

Question Number	Answer	Acceptable answers	Mark
<b>1(a)</b>	Any two suitable such as: <ul style="list-style-type: none"> <li>• Measurements can be taken (1)</li> <li>• Permanent record/evidence (1)</li> <li>• Can be magnified (1)</li> <li>• Can detect waves outside visible part of spectrum (1)</li> <li>• Long exposure (to see faint objects/track objects) (1)</li> </ul>	Analysis/compare 'can record data' Taking photo is insufficient zoom in/show more detail can detect gamma rays, X-rays, ultraviolet, infrared Allow collect more light  IGNORE better, brighter, clearer	<b>(2)</b>

Question Number	Answer	Acceptable answers	Mark
<b>1(b)</b>	An explanation linking: <ul style="list-style-type: none"> <li>• (Idea of) geocentric model believed initially (1)</li> <li>• Observation of moons orbiting Jupiter (rather than <u>Earth</u>) (1)</li> <li>• (Idea of) heliocentric model then preferred (1)</li> </ul>	Initially everything {orbits/goes around} Earth  Accept 'going around' for 'orbiting'  Then everything {orbits/goes around} Sun  Accept stopped believing geocentric Accept then not everything orbits the Earth	<b>(3)</b>

Question Number	Answer	Acceptable answers	Mark
<b>1(c)</b>	<b>B</b> 20 cm		<b>(1)</b>

Question Number	Answer	Acceptable answers	Mark
<b>1(d)(i)</b>	Substitution 12/(14-12) (1)  Evaluation 6.0 (1)	Award full marks for correct with no working  Ignore any units	<b>(2)</b>

Question Number	Answer	Acceptable answers	Mark
<b>1(d)(ii)</b>	-12	Negative sign essential	<b>(1)</b>

Question Number	Answer	Acceptable answers	Mark
<b>1(d)(iii)</b>	Suggestion to include one of: <ul style="list-style-type: none"> <li>Shows whether it is real or virtual (1)</li> <li>A positive sign for magnification indicates a {real image/inverted image/opposite side of lens to object} (1)</li> </ul>	Allow shows whether it is inverted or upright Allow shows which side of lens image is formed  A negative sign for magnification indicates a {virtual image/upright image/same side of lens as object}  IGNORE simple reference to magnification	<b>(1)</b>

Total for Question 4 = 10 marks

Question Number	Answer	Acceptable answers	Mark
<b>2 (a)</b>	normal (1)	normal line	<b>(1)</b>

Question Number	Answer	Acceptable answers	Mark
<b>2 (b) (i)</b>	plot the points: <ul style="list-style-type: none"> <li>• 0,0 (1)</li> <li>• 6,9 (1)</li> </ul>	allow within one square tolerance.  Bod if 0,0 not clearly visible but must be able to see a plotted point for 6,9 If they plot more than 2 points, take a mark off for each incorrect one plotted.	<b>(2)</b>

Question Number	Answer	Acceptable answers	Mark
<b>2 (b) (ii)</b>	straight line through both points joining existing curve (1)	Reject multiple lines and unreasonably wavering lines. allow ecf from wrongly plotted points, including curves if plausible	<b>(1)</b>

Question Number	Answer	Acceptable answers	Mark
<b>2 (b) (iii)</b>	42° (1)  +/- 0.5°		<b>(1)</b>

Question Number	Answer	Acceptable answers	Mark
<b>2 (c) (i)</b>	diagram showing: <ul style="list-style-type: none"> <li>• reflection (1)</li> <li>• angle of incidence = angle of reflection (1)</li> </ul>	reject (for this marking point) with an additional partial refraction / ray along boundary  judge by eye allow angles marked as equal	<b>(2)</b>

Question Number	Answer	Acceptable answers	Mark
<b>2 (c) (ii)</b>	The idea that it enters along the normal	At $90^\circ$ to the surface / at right angles to the surface / along a radius / perpendicular to the tangent / hits straight on reject 'goes through centre of glass'	<b>(1)</b>

**(Total for Question 1 = 8 marks)**

Question Number	Answer	Acceptable answers	Mark
<b>3 (a)</b>	<b>B</b>		<b>(1)</b>

Question Number	Answer	Acceptable answers	Mark
<b>3b(i)</b>	<p>A description including <b>three</b> of the following points</p> <ul style="list-style-type: none"> <li>• reflection (of light) at (either) mirror (1)</li> <li>• (the curved mirror) focuses the light (1)</li> <li>• (mirror) inverts (1)</li> <li>• (lens / eyepiece) magnifies image (1)</li> <li>• image is formed where the light rays cross (1)</li> </ul>	<p>Bounces for reflects</p> <p>flips it over/turns over</p> <p>lens/eyepiece refracts light</p> <p>Image is real(1)</p> <p>Accept for 1 mark if no other mark awarded: (Telescope) reflects <u>and</u> refracts light (1)</p>	<b>(3)</b>

Question Number	Answer	Acceptable answers	Mark
<b>3(b)(ii)</b>	<p>An explanation including two from</p> <ul style="list-style-type: none"> <li>• collects more light (1)</li> <li>• produces a magnified/bigger image (1)</li> <li>• shows more detail (1)</li> <li>• shows stars the naked eye is unable to see (1)</li> <li>• can observe stars day and night (1)</li> </ul>	<p>brighter</p> <p>looks closer/zooms in</p> <p>makes it clearer/better</p> <p>see further/more (stars)</p>	<b>(2)</b>

Question Number	Answer	Acceptable answers	Mark
<b>3(c)(i)</b>	transverse (wave)	mechanical	<b>(1)</b>

Question Number	Answer	Acceptable answers	Mark
<b>3(c)(ii)</b>	move up and down a bigger distance		<b>(1)</b>

Question Number	Answer	Acceptable answers	Mark
<b>3(c)(iii)</b>	substitution (1) 4 x 0.5  evaluation (1) 2 (m/s)	give full marks for correct answer, no working Accept power of ten error for 1 mark eg. 0.2, 20, 200, 2000	<b>(2)</b>

Question Number	Answer	Acceptable answers	Mark
<b>4(a)(i)</b>	refraction	refracting	<b>(1)</b>

Question Number	Answer	Acceptable answers	Mark
<b>4(a)(ii)</b>	B		<b>(1)</b>

Question Number	Answer	Acceptable answers	Mark
<b>4(a)(iii)</b>	<p>An explanation linking <b>two</b> of the following</p> <ul style="list-style-type: none"> <li>• change in direction (1)</li> <li>• towards the normal (1)</li> <li>• (resulting from ) decrease in speed (1)</li> <li>• (because) the left hand part of the wavefront { hits the boundary first / slows down first} (1)</li> </ul>	<p>bends</p> <p>Ignore away from normal</p> <p>change in speed (ignore increase in speed)</p>	<b>(2)</b>

Question Number	Answer	Acceptable answers	Mark
<b>4(b)</b>	<p>substitution (1)  <math>25 = 120 \times f</math></p> <p>transposition (1)  <math>f = 25/120</math></p> <p>evaluation (1)  0.21 (Hz)</p>	<p>substitution and transposition can be in any order</p> <p>0.2  0.20  0.208(3...)</p> <p>give (3) marks for correct answer, no working  Allow (2) marks for 20.8 stated with no working</p>	<b>(3)</b>

Question Number	Answer	Acceptable answers	Mark
<b>4(c)</b>	<p>an explanation linking the following</p> <ul style="list-style-type: none"> <li>• light waves are transverse waves / sound waves are longitudinal (1)</li> <li>• in transverse waves oscillations are at right angle to the direction of travel (1)</li> <li>• in longitudinal waves oscillations are parallel to the direction of travel (1)</li> </ul>	<p>Allow up and down ( or side to side) movement of lamp as evidence that water waves are transverse</p> <p>up and down. Side to side. 90°</p> <p>labelled diagram correctly identifying both axes</p> <p>backwards and forwards, push and pull compressions and rarefractions</p>	<b>(3)</b>



Question number	Answer	Additional guidance	Mark
<b>5(a)</b>	An answer that combines the following points of understanding to provide a logical description: <ul style="list-style-type: none"> <li>• shine the light along a radius (1)</li> <li>• by marking it on the paper before putting the block down (1)</li> </ul>	allow  shine the ray at the centre of the straight edge before putting the block down	<b>(2)</b>

Question number	Answer	Additional guidance	Mark
<b>5(b) (i)</b>	all points correctly plotted to $\pm$ half a square (2)	4 points plotted correctly (i.e. one error) (1)	<b>(2)</b>

Question number	Answer	Mark
<b>5(b) (ii)</b>	smooth curve through at least 3 of the points (1)	<b>(1)</b>

Question number	Answer	Additional guidance	Mark
<b>5(b) (iii)</b>	<ul style="list-style-type: none"> <li>• continues line as far as <math>90^\circ</math> (1)</li> <li>• estimate between <math>43^\circ</math> and <math>47^\circ</math> (1)</li> </ul>	award full marks for correct numerical answer without working	<b>(2)</b>

Question number	Answer	Mark
<b>5(c)</b>	An answer that provides a description by making reference to: <ul style="list-style-type: none"> <li>• (all) light reflected (1)</li> <li>• back inside block (1)</li> </ul>	<b>(2)</b>