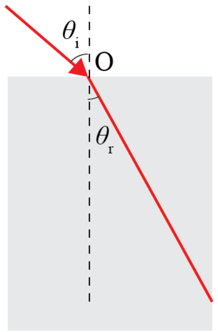
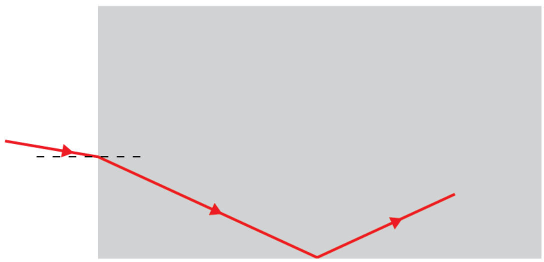
Assessment Schedule – 2023

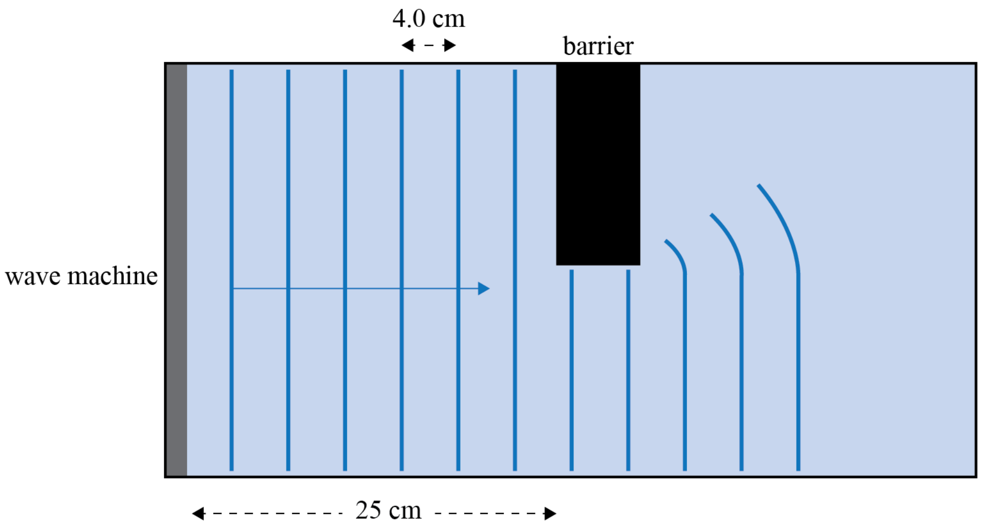
Physics: Demonstrate understanding of aspects of wave behaviour (90938)

Evidence

Q	Evidence	Achievement	Merit	Excellence
ONE (a)		• Both angles labelled correctly. (Angle θ_i between incident ray and normal, θ_r between reflected ray and normal.)		
(b)	Refraction is the change in direction of a wave passing from one medium to another, caused by its change in speed. When the light ray enters the glass (from air) at O, it slows down and therefore bends towards the normal. When it leaves it at P, the speed-up results in a bending away from the normal, back in a direction parallel to the original ray. Since the change of speed at O has the same magnitude as that at point P, the double-refracted ray appears to be shifted to the side, laterally displaced.	• Describes refraction and change in direction or “Bending” OR Describes refraction at O in terms of slowing down. OR Describes refraction at P in terms of speeding up. OR Identifies changes of speed at O and P as having the same magnitude.	• Defines refraction. AND Describes refraction at O in terms of slowing down. AND Describes refraction at P in terms of speeding up. AND Bends away and bends towards the normal and O and P respectively	• Describes refraction at O in terms of slowing down. AND Describes refraction at P in terms of speeding up. AND Explains parallel (identical) directions of incoming and outgoing ray in terms of equal changes of speed at P and O.

(c)	Compared to the first block, the second block has a larger optical density, so the ray slows down more. Therefore, the angle of refraction is smaller. This results in a larger lateral displacement.	States / implies that a greater optical density means a slower speed of light. OR States / implies that a smaller angle of refraction results in greater lateral displacement.	• Links the slower speed of light to smaller angle of refraction (closer to the normal), and therefore a greater lateral displacement.	
(d)	The phenomenon that occurs is total internal reflection. The two conditions for total internal reflection to occur are: • The incident medium (glass) has a higher optical density / lower speed of light than the refracting medium/”travels” • The incident angle is larger than the critical angle at the glass-air interface. 	• States ‘total internal reflection’. OR Draws reflection on diagram inside the glass (angle in = angle out). OR States ONE condition for total internal reflection.	• States ‘total internal reflection’. AND Draws reflection on diagram inside the glass (angle in = angle out). OR States ONE condition for total internal reflection.	• States ‘total internal reflection’. AND Draws reflection on diagram inside the glass (angle in = angle out). AND States TWO conditions for total internal reflection. <u>Optical density required</u>

Not Achieved			**Achievement**		**Achievement with Merit**		**Achievement with Excellence**	
NØ	**N1**	**N2**	**A3**	**A4**	**M5**	**M6**	**E7**	**E8**
No relevant evidence.	1a	2a 1m	3a 1a + 1m (1a + 1e) 1e	4a 2a + 1m (2a + 1e)	2m (1m + 1e) 3a + 1e	3m 1a + 1m + 1e 2a + 1m + 1e 2e	2m + 1e 1m + 2e 1a + 2e	1a + 1m + 2e

Q	Evidence	Achievement	Merit	Excellence
TWO (a)		• Draws wavefronts correctly: straight past the barrier, curving into wave shadow around the barrier.		
(b)	The wave speed is $v = \lambda f = 4.0 \times 2.6 = 10.4$ cm s^{-1}. The distance from the wave machine to the barrier, $d = 25$ cm, is therefore covered in $t = \frac{d}{v} = \frac{25}{10.4} = 2.4$ s. Or converts and calculates in base unit is $v = \lambda f = 0.04\text{m} \times 2.6 = 0.104$ m s^{-1} $d = 0.25$ m $t = \frac{d}{v} = \frac{0.25}{0.104} = 2.4$ s.	• Calculates 10.4 cm s^{-1} or 0.104 m / s. OR Calculates time correctly from incorrect speed and / or involving incorrectly converted units.	• Calculates 2.4 s correctly.	

(c)	The wave speed remains constant because the depth has not changed, nor has the medium the wave is travelling through. Therefore, from $v = \lambda f$, doubling the frequency results in halving of the wavelengths. With the wave speed remaining constant, the time for the waves to reach the barrier remains unchanged, too.	• States that the wavelengths decrease. OR States that the time for the waves to reach the barrier remains unchanged. OR States the waves' speed remains constant because the depth of water has not changed / medium stays same.	• Links decrease of wavelength to constant wave speed. OR Links time for the waves to reach the barrier remaining unchanged to constant wave speed.	• Links decrease of wavelength to constant wave speed. AND Links time for the waves to reach the barrier remaining unchanged to constant wave speed.
(d)	The wavelength is $\frac{23}{3} = 7.7$ cm. Therefore, the frequency is $f = \frac{v}{\lambda} = \frac{10.4}{7.7} = 1.35$ Hz. This is the number of drops that fall in the tank per second. Therefore, in one minute, $1.35 \times 60 = 81$ drops fall in the tank. Accept 82 drops due to rounding errors.	• Calculates 7.7 cm correctly. OR Calculates the frequency correctly from an incorrect wavelength (for example, $f = 1.809$ Hz from $\lambda = \frac{23}{4} = 5.75$ cm).	• Calculates 1.35 Hz. OR Calculates the number of drops in a minute correctly from an incorrect wavelength.	• Calculates 81 drops per minute correctly. (or 82, but not 81.5)

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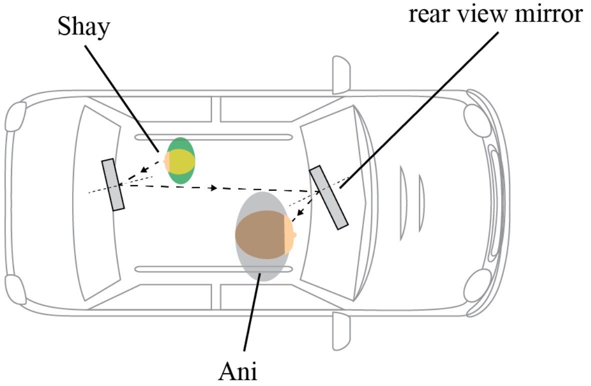
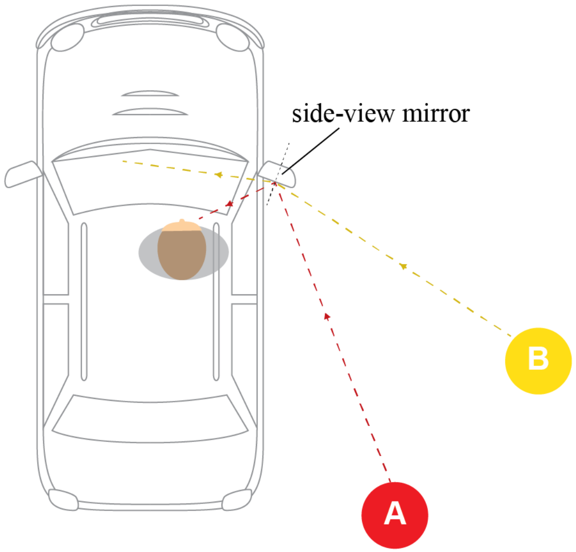
NØ	**N1**	**N2**	**A3**	**A4**	**M5**	**M6**	**E7**	**E8**
No relevant evidence.	1a	2a 1m	3a 1a + 1m (1a + 1e) 1e	4a 2a + 1m (2a + 1e)	2m (1m + 1e) 3a + 1e	3m 1a + 1m + 1e 2a + 1m + 1e 2e	2m + 1e 1m + 2e 1a + 2e	1a + 1m + 2e

Q	Evidence	Achievement	Merit	Excellence
THREE (a)	Period = $\frac{48}{3}$ = 16 s.	• Calculates 16 s correctly. (NOT "16", T = 16 or 16s)		
(b)	A transverse wave is a wave in which the particles of a medium are displaced in a direction perpendicular to the direction of travel of the wave. A longitudinal wave is one in which the particles of the medium are displaced in a direction parallel to the direction of travel of the wave. Surface waves in water are transverse. Sound waves in air are longitudinal. The speed of sound in air is approx. 330 m / s; much faster than the typical speed of ocean waves.	• Defines EITHER transverse or longitudinal waves correctly and identifies corresponding type of wave. OR Identifies both types of waves correctly. OR States / implies that sound waves are much faster than typical ocean waves.	• Defines BOTH transverse and longitudinal waves correctly and identifies corresponding types of waves.	• Defines BOTH transverse and longitudinal waves correctly and identifies corresponding types of waves. AND States / implies that sound waves are much faster than typical ocean waves.
(c)		• Draws rays from Shay's face reflected off the baby mirror, towards and off Ani's rear-view mirror, and towards Ani, with obviously incorrect angles of reflection. OR Correct angles without arrowheads / with arrow heads in the wrong **direction**. No normal required.	• Draws rays from Shay's face reflected off the baby mirror, towards and off Ani's rear-view mirror, and towards Ani, with approximately **correct angles of reflection** and with **arrowheads**.	

(d)	 For object A, rays can be drawn against and off Ani's side-view mirror, towards Ani, obeying the law of reflection: angle of incidence = angle of reflection. This is shown in the diagram. Contrastingly, for B, this is not possible. Rays from B against and off the mirror miss Ani if they bounce off the mirror symmetrically. Rays from B that bounce off the mirror, reaching Ani, must reflect asymmetrically. Therefore, Ani can't see B.	• States / implies law of reflection as 'angle of incidence = angle of reflection'. OR Draws rays from A against and off the mirror, towards Ani, reflecting off the mirror. OR States / implies that rays from B against and off the mirror, reaching Ani, cannot be reflected symmetrically off the mirror.	• States / implies law of reflection as 'angle of incidence = angle of reflection'. AND Draws rays from A against and off the mirror, towards Ani, reflecting off the mirror symmetrically. (Rays must have correct arrows indicating direction of light) – missing or incorrect -Achieved)	• States / implies law of reflection as 'angle of incidence = angle of reflection'. AND Draws rays from A against and off the mirror, towards Ani, reflecting off the mirror symmetrically. AND Draws rays from B against and off the mirror, towards Ani, reflecting off the mirror symmetrically. AND Links the impossibility of rays from B reflecting symmetrically off the mirror and reaching Ani to the fact that Ani cannot see B.

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No relevant evidence.	1a	2a 1m	3a 1a + 1m (1a + 1e) 1e	4a 2a + 1m (2a + 1e)	2m (1m + 1e) 3a + 1e	3m 1a + 1m + 1e 2a + 1m + 1e 2e	2m + 1e 1m + 2e 1a + 2e	1a + 1m + 2e

Cut Scores

Not Achieved	Achievement	Achievement with Merit	Achievement with Excellence
0 – 8	9 – 15	16 – 20	21 – 24