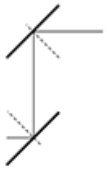
Mark scheme

Question			Answer/Indicative content	Marks	Guidance
1			Y: normal Z: refracted (ray) ✓	1 (AO 1.2)	**BOTH** answers needed for 1 mark **ALLOW** refraction for refracted **Examiner's Comments** Candidates found this question to be one of the most challenging questions. Few candidates were able to identify Y as the normal, and many candidates could not identify Z as the refracted ray.
			Total	**1**	
2			A	1 (AO 1.2)	**Examiner's Comments** Most candidates answered this question correctly, understanding that the rays were passing through a converging lens. The other three distractors were all chosen by the small minority of candidates who did not gain the correct answer.
			Total	**1**	
3			**Level 3 (5–6 marks)** Prediction of the results AND a detailed method / diagram OR Detailed prediction of results AND a basic method / diagram *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.* **Level 2 (3–4 marks)** Prediction of the results AND a basic (workable) method / diagram. OR Detailed prediction of the results OR Detailed method / diagram. *There is a line of reasoning presented with some structure. The information presented is relevant and supported*	6 (2 × AO 1.1) (4 × AO 3.3a)	**AO1.2 – Demonstrate knowledge and understanding of ray diagrams and reflection** • Prediction made e.g., both angles are equal • Angle of incidence = angle of reflection • Law of reflection mentioned for all angles • Marks can be awarded from labelled diagram showing the mirror with the normal, angle of incidence and angle of reflection • As i increase r increases **AO3.3a – Analyse information and ideas to develop experimental procedures**

			by some evidence. **Level 1 (1–2 marks)** A basic prediction OR a basic (workable) method / diagram. *There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.* **0 mark** *No response or no response worthy of credit.*		• Use of a darkened room • Use ray box (and slit) to produce ray of light. • Place mirror onto paper • Draw position of mirror • Shine ray of light at mirror • Draw normal at 90 degrees to the mirror • Trace rays by drawing crosses / marks on the paper. • Use ruler to join up crosses / marks • Measure angle between normal and incident ray / angle of incidence • Measure angle between normal and reflected ray / angle of reflection • Repeat for different angles of incidence • Marks can be awarded from labelled diagram **<u>Examiner's Comments</u>** Candidates found this question challenging. Candidates who scored higher marks tended to draw a diagram in the white space before the answer lines. Candidates should be encouraged to follow the bullet points in the question to structure their answers. To answer this question well, candidates needed to draw a diagram showing the position of the mirror and the ray box together with the incident ray, normal and reflected ray marked. The angle of incidence and the angle of reflection should also be indicated on the diagram. Candidates should also have included a description of how the ray could be drawn, e.g. the use of crosses and using the ruler to join the crosses. Then all that needed to be stated was that the protractor would be used to help in the drawing of the normal at 90° to the mirror and to measure the angle of incidence and angle of reflection.

					The prediction expected was that the angle of reflection was equal to the angle of incidence. It was also expected that the experiment would be repeated for different angles of incidence. The description of the experiment could also have included the use of a dark room and using a single slit in the ray box. Candidates often gave incorrect answers by drawing inaccurate diagrams often with the mirror drawn in the ray box or the incident ray drawn along the normal. Other answers were vague with little detail of an experiment.  **Assessment for learning** Candidates should have the opportunity to write plans of experiments including predictions.
			Total	**6**	
4			A	1 (AO 2.1)	**Examiner's Comments** Candidates found this question to be the most challenging in the multiple-choice section. The majority of the incorrect answers were option B.
			Total	**1**	
5			C ✓	1 (AO1.2)	**Examiner's Comments** The common incorrect response was A with the majority of candidates not able to evidence that the refracted ray within the glass is not possible unless the incident ray is along the normal.
			Total	**1**	
6			Angle of reflection = angle of incidence at mirror 1 (by eye) ✓ Light ray carries on in a straight line to mirror 2 and reflects from the surface of mirror 2 into the eye ✓	3 (3× AO1.2)	**DO NOT ALLOW** if arrow pointing from eye **Examiner's Comments** Many candidates did not include the normal line on mirror 2. Some

			Correct normal drawn at ~90° to the mirror at point ray reflects from mirror 2 (by eye) ✓ 		candidates did not draw the ray accurately and either the angle of incidence did not equal the angle of reflection or the light ray did not enter the eye.
			Total	**3**	
7			A ✓	1 (AO1.2)	**Examiner's Comments** A common incorrect response was B where candidates read the angle from the surface to the ray.
			Total	**1**	