3.4 Waves: Light and Sound: Test Pack

Calculator allowed · about 45 minutes

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 State whether each example involves sound waves or light waves.

(a) A person hears a dog barking in the street. **(1)**

(b) Sunlight passing through a window to brighten a room. **(1)**

(c) A submarine using sonar to detect objects underwater. **(1)**

(d) Seeing the colour of a flower. **(1)**

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2 Complete the sentences about reflection of light.

(a) When a ray of light reflects from a flat mirror the angle of incidence is ____ the angle of reflection. **(2)**

(b) If light hits a rough surface the reflection is called ____ reflection. **(1)**

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3 A student shines white light through a triangular glass block and observes a beam emerging the other side bent.

(a) Name the process that causes the beam to change direction when it enters the glass. **(1)**

(b) Explain in simple terms why the direction changes when light enters glass from air. **(2)**

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4 A student measures the time for a pulse to travel along a spring: distance 1.5 m, time 0.30 s. a) Calculate the speed of the pulse. b) Give the unit.

(3)

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5 A student uses a concave mirror to form an image of a candle. State two differences between the image formed by a concave mirror when the candle is placed very close to the mirror compared with when the candle is far from the mirror.

(3)

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6 Light shines from air into glass at an angle. Complete the sentences: a) When light enters the glass it bends _____ the normal. b) Inside glass the speed of light is _____ compared with air. c) This change in direction is called _____.

(3)

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7 An experiment measures the frequency of a mass bouncing on a spring by timing 120 vibrations. The stopwatch shows 60.0 s. a) Calculate the frequency of the vibrating mass. b) State the unit of frequency.

(3)

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8 A ray of light passes from glass (refractive index higher) into water (refractive index lower). The angle to the normal in glass is 35 degrees. Use Snell-like reasoning: predict whether the angle in the water will be bigger, smaller or the same and explain why.

(4)

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9 Astronauts on the Moon cannot hear each other speak directly through the air; they must use radios to communicate.

(a) Explain why sound cannot travel through the vacuum of space. **(2)**

.....

.....

(b) State whether radio waves can travel through a vacuum. **(1)**

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10 Priya sees a flash of lightning. She counts 6 seconds before she hears the thunder. Assume the speed of sound in air is 340 m/s, and that the time for the light to reach Priya is negligible.

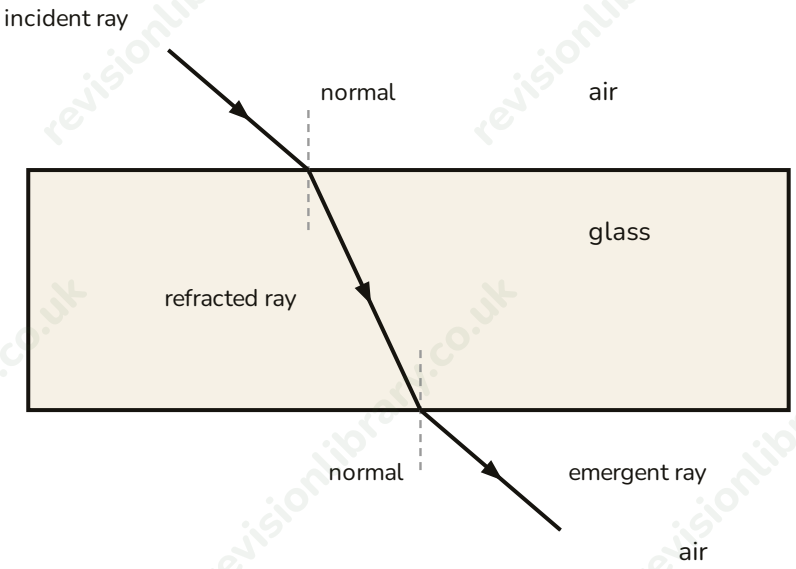
(a) Calculate the distance between Priya and the lightning strike. **(3)**

.....

(b) Give your answer to part (a) in kilometres. **(1)**

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11 A ray of light travels from air into a glass block and bends towards the normal.



(a) Name the effect that causes the light ray to change direction as it enters the glass. **(1)**

(b) Explain, in terms of the speed of light, why the ray bends towards the normal as it enters the glass. **(2)**

(c) The ray then exits the glass block through a face parallel to the one it entered. State the direction of the emergent ray, compared with the original incident ray. **(1)**

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Mark scheme · 3.4 Waves: Light and Sound: Test Pack

Question 1

(a) sound waves cao **B1**

(a) Answer: **Sound waves**

(b) light waves cao **B1**

(b) Answer: **Light waves**

(c) sound waves cao **B1**

(c) Answer: **Sound waves**

(d) light waves cao **B1**

(d) Answer: **Light waves**

Question 2

(a) state angles are equal or the angle of incidence equals the angle of reflection **M1**

(a) angles are equal cao **A1**

(a) Answer: **equal to the angle of reflection**

(b) diffuse reflection cao **B1**

(b) Answer: **diffuse reflection**

Question 3

(a) refraction cao **B1**

(a) Answer: **Refraction**

(b) state that light changes speed when entering a different material **M1**

(b) so the change in speed causes the ray to change direction at the boundary (oe) **A1**

(b) Answer: **Light slows down when it enters glass from air, causing the ray to change direction at the boundary.**

Question 4

use speed = distance / time with 1.5 / 0.30 **M1**

5 m/s cao **A1**

unit m/s stated **B1**

Answer: **5 m/s**

Question 5

when very close the image is virtual / upright **B1**

when close the image is larger (magnified) compared with when far **B1**

when far the image is real and inverted and may be smaller or at focus, oe **B1**

Answer: **When the candle is very close the image is virtual, upright and larger (magnified); when the candle is far the image is real, inverted and smaller or near the focus.**

Question 6

towards the normal cao **B1**

slower (than in air) cao **B1**

mention that refraction causes the bending, oe **B1**

Answer: **a) towards the normal; b) slower; c) refraction**

Question 7

use frequency = number of vibrations / time or f = 120 / 60.0 **M1**

2 Hz cao **A1**

state unit hertz or Hz **B1**

Answer: **2 Hz**

Question 8

state that light goes from more optically dense to less optically dense medium (glass to water) **M1**

light bends away from the normal when moving into a less dense medium cao **A1**

therefore angle in water will be larger than 35 degrees, oe **B1**

mention that speed of light increases when going into water from glass, leading to bending away from the normal, oe **B1**

Answer: **The angle in the water will be larger than 35 degrees because light moves from a more optically dense medium (glass) into a less optically dense medium (water) and so bends away from the normal; the speed of light increases, causing the larger angle.**

Question 9

(a) sound is caused by vibrations of particles, and needs a medium (solid, liquid or gas) of particles to travel through, oe **B1**

(a) a vacuum contains no particles, so there is nothing to vibrate/carry the compressions and rarefactions of the sound wave, oe **B1**

(a) Answer: **Sound needs particles to vibrate; a vacuum has no particles, so sound cannot travel through it.**

(b) yes, radio waves are electromagnetic waves and do not need particles/a medium to travel, oe **B1**

(b) Answer: **Yes, radio waves can travel through a vacuum.**

Question 10

(a) correct method: distance = speed x time **M1**

(a) correct substitution: 340 x 6 **M1**

(a) 2040 m, cao **A1**

(a) Answer: **2040 m**

(b) 2.04 km, ft from candidate's answer to (a) **B1**

(b) Answer: **2.04 km**

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Question 11

(a) refraction **B1**

(a) Answer: **Refraction**

(b) light travels more slowly in glass than in air, because glass is a (more optically) denser medium, oe **B1**

(b) when a wave slows down on entering a denser medium at an angle (not along the normal), it changes direction and bends towards the normal, oe **B1**

(b) Answer: **Light slows down entering the denser glass, causing the ray to bend towards the normal.**

(c) the emergent ray travels parallel to the original incident ray (it is sideways-displaced), oe **B1**

(c) Answer: **Parallel to the original incident ray, but shifted sideways.**

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