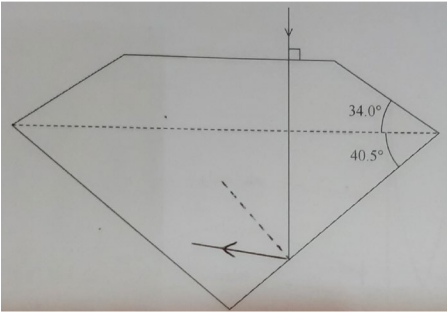


Question Number	Answer	Mark
11a	<p>Use of $n_1 \sin \theta_1 = n_2 \sin \theta_2$ (1)</p> <p>Use of $n = c/v$ with $c = 3.00 \times 10^8 \text{ (m s}^{-1}\text{)}$ (1)</p> <p>$v = 1.4 \times 10^8 \text{ (m s}^{-1}\text{)}$ so material is cubic zirconia (1)</p> <p>(For MP1, allow use of $n = \sin i / \sin r$)</p> <p>(All marks can be achieved if candidate calculates n for all of the gemstones and compares to value calculated in MP1)</p> <p><u>Example of calculation</u></p> <p>$n_1 \sin \theta_1 = n_2 \sin \theta_2$, $1.00 \sin (50^\circ) = n_2 \sin (21^\circ)$, $n_2 = 2.14$</p> <p>$n = c/v$, so $v = (3.00 \times 10^8 \text{ m s}^{-1}) / 2.14 = 1.4 \times 10^8 \text{ m s}^{-1}$</p>	3
11bi	<p>Use of $\sin C = 1/n$ where $n = c/v$ (1)</p> <p>Critical angle for diamond is 24° (1)</p> <p>$(40.5^\circ > 24^\circ)$ so diagram shows reflection at the boundary (1)</p> <p>Ray completed showing TIR in correct direction by eye (1)</p> <p>OR</p> <p>Use of $n_1 \sin \theta_1 = n_2 \sin \theta_2$ (1)</p> <p>$n_1 \sin \theta_1 = 1.57$ (1)</p> <p>$(\sin \theta_2 > 1)$ so diagram shows reflection at the boundary (1)</p> <p>Ray completed showing TIR in correct direction by eye (1)</p> <p>(Only allow MP3 if TIR is drawn on the diagram, not just stated)</p>  <p><u>Example of calculation</u></p> <p>$\sin C = 1/n = (1.24 \times 10^8 \text{ ms}^{-1}) / (3.00 \times 10^8 \text{ ms}^{-1}) = 0.41$.</p> <p>$C = \sin^{-1} (0.41) = 24^\circ$</p>	4
11bii	<p>Silicon carbide has a greater refractive index (than diamond)</p> <p>Or silicon carbide has a smaller critical angle (than diamond)</p> <p>Or critical angle for silicon carbide is 23°</p> <p>Or critical angle is still less than the angle of incidence</p> <p>Or $\sin \theta_2$ is still > 1 (1)</p> <p>So total internal reflection (TIR) would (still) take place (MP2 dependent on MP1) (1)</p> <p>(Calculation of n for silicon carbide not good enough for MP1)</p>	2
Total for question 11		9