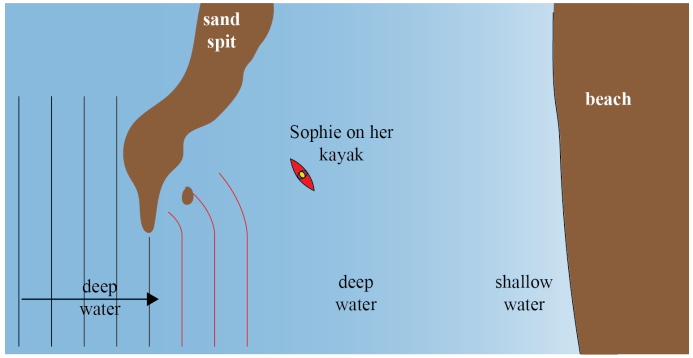
Assessment Schedule – 2022

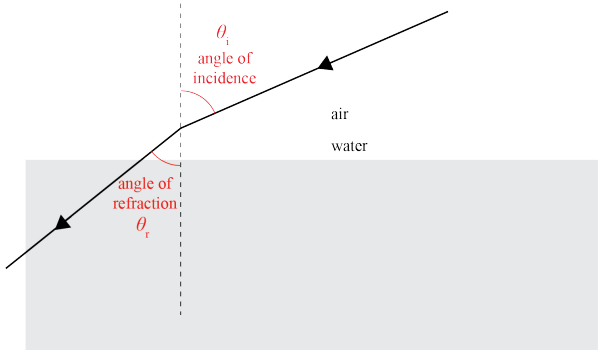
Physics: Demonstrate understanding of aspects of wave behaviour (90938)

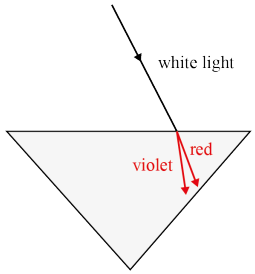
Evidence

Q	Evidence	Achievement	Merit	Excellence
ONE (a)	Diffraction.	• Stated correctly.		
(b)(i)	 Waves diffracting around the barrier drawn.	• Draws diffracted waves. OR	• Draws diffracted waves correctly. AND	
(ii)	The wavelengths of the incoming wave and the diffracted wave are the same. As the depth does not change. OR As f stays the same along with v and $v = f\lambda$.	States that wavelengths are the same.	States that wavelengths are the same. AND Correct explanation.	
(c)	The wavelength in the shallow water is smaller because the waves travel at a slower speed. With $v = f\lambda$ and frequency being constant, a smaller λ (wavelength) implies a slower speed.	• States / implies waves travelling at a slower speed.	• States / implies waves travelling at a slower speed. AND States / implies that frequency is constant and $v = f\lambda$.	

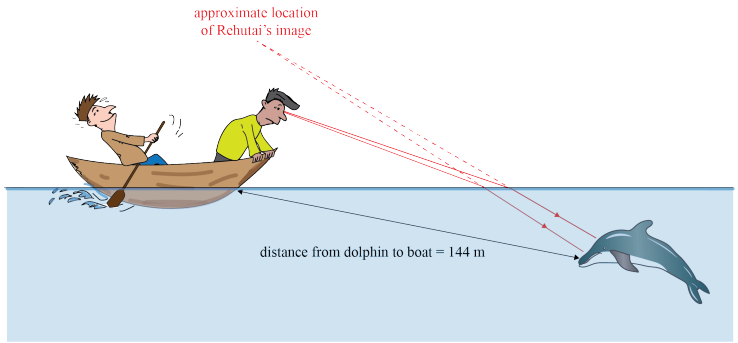
(d)	In the deep water, the waves travel at $v = \frac{\lambda}{T} = \frac{12.0}{5.2} = 2.31 \text{ m s}^{-1}$ In the shallow water, the speed is a third of that: 0.77 m s^{-1}. As the period is the same in the deep and the shallow water, the wavelength in the shallow water is therefore $\lambda = vT = 0.77 \times 5.2 = 4.0$ m. This is a third of the wavelength of the waves in deep water. With 1 = deep and 2 = shallow, this can be shown from $T = \frac{\lambda}{v}$ and $\frac{\lambda_1}{v_1} = \frac{\lambda_2}{v_2}$, implying that $\lambda_2 = \frac{\lambda_1}{3}$ when $v_1 = 3v_2$.	• Calculates $f = \frac{1}{T} = 0.192$ Hz AND subsequently attempts to calculate v as λf. OR Calculates wave speed in the deep water, $v = \frac{\lambda}{T}$ = 2.31 m s^{-1}, correctly. OR Calculates the shallow water speed 0.77 m s^{-1}.	• Calculates wavelength in the shallow water, λ = 4.0 m, OR Shows algebraically that $\lambda_2 = \frac{\lambda_1}{3}$ without numerical values.	• Calculates wavelength in the shallow water, λ = 4.0 m, correctly and with reasoning evident. AND States / implies that 4.0 m in the shallow water is a third of λ in the deep water (or vice versa).

NØ	N1	N2	A3	A4	M5	M6	E7	E8
No relevant evidence.	Very little evidence at the Achievement level. Most evidence is at the Not Achieved level.	Some evidence at the Achievement level; partial explanations.	Most evidence provided is at the Achievement level, while some is at the Not Achieved level.	Nearly all evidence provided is at the Achievement level.	Some evidence is at the Merit level with some at the Achievement level.	Most evidence is at the Merit level, with some at the Achievement level.	Evidence is provided for most tasks, with evidence at the Excellence level weak or with minor errors / omissions.	Evidence provided for all tasks. Evidence at the Excellence level accurate and full.
0	1A	2A	3A	4A	1A + 2M	2A + 2M	1A + 1M + 1E	2M + 1E

Q	Evidence	Achievement	Merit	Excellence
TWO (a)		• Labelled both angles correctly.		
(b)	The optical density of water is larger. This is evident in the diagram because the incident ray refracts towards the normal. OR Optical density linked to angle of incidence > angle of refraction.	• States / implies that water has a larger optical density OR that the speed of light is less in water (than in air).	• Links the larger optical density of water (OR lesser speed of light in water) to refraction of incident ray towards the normal. OR Optical density linked to angle of incidence > angle of refraction.	
(c)	The ray can be reflected on the inside surface at point A by means of total internal reflection. For TIR to occur, the ray must attempt to enter a medium of lesser optical density (air) from a denser one (water). Furthermore, the angle of incidence must be equal or larger than the critical angle of the water–air boundary. Then, no refraction into air occurs, and the ray is reflected back into the water.	• States / implies that TIR occurs. OR States / implies that the angle of incidence must be equal or greater than the critical angle.	• Links TIR to occur to both the angle of incidence being equal or greater than the critical angle AND the ray attempting to enter a less optically dense medium from a more dense one.	

(d)	 The glass of the prism is a dispersive medium: it refracts different colours (frequencies) by different amounts. Red light travels fastest in the prism; it is refracted the least. Violet light travels slowest in the prism; it is refracted the most. As white light contains all frequencies but these are refracted (or bent) differently, the prism appears to split the white light into the colours of the rainbow.	• Draws and labels at least two singly dispersed rays OR States / implies that white light consists of all colours. OR States / implies that different colours travel at different speeds in the prism. OR States / implies that the prism refracts different colours by different amounts. OR States dispersion.	• Draws and labels at least two doubly dispersed rays correctly. OR • Explains that the prism splits white light because different colours travel at different speeds / wavelength / frequency in the prism so that it refracts different colours by different amounts.	• Draws and labels at least two doubly dispersed rays correctly. AND Explains that the prism splits white light because different colours travel at different speeds / wavelength / frequency in the prism so that it refracts different colours by different amounts.

NØ	N1	N2	A3	A4	M5	M6	E7	E8
No relevant evidence.	Very little evidence at the Achievement level. Most evidence is at the Not Achieved level.	Some evidence at the Achievement level; partial explanations.	Most evidence provided is at the Achievement level, while some is at the Not Achieved level.	Nearly all evidence provided is at the Achievement level.	Some evidence is at the Merit level with some at the Achievement level.	Most evidence is at the Merit level, with some at the Achievement level.	Evidence is provided for most tasks, with evidence at the Excellence level weak or with minor errors / omissions.	Evidence provided for all tasks. Evidence at the Excellence level accurate and full.
0	1A	2A	3A	4A	1A + 2M	2A + 2M	1A + 1M + 1E	2M + 1E

Q	Evidence	Achievement	Merit	Excellence
THREE (a)	Longitudinal wave.	• Correct answer.		
(b)	Water particles vibrate back and forth parallel to the direction of the travel of the sound wave.	Particles / vibrate back and forth.	• Comparison that sound waves travel parallel to the water particles' vibrations (do not accept they travel in the same direction).	
(c)	The sound travels at a speed of $v = \lambda f = 0.012 \times 120 \times 10^3 = 1440$ m s^{-1}. In 0.20 s, the sound travels a distance of $\Delta d = v \times \Delta t = 1440 \times 0.20 = 288$ m. This is not the distance of 144 m labelled in the diagram because the sound has to travel the distance from the dolphin to the boat and back again for the dolphin to be able to hear it.	• Calculates $v = 1440$ m s^{-1}. OR • Calculates Δd correctly from an incorrect speed. OR • States 288 m as double the distance labelled in the diagram, without further reasoning.	• Calculates $v = 1440$ m s^{-1}. AND Calculates $\Delta d = 288$ m.	• Calculates $\Delta d = 288$ m AND Explains that this is the distance from the dolphin to the boat and back.
(d)		• Draws two rays from one point on Rehutai and refracting correctly (towards the normal) into the water. OR Locates Rehutai's image along a straight line from a refracted ray / line into the dolphin's eye.	• Draws two rays from one point on Rehutai and refracting correctly (towards the normal) into the water and into the dolphin's eye. AND Locates Rehutai's image along straight backtracked lines from the refracted rays into the dolphin's eye.	

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0	1A	2A	3A	4A	1A + 2M	2A + 2M	1A + 1M + 1E	2M + 1E

Cut Scores

Not Achieved	Achievement	Achievement with Merit	Achievement with Excellence
0 – 7	8 – 13	14 – 19	20 – 24