Polarisation Mark Scheme

Q1.

Question Number	Answer	Mark
	C bright dark	1
	A - at 90° the lamp appears bright B - at 90° the lamp appears bright and at 180° the lamp appears dark D - at 180° the lamp appears dark	

Q2.

Question Number	Answers	Additional Guidance	Mark
	C	180° clockwise, 90° anticlockwise	**(1)**

Q3.

Question Number	Answer	Additional guidance	Mark
	C	(polarisation)	**(1)**

Q4.

Question Number	Answer	Mark
	C	1

Q5.

Question Number	Acceptable answer	Additional guidance	Mark
	B	The only correct answer is **B**: light leaving Y is polarised in its plane of polarisation and 135° is perpendicular to the plane of Y, so there will be maximum absorption by filter Z A is not correct because Z is not perpendicular to the plane of Y so some light is transmitted C is not correct because Z is not perpendicular to the plane of Y so some light is transmitted D is not correct because Z is not perpendicular to the plane of Y so some light is transmitted	1

Q6.

Question Number	Answer	Mark
	B	1

Q7.

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

Q8.

Question Number	Acceptable answers	Additional guidance	Mark
	The only correct answer is A B is not correct as the filter would be the same intensity as the first position if rotated through π C is not correct as the light is polarised D is not correct as the light is polarised		1

Q9.

Question Number	Acceptable answers		Additional guidance	Mark
	Either • Polarised light is light where the oscillations are in a single plane • Which includes the direction of propagation **Or** • Polarised light is light where the oscillations are in a single direction • Which is perpendicular to the direction of propagation	(1) (1) (1) (1)		**2**

Q10.

Question Number	Acceptable Answers		Additional guidance	Mark
	• Unpolarised light oscillates in many planes • The light perpendicular to the plane of polarisation of the filter is absorbed **Or** only light parallel to the plane of polarisation of the filter is transmitted • So polarised light oscillates in only one plane • So light intensity is reduced	(1) (1) (1) (1)	dependent upon MP2 or MP3	**4**

Q11.

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 So intensity / flux / amplitude (reaching each eye) reduced	(1) (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

Q12.

<table>
<tr><th>Question Number</th><th>Acceptable Answers</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

At 180° the screen is normal/bright
When oscillations/vibrations are parallel to the filter all the light is transmitted
or
When oscillations/vibrations are parallel to the filter no light is absorbed
At 270° the screen is dark/darkest/black
When oscillations/vibrations are perpendicular to the filter all the light is absorbed
or
When oscillations/vibrations are perpendicular to the filter no light is transmitted
The idea of a gradual change as the filter is rotated
(as) Light from the screen is (partially) polarised

</td></tr>
</table>

<table>
<tr><th>Question Number</th><th>Additional guidance</th><th>Mark</th></tr>
<tr><td>*</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></td><td>6</td></tr>
</table>

Q13.

Question Number	Acceptable answers	Additional guidance	Mark
(i)	• Oscillations/vibrations (of the light) are in one plane only (1) • Plane includes the direction of energy transfer **Or** Plane includes the direction of travel/propagation (1)	Accept: • Oscillations/vibrations (of the light) are in one direction only • perpendicular to the direction of propagation/travel **Or** perpendicular to the direction of energy transfer Allow labelled diagrams for each marking point	2
(ii)	• The (angle of polarisation of the) filters are 90° to one another (1) **Either** • If plane of polarisation of light is rotated (by 90°) when it passes through the crystal (with no p.d. across it), it can still pass through the upper filter (1) **Or** • If plane of polarisation of light is not rotated (by 90°) when it passes through the crystal (with a p.d. across it), it cannot pass through the upper filter (1)	MP2: it must be clear as to whether the candidate is describing a light screen or a dark screen	2

Q14.

Question Number	Acceptable Answers	Additional Guidance	Mark
	An explanation that makes reference to: • microwaves from source are polarised **(1)** • plane of polarisation of filter and the plane of polarisation of the waves are parallel at first, therefore microwaves pass through **(1)** • plane of polarisation of filter and the plane of polarisation of the waves are perpendicular to each other after rotation, therefore microwaves are absorbed **(1)**		3

Q15.

Question Number	Acceptable Answers	Additional Guidance	Mark
	A description that makes reference to: • for unpolarised waves – oscillations/vibrations in many directions **(1)** • after undergoing polarisation – oscillations/vibrations in a single direction **(1)** • which is perpendicular to direction of propagation **(1)** **OR** • for unpolarised waves – oscillations/vibrations in many planes **(1)** • after undergoing polarisation – oscillations/vibrations in a single plane **(1)** • and this plane includes direction of propagation **(1)**	Marks should be awarded from one sequence only.	**3**

Q16.

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

Q17.

<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><th></th><th>Number of marks awarded for structure and lines of reasoning</th></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>

Q18.

Question Number	Answer	Mark
	D Transverse waves are always plane polarised.	**1**
	Incorrect Answers: A – An unpolarised wave may be polarised on reflection from a surface. B – Longitudinal waves cannot be plane polarised. C – The vibrations in an unpolarised wave are in many directions.	

Q19.

Question Number	Answer	Mark
	Electromagnetic waves are transverse, with oscillations *perpendicular* **(1)** 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)**	**4**

Q20.

Question Number	Acceptable Answers	Additional Guidance	Mark
	• Rotate filter or laptop (1) • brightness of the screen goes bright-dark every 90° (1) • When screen goes dark plane of emitted / polarised light is perpendicular to the plane of polarisation of the filter **OR** When screen is brightest plane of emitted / polarised light is parallel to the plane of polarisation of the filter (1)		**3**