

Question	Answer	Marks	Guidance
1	<p><b>Level 3: (5 – 6 marks)</b>  <b>Answer shows understanding of</b>  <b>For higher frequencies the speed slows / direction changes the most.</b>  <b>AND for higher refractive index the speed slows / direction changes the most.</b>  Quality of written communication does not impede communication of the science at this level.</p> <p><b>Level 2: (3 – 4 marks)</b>  <b>Answer shows understanding of the nature of the colour of light.</b>  Quality of written communication partly impedes communication of the science at this level.</p> <p><b>Level 1: (1 – 2 marks)</b>  <b>Answer shows a simple appreciation of the nature of light.</b>  Quality of written communication impedes communication of the science at this level.</p> <p><b>Level 0: (0 marks)</b>  Insufficient or irrelevant science. Answer not worthy of credit.</p>	6	<p><b>This question is targeted up to grade A*</b>  <b>NB. Answers can be given (ORA) in terms of red light.</b>  <b>Indicative scientific points may include:</b></p> <p><b>Level 3:</b></p> <ul style="list-style-type: none"> <li>• violet light has highest frequency / shortest wavelength and speed slows most / direction changes the most / AW</li> <li>• violet light has highest refractive index and slows most / direction changes the most / AW</li> </ul> <p><b>Level 2:</b></p> <ul style="list-style-type: none"> <li>• EITHER violet light slows down most</li> <li>• OR violet light has higher frequency / shorter wavelength</li> <li>• OR violet light has higher refractive index</li> </ul> <p><b>Level 1:</b></p> <ul style="list-style-type: none"> <li>• EITHER light slows down when entering glass</li> <li>• OR different colours have different speed changes</li> <li>• OR different colours have different refractive index</li> <li>• OR different colours have different frequencies / wavelength</li> </ul> <p><b>Use the L1, L2, L3 annotations in Scoris; do not use ticks.</b></p>
<b>Total</b>		<b>6</b>	

Question		Answer	Marks	Guidance
2	(a)	$2.25 \times 10^8$ or $2.3 \times 10^8$ (m / s) (2)  <b>but if answer is incorrect</b>  $3 \times 10^8 / 1.333$ (1)	2	<b>allow</b> 225(056264.1) (2) <b>allow</b> 225 563 909.8 (2)
	(b)	glass – arsenic trisulphide (1)	1	
	(c)	blue light is <b>refracted</b> more / ORA (1)   blue light slows down more (than red) / ORA (1)	2	<b>eg.</b> red refracted less than blue (1) <b>ignore</b> blue bends / deviates more  <b>allow</b> blue has a shorter wavelength (1) <b>ignore</b> frequency  <b>allow</b> higher level answers in terms of the equation: $n = \text{speed in vacuum} / \text{speed in medium}$ eg smaller speed in glass has larger refractive index. Red light travels faster than blue so blue has larger n. (2)
		<b>Total</b>	<b>5</b>	

Question	Answer	Marks	Guidance
3	<p><b>Level 3: (5 – 6 marks)</b>  <b>Describes the nature of laser beam AND explains where and how information is stored AND explains how information is read from the disc.</b> Quality of written communication does not impede communication of the science at this level.</p> <p><b>Level 2: (3 – 4 marks)</b>  <b>Describes any two from: the nature of laser beam OR explains where and how information is stored OR explains how information is read from the disc.</b>  Quality of written communication partly impedes communication of the science at this level.</p> <p><b>Level 1: (1 – 2 marks)</b>  <b>Describes any one from: the nature of laser beam OR explains where and how information is stored OR explains how information is read from the disc.</b>  Quality of written communication impedes communication of the science at this level.</p> <p><b>Level 0: (0 marks)</b>  Insufficient or irrelevant science. Answer not worthy of credit.</p>	6	<p><b>This question is targeted up to grade A*</b>  <b>Indicative scientific points may include:</b></p> <p><b>Nature of a laser beam</b></p> <ul style="list-style-type: none"> <li>• <b>EITHER</b> laser beam is coherent</li> <li>• <b>OR</b> is in phase or in sync <b>AND</b> has same frequency / wavelength / is monochromatic</li> </ul> <p><b>Where and how information is stored</b></p> <ul style="list-style-type: none"> <li>• storage by pits and bumps / lands</li> </ul> <p><b>How information is read from the disc</b></p> <ul style="list-style-type: none"> <li>• read by reflection of laser from pits and / or bumps or lands (collected by receiver)</li> </ul> <p><b>Use the L1, L2, L3 annotations in Scoris; do not use ticks.</b></p>
<b>Total</b>		<b>6</b>	

Question			Answer	Marks	Guidance																
4	(a)	(i)	$1.5 \times 10^{14}$ (Hz) (2) <b>but if answer is incorrect</b> $2.2 \times 10^8 \div 1.5 \times 10^{-6}$ (1)	2	$1.47 \times 10^{14}$ (2) <b>allow</b> other Hz prefixes eg $1.5 \times 10^8$ MHz/150THz if multiple clearly shown on answer line  <b>allow</b> $1.4666 \times 10^{14}$ (1) <b>allow</b> 1466666600000000 (1)																
		(ii)	<table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th></th> <th>&gt; i fibre</th> <th>= in fibre</th> <th>&lt; in fibre</th> </tr> </thead> <tbody> <tr> <td><b>speed</b> of IR in air</td> <td style="text-align: center;">✓</td> <td></td> <td></td> </tr> <tr> <td><b>wavelength</b> of IR in air</td> <td style="text-align: center;">✓</td> <td></td> <td></td> </tr> <tr> <td><b>frequency</b> of IR in air</td> <td></td> <td style="text-align: center;">✓</td> <td></td> </tr> </tbody> </table>		> i fibre	= in fibre	< in fibre	<b>speed</b> of IR in air	✓			<b>wavelength</b> of IR in air	✓			<b>frequency</b> of IR in air		✓		2	all 3 correct (2)  1 or 2 correct (1)
	> i fibre	= in fibre	< in fibre																		
<b>speed</b> of IR in air	✓																				
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	(b)		<b>max one from standard demand marks:</b> rapid (high rate) of transmission of data (1) idea that it is easier to remove noise (1)  <b>any two from higher demand marks:</b> multiple signals / more information transmitted / multiplexing (1) output signal / sound / picture is clearer (1)  noise not recognised or amplified (1)	2	<b>ignore</b> interference can be removed  <b>ignore</b> less interference in signal  <b>allow</b> interference is not recognised (1)																
<b>Total</b>				<b>6</b>																	