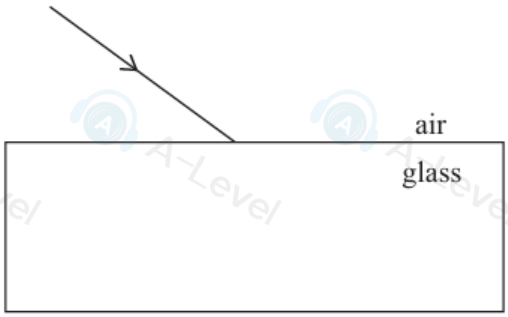
(a) (i) Determine the angle of incidence.

(1)

Angle of incidence = ...

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12: 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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(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.

(3)

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(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.

(3)

(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.

(3)

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