Name: _____

Polarisation

Mark Scheme

Date:

Time:

Total marks available:

Total marks achieved: _____

Mark Scheme

Q1.

Question Number	Answer	Mark
	C	1

Q2.

Question Number	Acceptable answers	Additional guidance	Mark
	D oscillates in one direction, no light		1

Q3.

Question Number	Answer	Mark
	B	1

Q4.

Question Number	Acceptable Answers	Additional guidance	Mark
	• Intensity (of sound) varies (1) • (Intensity) is a minimum at 90° **and** a maximum at 180° (1)	For MP1 there must be an indication of intensity, volume, loudness or amplitude. Any reference to pitch changing means this mark cannot be awarded. MP2 can be awarded if answer only refers to audible output.	2

Q5.

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Question Number	Answer		Mark
	Electromagnetic waves are transverse, with oscillations *perpendicular*	**(1)**	**4**
	to the direction of *energy transfer* **Or** *wave travel* **Or** *propagation*	**(1)**	
	When they pass through a polarising filter all the components of the oscillations perpendicular to the plane of polarisation are *absorbed*. (accept *blocked*) **Or** When they pass through a polarising filter all the components of the oscillations *parallel* to the plane of polarisation are *transmitted*.	**(1)**	
	The oscillations of the polarised wave are all in the same plane which *includes* the direction of energy transfer. **Or** The oscillations of the polarised wave are all in the same *direction* which is perpendicular to the direction of energy transfer	**(1)**	

Q6.

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<table>
<tr><th>Question Number</th><th>Acceptable answers</th><th>Additional guidance</th><th>Mark</th></tr>
<tr>
<td></td>
<td>
This question assesses a student's ability to show a coherent and logical structured answer with linkage and fully-sustained reasoning. Marks are awarded for indicative content and for how the answer is structured and shows lines of reasoning.
The following table shows how the marks should be awarded for indicative content.
<table>
<tr><th>Number of indicative points seen in answer</th><th>Number of marks awarded for indicative points</th></tr>
<tr><td>6</td><td>4</td></tr>
<tr><td>5-4</td><td>3</td></tr>
<tr><td>3-2</td><td>2</td></tr>
<tr><td>1</td><td>1</td></tr>
<tr><td>0</td><td>0</td></tr>
</table>
Indicative content

Light from the source is unpolarised
Or light from source has oscillations in all planes.
Intensity is reduced to ½ by filter 1
By absorbing the perpendicular components
Or by transmitting the parallel components.
At 0° / 180° filter 2 aligned with filter 1 so all light through filter 1 passes through filter 2
As filter 2 is rotated only the component of the light from filter 1 in the plane of filter 2 is allowed through, so the intensity reduces.
At 90°, all light is absorbed because their planes (of polarisation) are at right angles.

</td>
<td>
The following table shows how the marks should be awarded for structure and lines of reasoning
<table>
<tr><td></td><td>Number of marks awarded for structure and lines of reasoning</td></tr>
<tr><td>Answer shows a coherent and logical structure with linkage and fully sustained lines of reasoning demonstrated throughout</td><td>2</td></tr>
<tr><td>Answer is partially structured with some linkages and lines of reasoning</td><td>1</td></tr>
<tr><td>Answer has no linkage between points and is unstructured</td><td>0</td></tr>
</table>
<table>
<tr><th>Number of IC points awarded</th><th>Possible linkage marks</th></tr>
<tr><td>0,1</td><td>0</td></tr>
<tr><td>2, 3</td><td>1</td></tr>
<tr><td>4, 5, 6</td><td>2</td></tr>
</table>
IC3,6 allow, no light passes through, blocked by, stopped by
</td>
<td>6</td>
</tr>
</table>

Q7.

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Question Number	Answer		Mark
(a)	Unpolarised – oscillations/vibrations in many directions	(1)	
	Polarised – oscillations/vibrations in single direction	(1)	
	oscillations/vibrations are perpendicular to direction of propagation	(1)	
	Or		
	Unpolarised – oscillations/vibrations in many planes	(1)	
	Polarised – oscillations/vibrations in single plane	(1)	
	Plane includes direction of propagation	(1)	**3**
(b)	(QWC- Work must be clear and organised in a logical manner using technical wording where appropriate.)		
	The idea that light transmitted only when in same plane/direction as plane/direction of polarisation of filter **Or** The idea that light not transmitted when plane/direction at 90° to plane/direction of polarisation of filter	(1)	
	Rays for each image are (polarised) in different planes/directions, (so only one image is seen)	(1)	
	When the (polarising) filter is rotated the image becomes fainter **Or** When the (polarising) filter is rotated the other image becomes visible	(1)	
	A statement correctly linking image(s) seen with angle. • at 90° only the other image is seen • at 180° only the 1st image is seen • at 270° only the other image is seen • at in between angles both images will be seen, (but neither at full intensity)	(1)	**4**
	Total for question		7

Q8.

Question Number	Answer		Mark
(a)	Idea of two or more waves meeting	(1)	
	Displacement is sum of individual displacements	(1)	**2**

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Question Number	Answer		Mark
(b) (i)	(QWC – Work must be clear and organised in a logical manner using technical wording where appropriate – e.g. if the term 'superimpose' is used this mark is not awarded)		
	When in phase constructive interference/superposition occurs **Or** when path difference is $n\lambda$ constructive interference/superposition occurs	**(1)**	
	When in antiphase destructive interference/superposition occurs **Or** when path difference is $(n + ½) \lambda$ destructive interference/superposition occurs	**(1)**	
	Light band forms when in phase **Or** path difference is $n\lambda$ **Or** constructive **Or** Dark band forms when in antiphase **Or** path difference is $(n + ½) \lambda$ **Or** destructive	**(1)**	**3**
(b) (ii)	Oscillations of light from the two filters are perpendicular to each other	**(1)**	
	So there are no opposite components to cancel each other out **Or** so the waves do not interact/interfere	**(1)**	
	So zero amplitude not possible	**(1)**	
	OR (If the candidate assumes that it is a source of polarised light) One filter is parallel to the plane of polarisation of the light source, so light is transmitted but the other one absorbs light	**(1)**	
	So light now only reaches the screen from one filter, so there is no interference	**(1)**	
	So zero amplitude not possible	**(1)**	**3**

Q9.

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Question Number	Answer		Mark
(a)	Reference to oscillations of electric / magnetic field (accept vibrations)	**(1)**	
	Oscillations/vibrations in one plane only	**(1)**	
	Plane includes direction of propagation/travel (of the light) **Or** Plane includes direction of energy transfer (third mark dependent on second mark)	**(1)**	**3**
	Alternative mark scheme Reference to oscillations of electric / magnetic field (accept vibrations)	**(1)**	
	Oscillations/vibrations in one direction only…	**(1)**	
	… perpendicular to direction of propagation/travel (of the light) **Or** … perpendicular to direction of energy transfer (third mark dependent on second mark)	**(1)**	
(b)	Identifies 90 degree difference	**(1)**	
	Light aligned/intended for one filter will be blocked/absorbed/stopped by the other filter **Or** light aligned/intended for one filter will only be transmitted by that filter (2^{nd} mark dependent on 1^{st})[accept reference to lens]	**(1)**	**2**
(c)	(Polarisation) absorbs/blocks/stops the unaligned part of the radiation		
	Or only aligned part of radiation is transmitted	**(1)**	
	So intensity / flux / amplitude (reaching each eye) reduced	**(1)**	**2**
(d)	Angle between one filter/lens/eye and plane (of polarisation) of the light (intended for the other filter) has changed	**(1)**	
	The light for one eye has component in plane of polarisation of the other filter (and passes through to the other eye)	**(1)**	**2**
	Total for question		**9**

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